

The Perceptual Discrimination of Reduced and Clear Speech in Adverse Conditions

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Introduction

- Adverse listening conditions commonly encountered in daily life can present significant challenges to successful speech communication
- Beyond background noise and/or other masking speech, real-life speech communication also entails a great deal of natural variability in the speech signal
- Human listeners must adapt to variability in the realization of sounds and words in order to understand the utterance and also extract information about the environment and talker
- Such adaptation may be extra difficult for hearing-impaired users of cochlear implants (CIs), since they also have to deal with degradations of the speech signal transmitted by a CI
- Speech perception in CI listeners may be robust for ideal, clear speech, or *carefully articulated speech*, but our knowledge of CI listeners' perception of more realistic, reduced speech, or *casually articulated speech*, is still limited

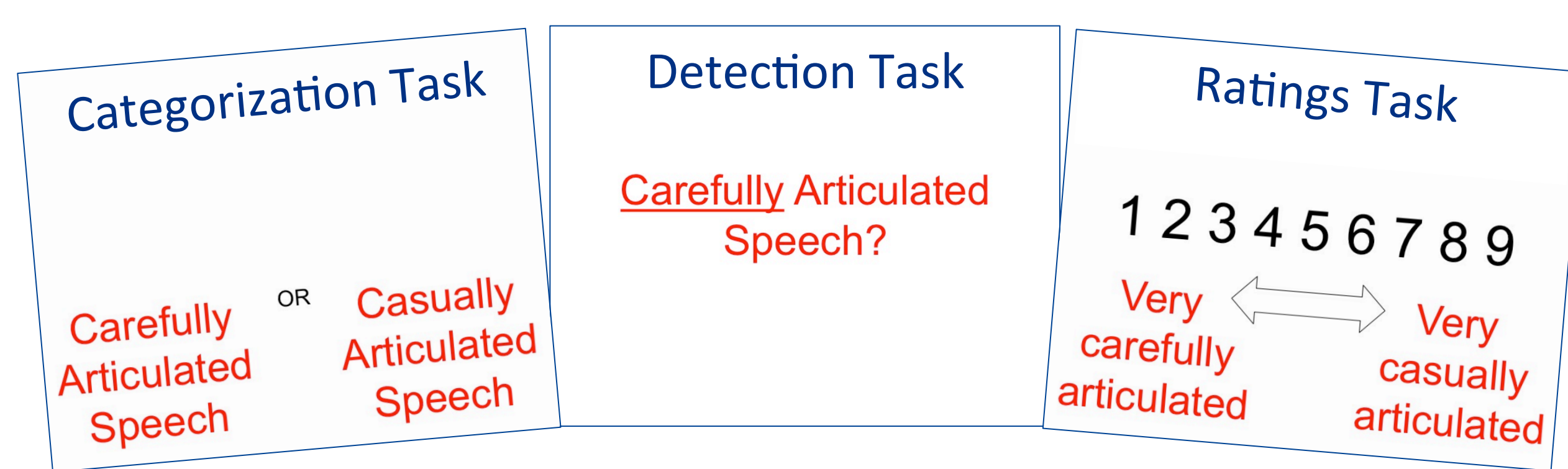
Research Questions

- Can listeners reliably perceive differences in speaking styles?
- How does simulated CI hearing affect the perception of speaking styles?
- Do differences in the simulated CI device influence the perception of speaking styles?

Methods

Tasks

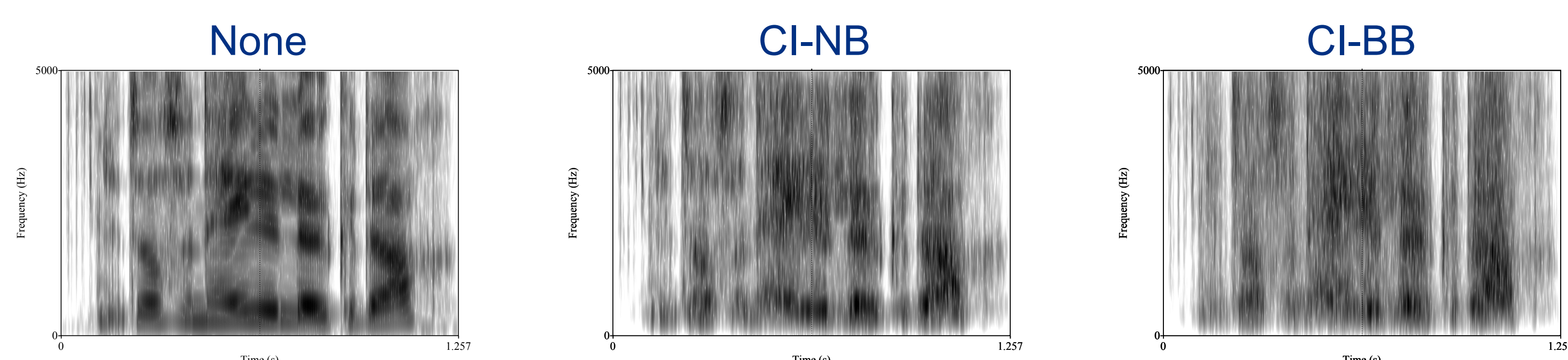
- Categorization Task** – Categorize an utterance as either carefully articulated ('Careful') or casually articulated ('Casual') as quickly as possible → *categorization responses & response times (RT)*
- Detection Task** – Indicate if an utterance was carefully articulated ('Careful') as quickly as possible → *detection responses & RTs*
- Ratings Task** – Rate utterances on a scale (1-9) from very carefully articulated ('Careful') to very casually articulated ('Casual') → *ratings*



Examples of the response screens for all three experimental tasks.

Materials

- 8 native speakers of Dutch (4 female & 4 male) producing a range of carefully to casually articulated sentence-length utterances about vacation trips
- 3 Speaking Styles – Unique utterances from a **Read Text**, a **Retold Story**, or an **Informal Story**
- 3 CI Simulation Conditions – No simulation (**None**) and 2 different CI simulations varying by sharpness of the synthesis filters
 - CI-NB**: 16 channel CI simulation with *narrowband* filters (Advanced Bionics settings with 12th order filters)
 - CI-BB**: 16 channel CI simulation with *broadband* filters (Advanced Bionics settings with 4th order filters)



Female Speaker, Read Text: *Het was een heel leuke dag. (It was a very nice day.)*

Listeners

- 6 young, normal-hearing native Dutch speakers (6 female)

Selected References

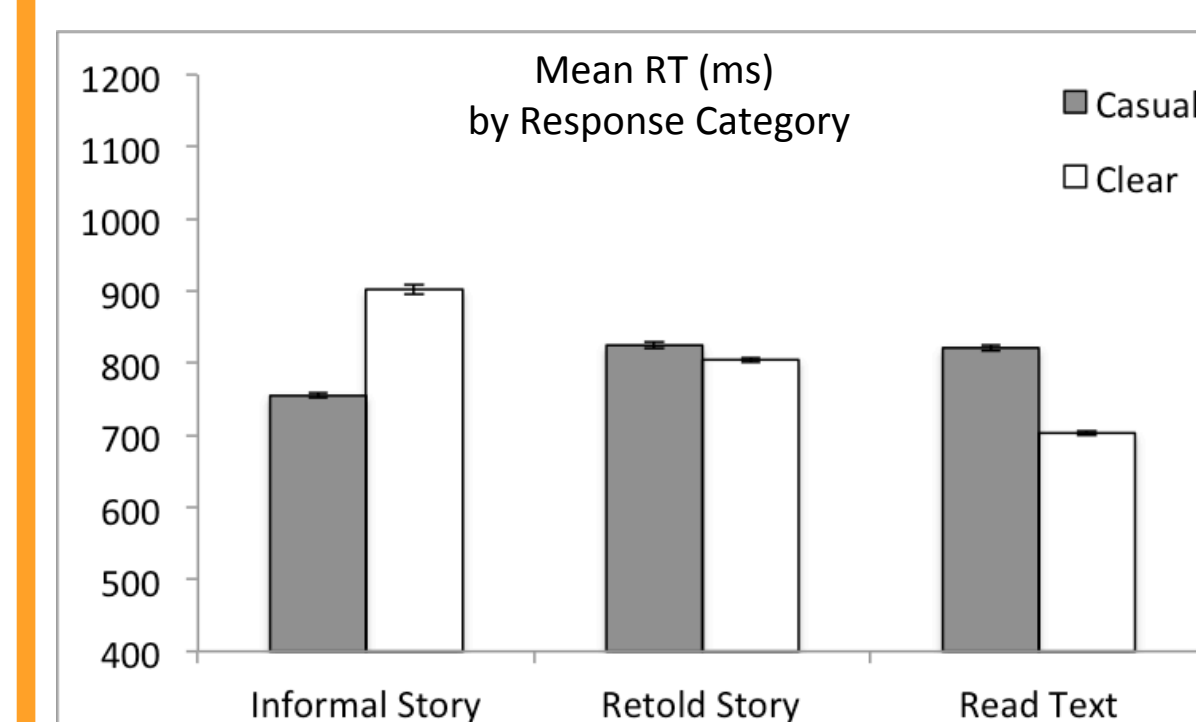
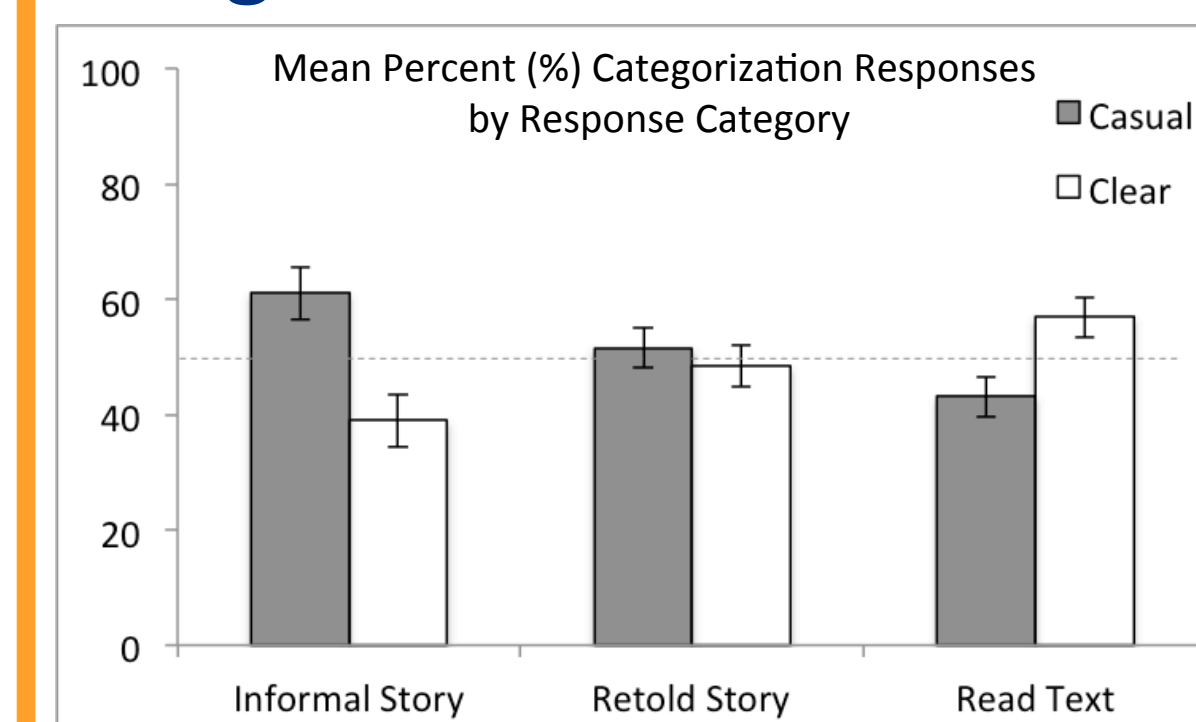
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Acknowledgements

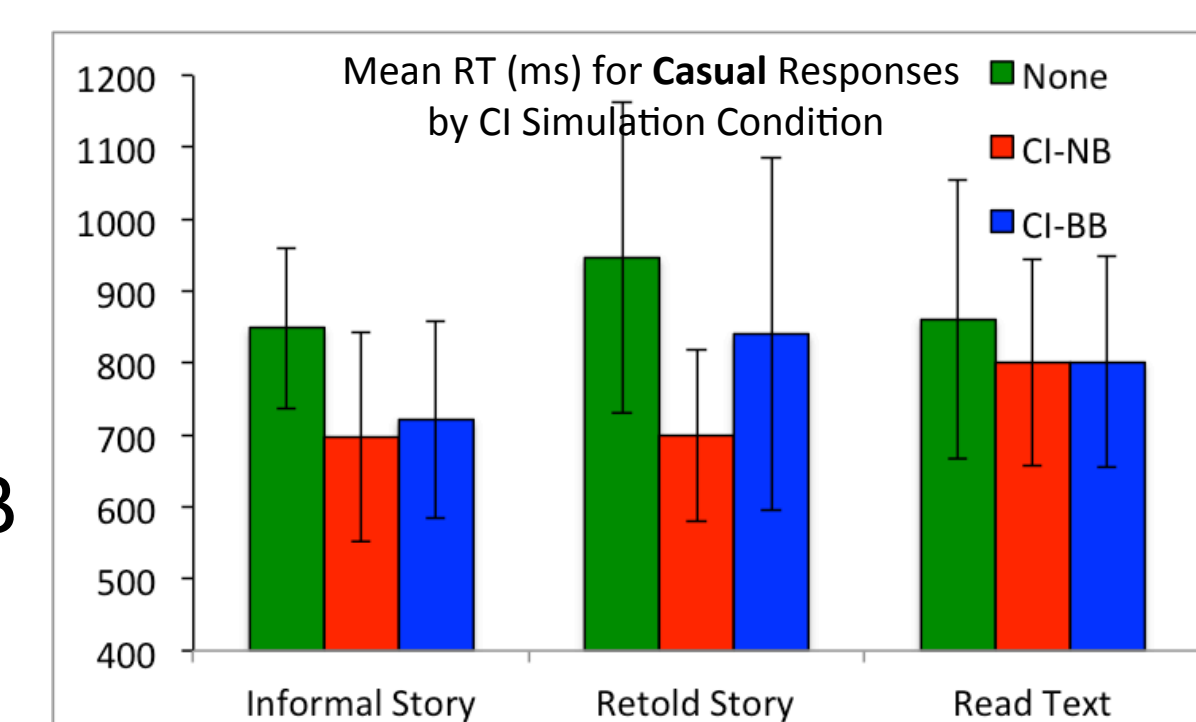
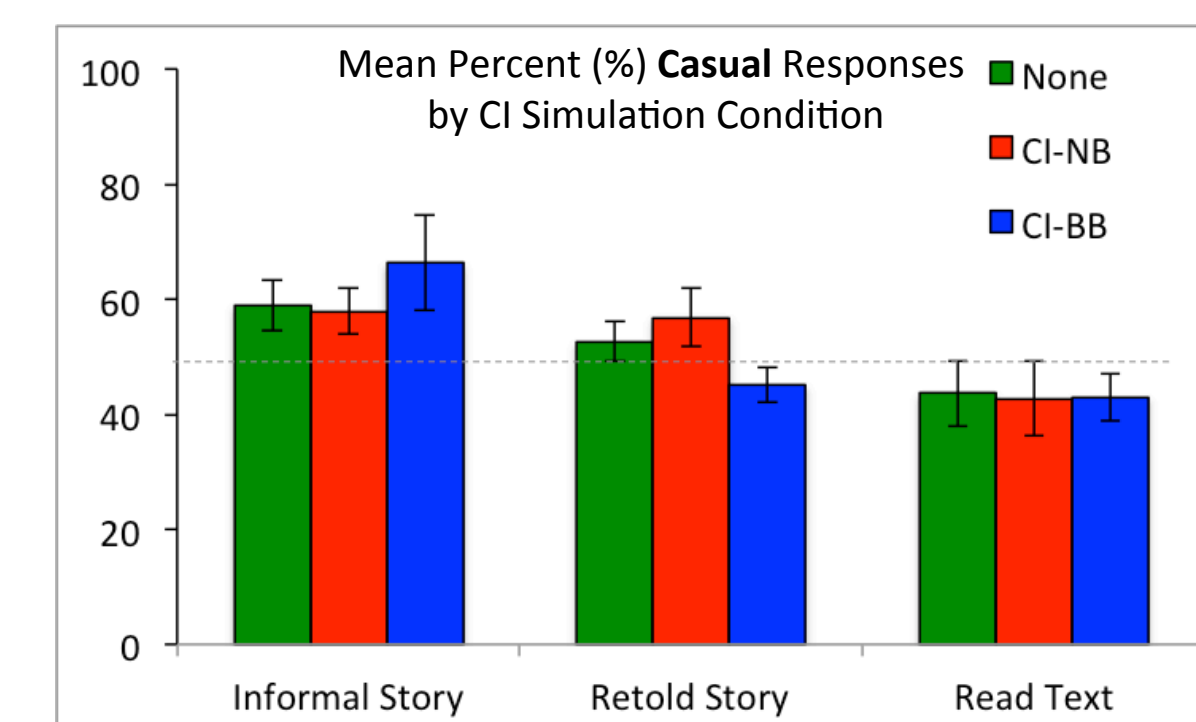
Thanks to members of the SPL for their time and valuable feedback. Thanks especially to Dr. E. Gaudrain for his assistance with the CI simulation.

Results

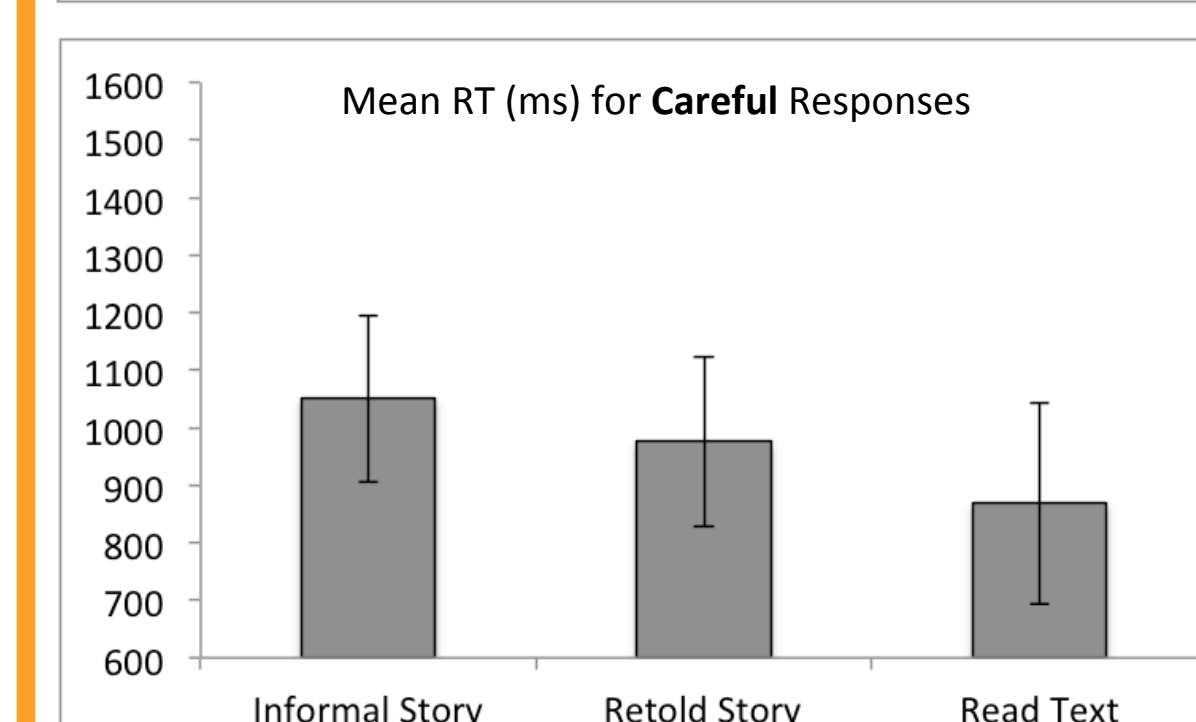
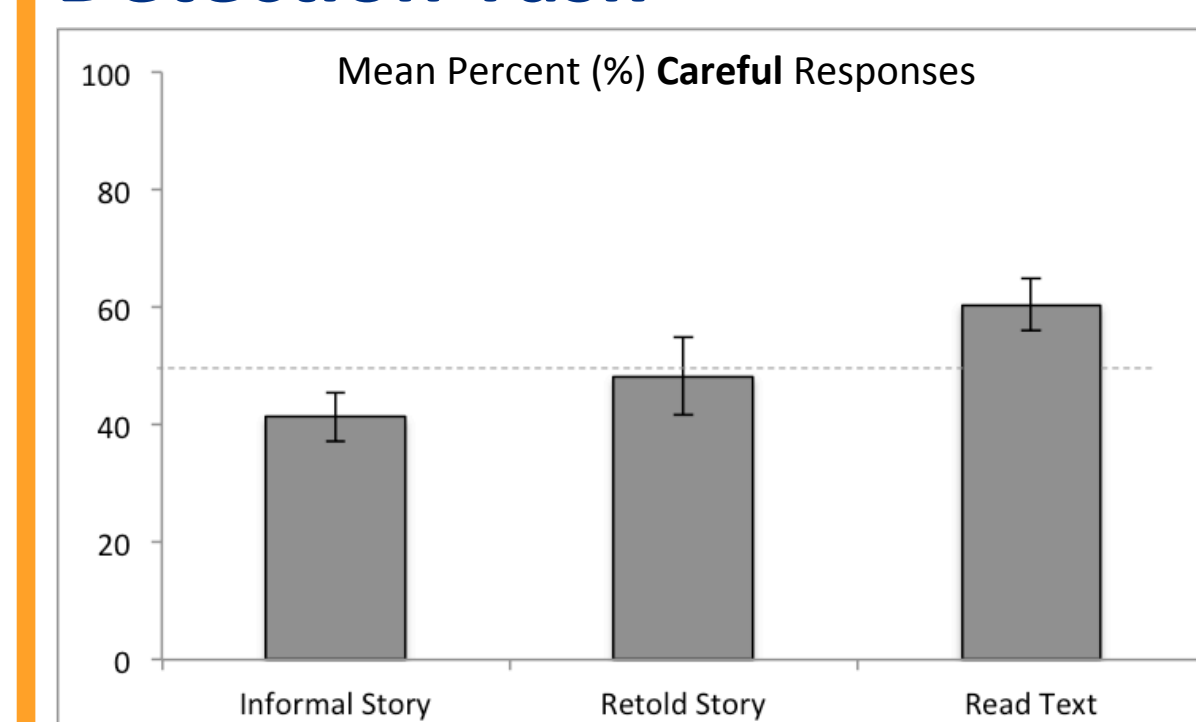
Categorization Task



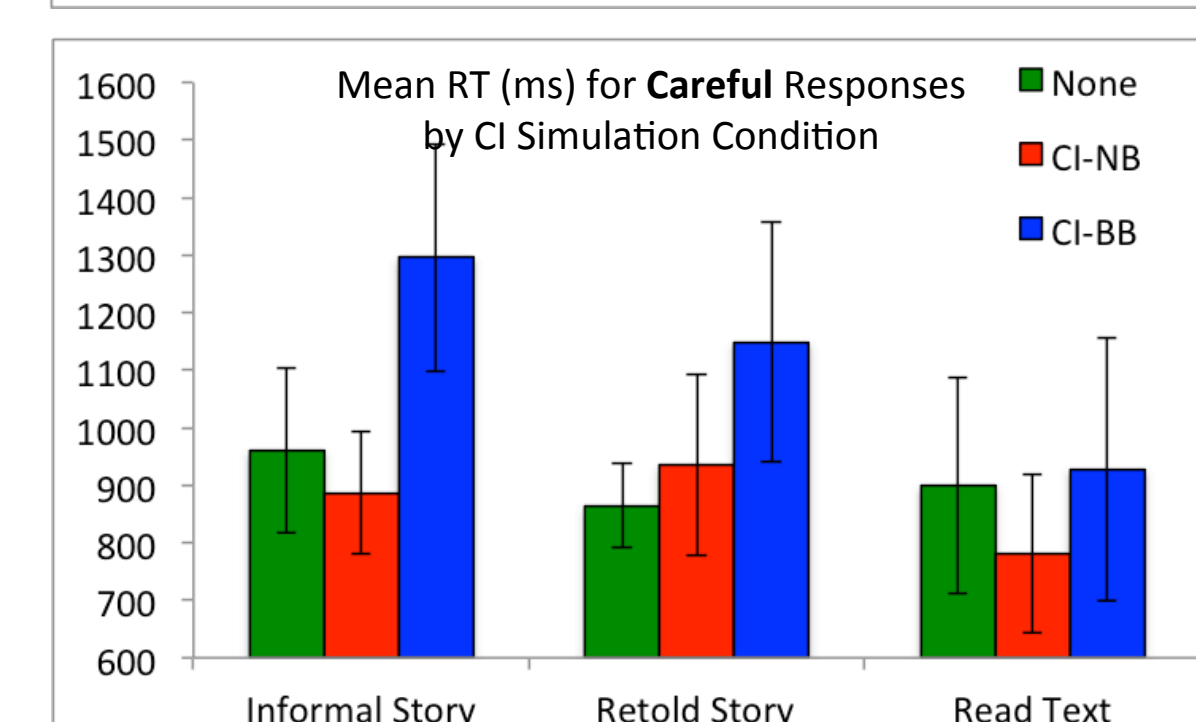
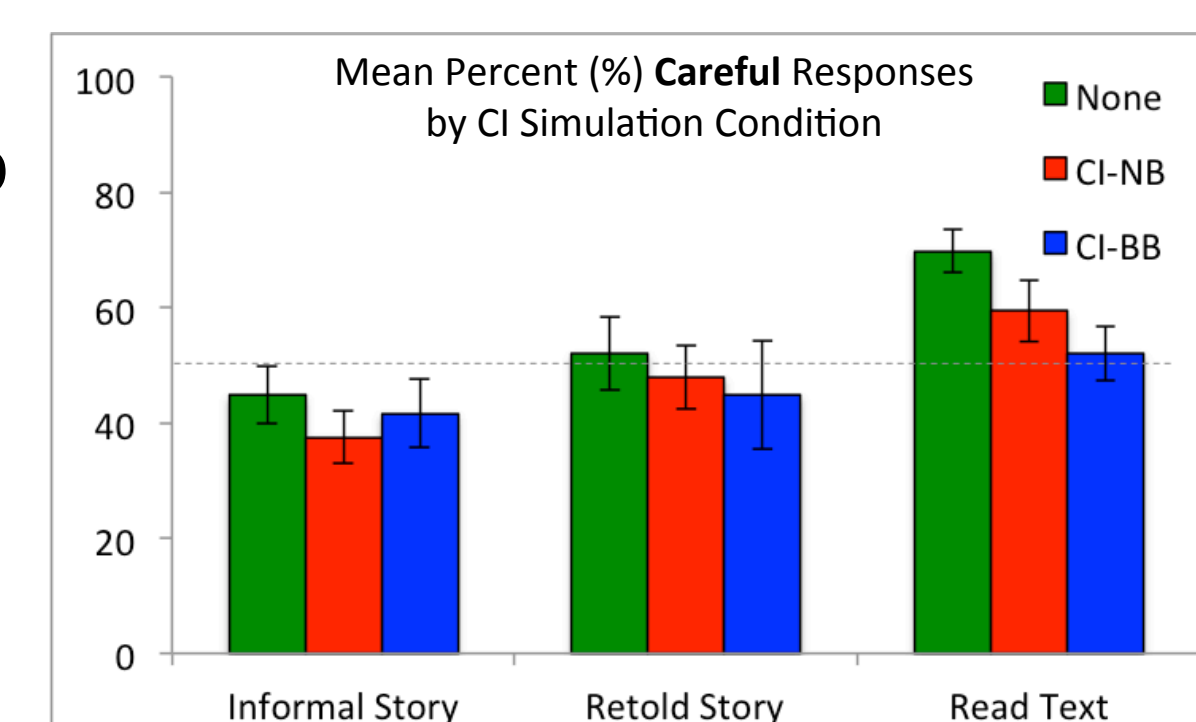
- Speaking Style: More/faster 'Casual' responses to Informal Story; More/faster 'Careful' responses to Read Text
- CI Simulation: More 'Casual' responses to Informal Story in CI-BB condition compared to CI-NB and no simulation conditions
- CI Simulation: Faster responses to CI-NB and CI-BB compared to no simulation condition



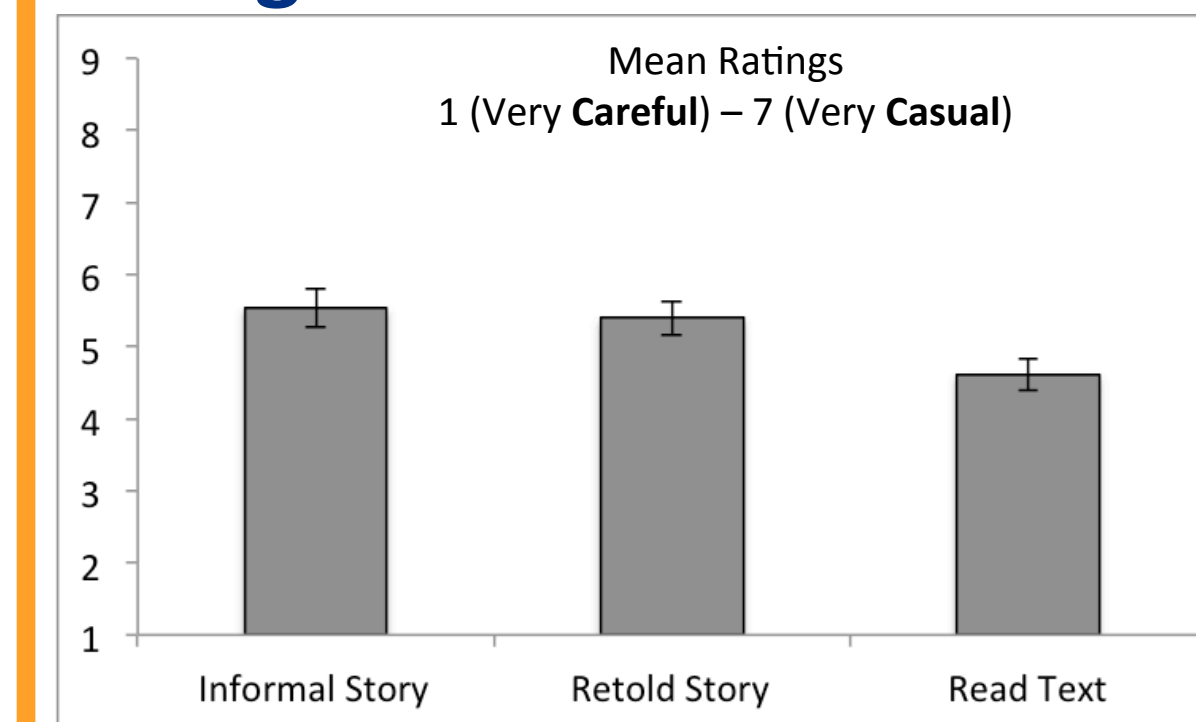
Detection Task



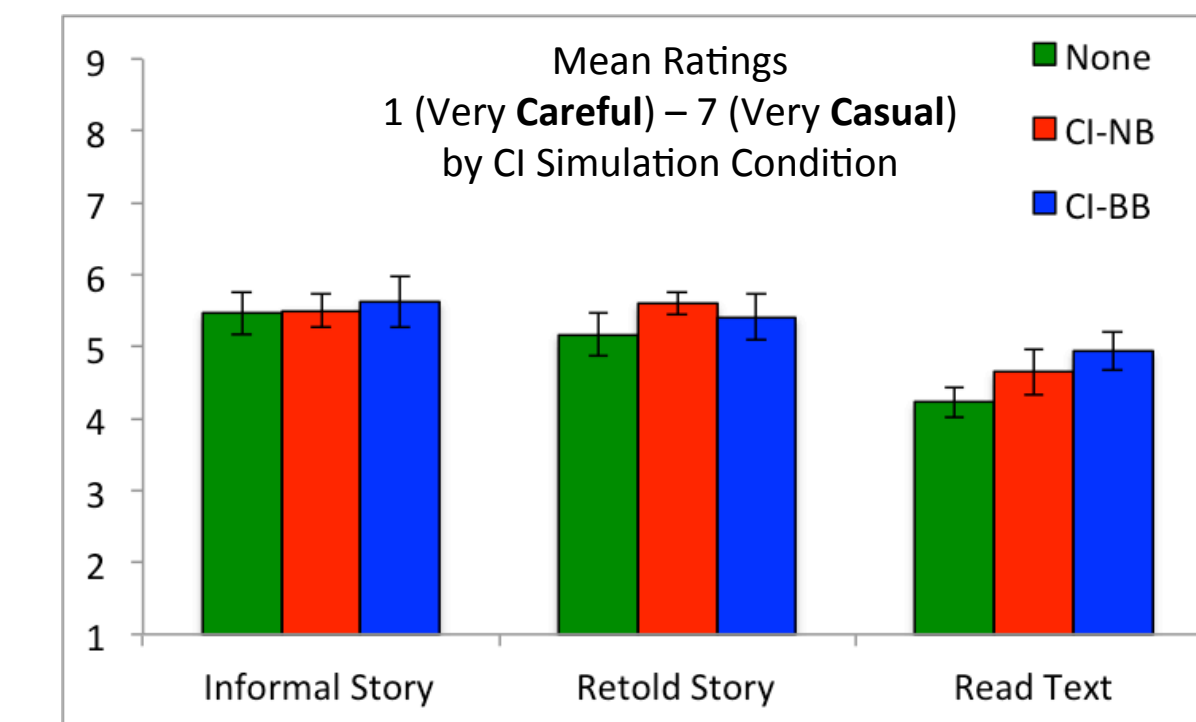
- Speaking Style: Fewer/slower 'Careful' responses to Informal Story; More/faster 'Careful' responses to Read Text
- CI Simulation: Fewer 'Careful' responses in CI-NB and CI-BB conditions than in no simulation condition
- CI Simulation: Slower responses in CI-BB condition compared to CI-NB and no simulation conditions



Ratings Task



- Speaking Style: Informal Story and Retold Story rated as more casual than Read Text
- CI Simulation: More casual ratings in CI-NB and CI-BB conditions than in no simulation condition



Conclusions

Research Questions

- Can listeners reliably perceive differences in speaking styles?
 - Overall, listeners were able to reliably perceive differences among 3 speaking styles
- How does simulated CI hearing affect the perception of speaking styles?
 - Although performance varied by task, response patterns and RT were not greatly affected by CI simulation
 - CI listeners may be able to reliably perceive differences in speaking styles
- Do differences in the simulated CI device influence the perception of speaking styles?
 - Performance differed the most for the less favorable CI-BB condition, compared to the CI-NB condition and the no simulation condition
 - CI listeners may benefit from settings similar to the simulations with narrow synthesis filters in the perception of different speaking styles (narrow spread of excitation)

NH listeners were able to make reliable judgements about speaking style in normal and CI simulated conditions. Although performance varied by task, judgements may only have suffered when listening conditions were substantially degraded. These findings suggest that CI listeners may be able to perceive and use information about speaking styles in real-life speech communication, and that the use of settings similar to those simulated with the sharper synthesis filters may improve CI perception of speaking styles (or other forms of speech variability).

Current & Future Directions

- How does the task affect the perception of different speaking styles?
 - Comparisons across discrimination tasks; Inclusion of a broader set of linguistic tasks (e.g., recognition, perceptual learning, training)
- What are listeners using to make their judgements in different conditions?
 - Comparisons across more CI simulation conditions; Different types of materials (e.g., words, sentences, passages)
- How does a listener's background influence his/her perception of different speaking styles?
 - Larger listener group with diverse language backgrounds and hearing status



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