Recall of clearly spoken sentences

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Background

- Relative to conversational speech (**CO**), clear speech (**CS**) improves **intelligibility** [1,2,3] and **sentence recognition memory** (i.e., ability to recognize sentences as previously heard) [3,4,5] for native and non-native listeners, even when only orthographic forms are presented at test [4].
- **Recall** is a more complex and effortful type of declarative memory that requires processing at phonological, lexical-semantic, morphosyntactic, and syntactic levels. Cognitive complexity: aging affects recall more than recognition memory [6].

Goal: Test a more complex and effortful memory task, i.e., recall, and test the robustness of CS representation in memory.

- Recall for native and **non-native listeners**: poorer verbatim sentence recall for non-native than native listeners [7], however, non-native tend to recall surface forms more faithfully while native tend to recall with synonym shifts [8].

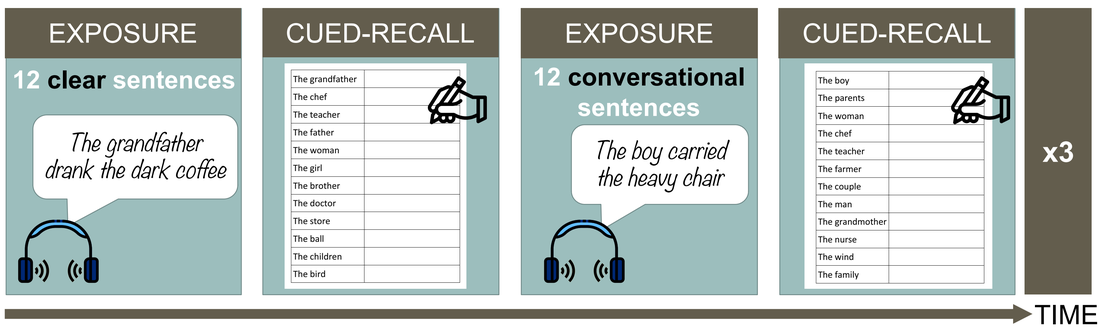
Goal: Evaluate whether greater availability of salient acoustic cues in CS promote verbatim memory for native and non-native listeners.

Methods

Listeners: ➢ **34 native monolingual English**: 18 F, mean age: 19.5 (18-23); reported no exposure to other languages before age 14 (mean).
➢ **32 non-native English**: 22 F, mean age: 22.7 (18-37); 11 different L1; all tested in Austin TX; mean Eng. acquisition: 7.9 (5-19); mean US arrival: 17 (0-37); 26 reported higher proficiency in their L1 than in English.

Materials: 72 unique meaningful sentences produced in CO and CS by a 26-year-old female American English speaker (intelligibility assessed in [3,4]).

Procedure: 12 sentences per block followed by cued-recall. 6 blocks, alternating speaking style (order of presentation counterbalanced). Total of 72 sentences, 36 in CS, 36 in CO). Listeners never heard the same sentence twice.



Statistical analyses: Logistic mixed-effect model [9]: DV(1-0)~ Style (CS-CO) * Group (Native-NN) + wordposition + sentenceposition + blockposition + counterbalance + 1|Subject + 1|Sentence

Discussion

- **Non-native listeners** were better able to **recall words** and **entire sentences** if the utterance was **produced clearly** (Fig.1&3). Availability of salient acoustic cues in CS boosted **verbatim recall** for entire unit of connected meaning and improved the odds of recalling the **gist** of the sentence (higher rate of paraphrase in CS). Lower verbatim and gist recall in CO suggest that non-native listeners were less able to retrieve the sentence if acoustic input is not maximally enhanced. (Fig.3,4)

- Clear speaking style enhanced word recall for **native listeners** as well, but did not necessarily predict a better recall for the entire sentence and did not enhance gist recall.

- For **both listener groups**, sentences rehearsed in the long-term memory (i.e., beginning of the list), were better recalled in CS than CO, while speaking style had no effect on the easier short-term memory rehearsal (i.e., last few sentences of a block). Additionally, sentences presented in the first, most unfamiliar, block were better recalled if heard in CS than CO. This supports the effortfulness hypothesis [10] in that CS is particularly beneficial for memory encoding in effortful conditions.

Summary

This study provides additional evidence of the clear speech benefit on memory in a more complex task, i.e., recall. Non-native listeners especially benefited from memorizing sentences spoken clearly.

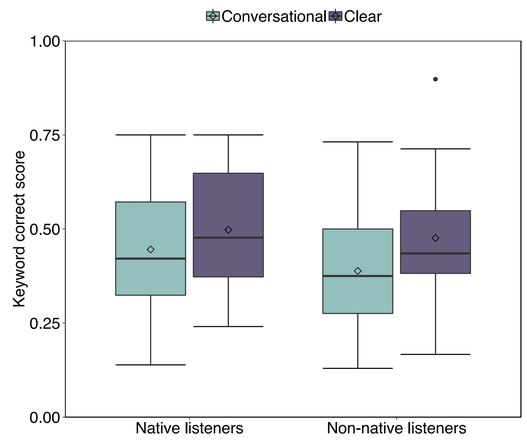
Future directions

Recall of even larger unit of speech (paragraphs) heard in CO and CS; delayed testing.

Results

Recall of keywords

Each keyword scored as correct(1) or incorrect(0). The grandfather (cue) drank (keyword1) the dark (keyword2) coffee (keyword3)



How many keywords each listener correctly recalled out of 108 keywords in CS and 108 keywords in CO?

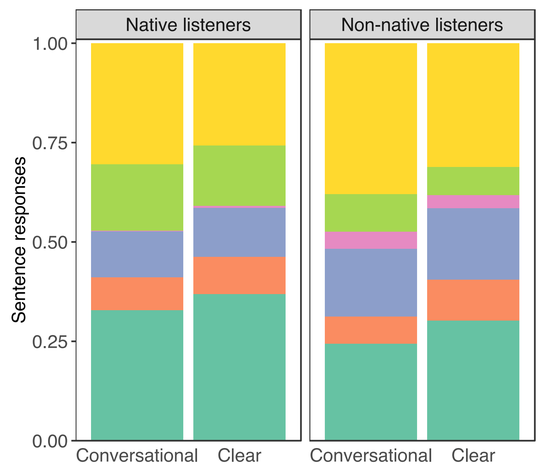
Fig 1. Keywords correct score

- Both listener groups **recalled more words spoken clearly** than conversationally. Significant 2-way interaction *Style*Group* p<.05*). Post-hoc showed a significant effect of *Speaking Style* for native (p<.05*) and non-native listeners (p<.001***).
- The magnitude of CS effect on recall was larger for non-native than native listeners. Separate analysis within each speaking style showed no significant differences in recall between groups.

Recall of entire sentences

Each response assigned to one of 6 categories:

- Entire correct: The grandfather *drank the dark coffee*
- Paraphrase: The grandfather *drank the black coffee*
- Partial: The grandfather *drank coffee*
- Morpho-phono: The grandfather *drinks the dark coffee*
- Error: The grandfather *went to the zoo*
- Omit: The grandfather […]



How did listeners recall entire unit of meaning i.e., entire sentences?

Fig 2. Proportions of responses

- Non-native English listeners recalled more **entire sentences spoken clearly** than conversationally (dark green) and **recalled clear sentences as paraphrase** more often than conversational sentences (orange). This was not the case for native listeners.

Table 1. Summary of logistic mixed-effect models

Entire correct	Style*Group (p<.05*); Simple effect of Style for non-native (p<.05*) but not for native (p=.09)
Paraphrase	Style*Group (p<.05*); Simple effect of Style for non-native (p<.01**) but not for native (p=.2)
Partial	Main effect of Group (p<.001***), no effect of Style (p=.39).
Morpho-phono	Main effect of Group (p<.001***), no effect of Style (p=.47)
Error	Main effect of Style (p<.05*) and Group (p<.05*).
Omit	Main effect of Group (p<.001***), no effect of Style (p=.39)

Recall within and across blocks

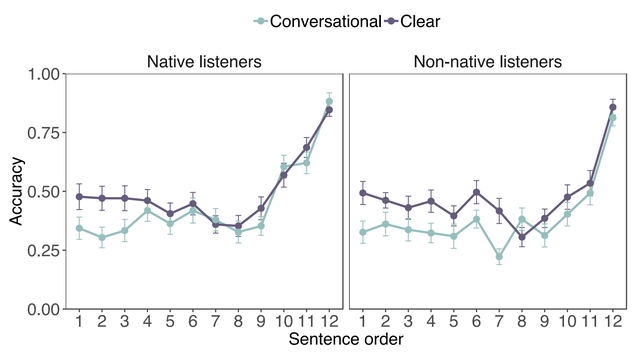


Fig 5. Recall within block: primacy and recency
Recency effect, regardless of speaking style: last few sentences of a block were recalled more accurately. Primacy effect enhanced in CS: sentences at the beginning of the list were better recalled in CS than CO.

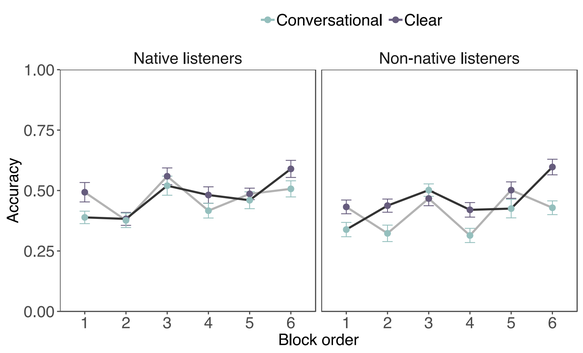


Fig 6. Recall across blocks: practice effect (light and dark grey lines represent two speaking style counterbalance orders)
First block, arguably the most difficult block (i.e., before any practice effect takes place), better recalled if heard in CS than in CO. Large memory boost for CS going from 5 to 6.

References

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Acknowledgments

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