

# Brain-Controlled Augmented Hearing for **Spatially Moving Conversations** in Multi-Talker Environments

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\*Equal Contribution

# Motivation

- **Problem:** People with hearing impairments struggle to focus on a single talker in noisy, multi-talker environments.



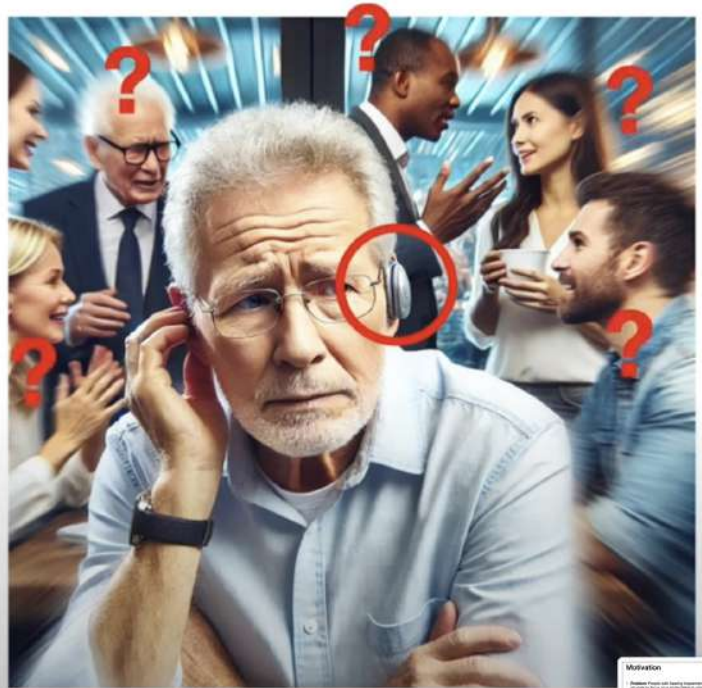
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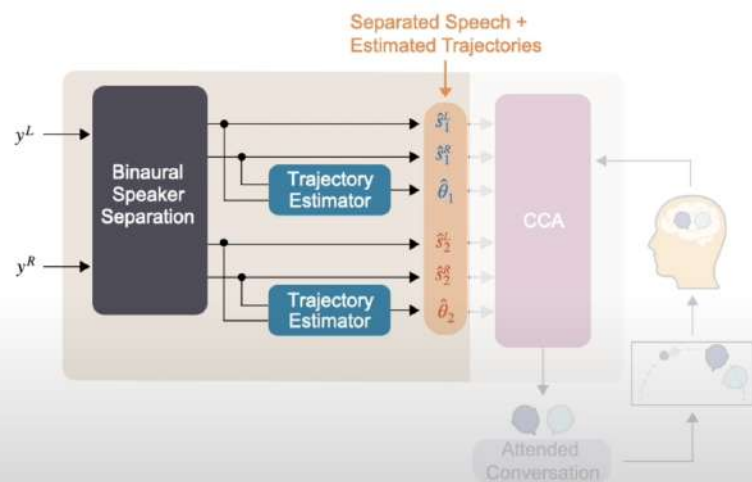
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- **Experiment Design:** Two concurrent conversations with moving talkers and background noise.
- **Data Collection:** Intracranial EEG (iEEG) data from three subjects as they focused on one conversation.



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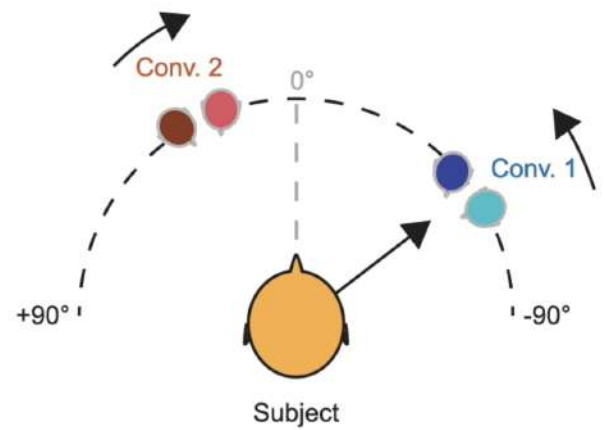
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Pedestrian



Babb

Knowledge Gap  
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- **Current Research:** Most AAD studies use overly simplified environments—stationary talkers, no background noise.
- **Real-Life Complexity:** Conversations often involve moving talkers, background noise, and turn-taking.
- **Need:** A system that tackles these complexities, preserves spatial cues and enables more naturalistic listening.





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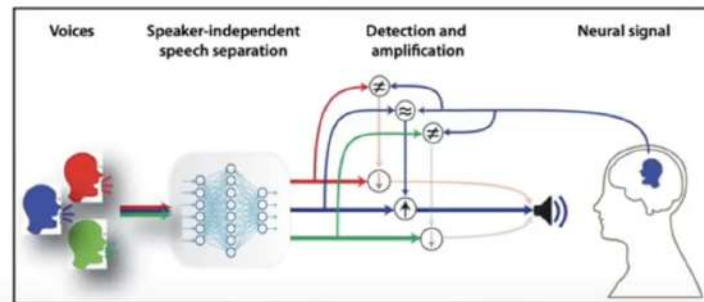
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- **Current Limitation:** Hearing aids can suppress background noise but can't selectively enhance the attended talker.
- **Opportunity:** Auditory attention decoding (AAD) allows decoding brain signals to identify the attended talker, can be combined with speech separation to isolate and enhance the attended talker.

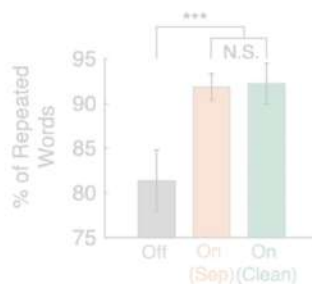


Han, O'Sullivan et al., 2019

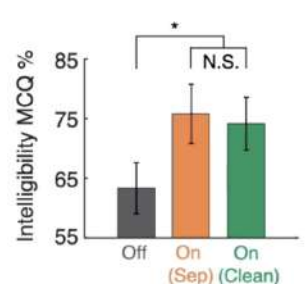
# Results

- **Decoding Accuracy:** Auditory attention was decoded with 88% accuracy using a 4-second window of neural data.
- **System Performance:** The binaural speech separation system showed no significant drop in AAD accuracy compared to clean ground truth stimuli.
- **User Testing:** 24 normal-hearing listeners reported improved conversation tracking, enhanced intelligibility, retention of spatial cues and reduced listening effort.

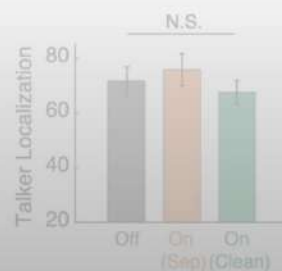
a. The system helps track the attended conversation.



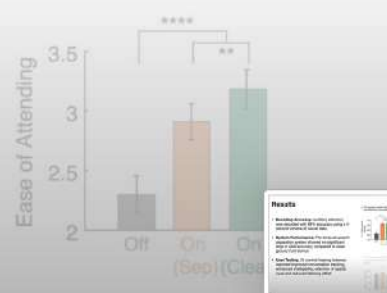
b. Increases the intelligibility of the attended conversation.



c. Talkers in a conversation can still be localized in space.

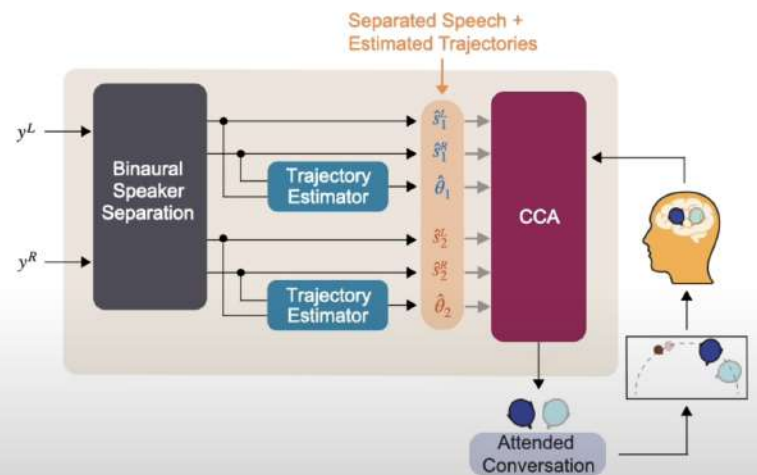


d. Increases the ease of selectively attending to the cued conversation.



# Conclusions

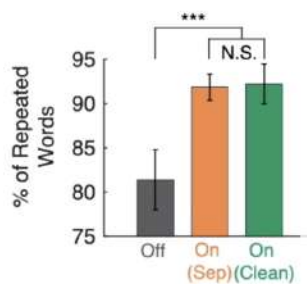
- Designed an auditory attention experiment simulating real-world listening.
- Proposed a causal, real-time brain-controlled hearing system combining auditory attention decoding and binaural speech separation.
- Promises to enhance the quality of life for individuals with hearing impairments.
- Marks a crucial step toward practical, real-time brain-controlled hearing devices.



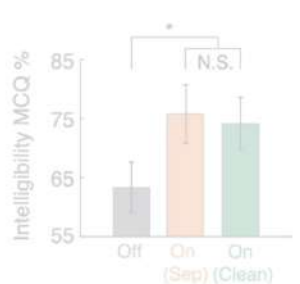
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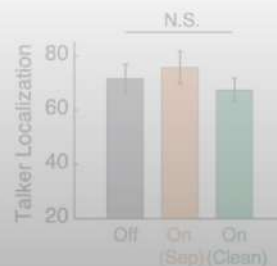
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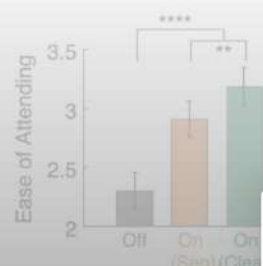
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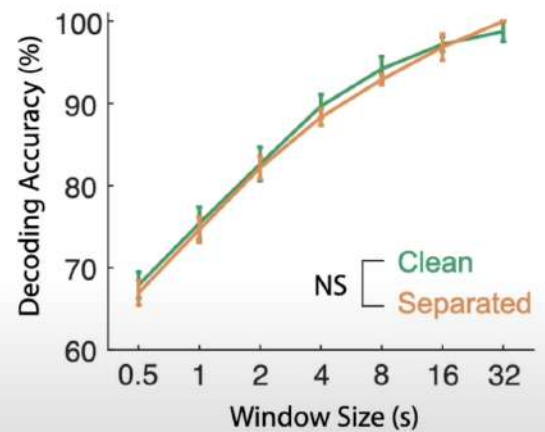
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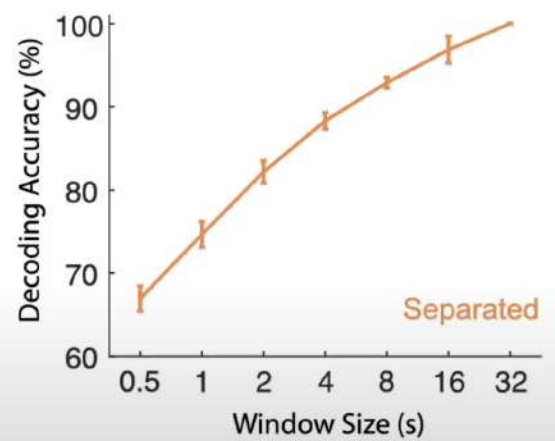
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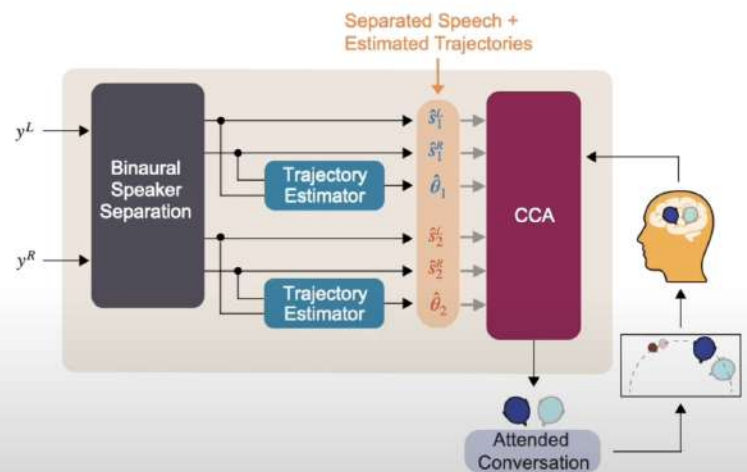
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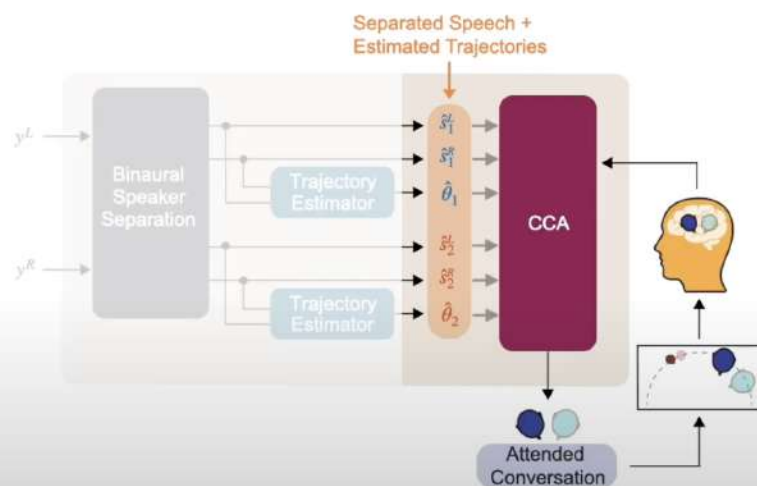


**Causal + Real-Time**



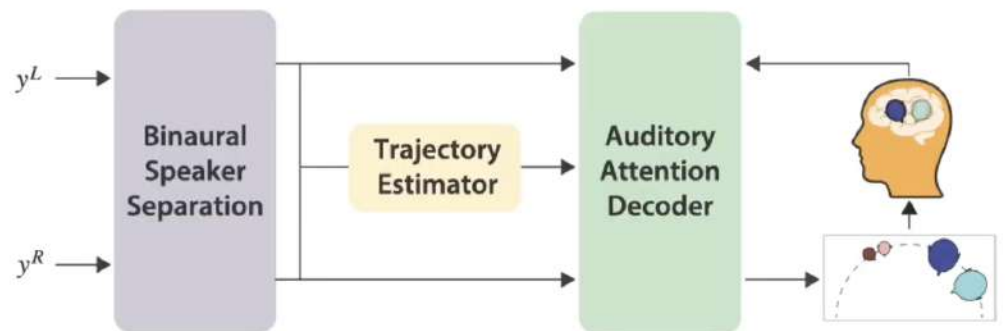
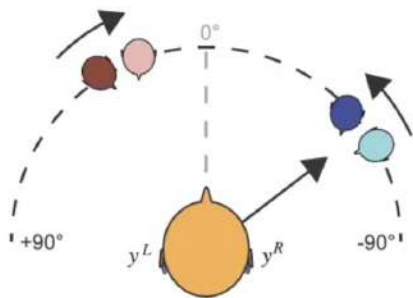
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## Brain-Controlled Augmented Hearing for Spatially Moving Conversations



The system uses the listener's brainwaves to detect and amplify the focused conversation, while preserving the speaker's perceived location



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www.youtube.com – to exit full screen, press esc

