Memory for speech of varying intelligibility

Sandie Keerstock & Rajka Smiljanic | Department of Linguistics, The University of Texas at Austin | #46

1 Introduction

- **Clear speech (CL)** is a listener-oriented speaking style adaptation. Compared to conversational speech (CO), it is characterized by:
  - ➢ Decreased speaking rate and increased intensity, pitch range, and vocalic space (exaggerated vowels), etc. [1]
- CL improves **word recognition in noise** for **native** and **non-native listeners** [1,2]
  - ➢ Provides a good match between the acoustic input & stored phonological/lexical representations and is more effective in overcoming the masking effect of the noise
- CL improves **sentence recognition memory** for native listeners [3,4,5]
  - ➢ **Effortfulness hypothesis**: Perceptual effort during processing of degraded speech may come at the cost of attentional resources that would otherwise be available for memory encoding [6].

What is the effect of CL on memory?

GOALS:
1. Assess the effect of speech clarity on memory for different listeners: **native & non-native listeners**
   - ➢ Speech processing in second language is taxing and may require additional cognitive resources [7].
2. Assess the effect of speech clarity on **recognition memory & recall**
   - ➢ Recall is a more complex and effortful (cf. aging affects recall more than recognition memory [8])

2 Methods

Material

Meaningful sentences produced by a 26-year-old female American English speaker both in CO and CL. CL word recognition in noise higher for both native [3] and non-native listeners [5].

- 80 sentences used in recognition memory (Exp. 1 & 2)
- 72 sentences used in recall (Exp. 3)

Participants

	Recognition memory		Recall (Exp. 3)
	Within (Exp. 1)	Cross (Exp. 2)	
Native	*n*=30 21F; mean age 19 (18-23)	*n*=30 17F; mean age 20 (18-32)	*n*=61 34 F; mean age 19 (18-23)
Non-native	*n*=30 24F; mean age 23 (18-31); age English acquisition 9 (6-17)	*n*=30 18F; mean age 22 (18-31); age English acquisition 8 (6-13)	*n*=31 22 F; mean age 23 (18-37), age English acquisition 7.6 (5-19)
Total	***n*=60**	***n*=60**	***n*=92**

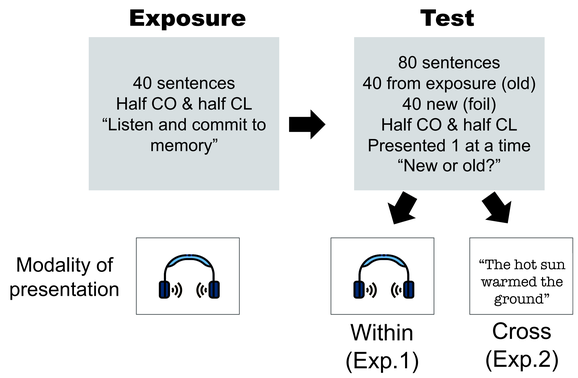
Analysis

Recognition memory (Exp. 1 & 2)
Signal detection theory: accuracy as d' = z(H) - z(FA)
LMER [9]: d' ~ Style (CO vs. CL) and Group (Native-NN) + 1|Subject

Recall (Exp. 3)
Keyword: accuracy of each keyword (108 in each style per subject) scored as 1-0. GLMER[9]: Accuracy~ Style * Group + Wordposition + Sentposition + Blockposition + Counterbalance + 1|Subject + 1|Sentence
Sentence position: Best model (model comparison): Accuracy~ Sentposition*Style+(1|Subject)

3 Recognition memory

Procedure



Results

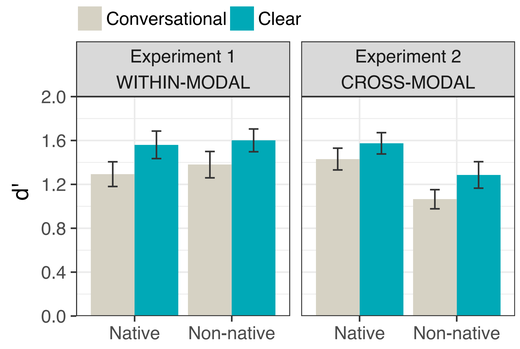
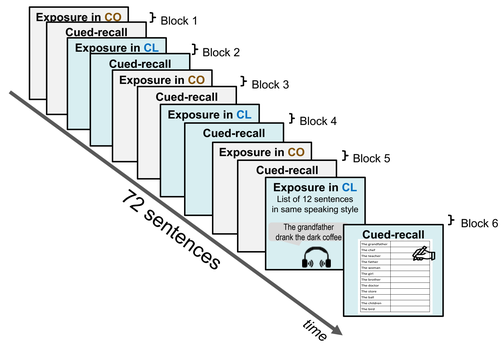


Figure 1. Average *d'* scores
- Within: main effect of Style (p <.001)
- Cross: main effect of Style (p <.001) & main effect of Group (p<.05)
- Lower d' in cross- than in within-modal task for non-native (p<.05).

⇒ Higher *d'* scores in CL than CO for both groups and modalities.
⇒ Cross-modal recognition memory overall more difficult for non-native listeners.

4 Recall

Procedure



- 6 blocks of 12 sentences (72 sentences total): 3 CO, 3 CL
- Speaking style order of presentation counterbalanced

Results

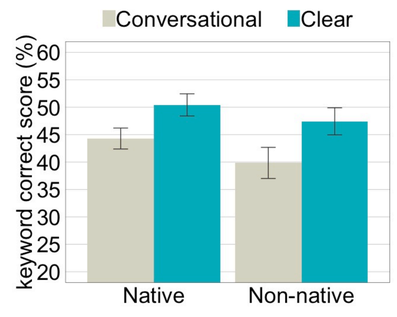


Figure 2. Percentage keyword correct recall
- Main effect of Style (p<.001)
- No Group effect or interaction

⇒ More keywords recalled in CL than CO
⇒ More entire sentences & paraphrases and less errors & omissions in CL vs. CO

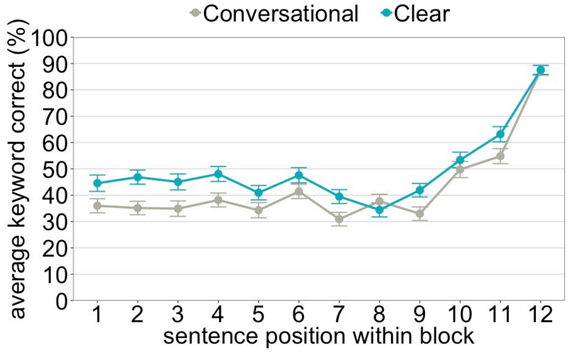


Figure 3. Percentage keyword correct recall for each sentence position across groups
- Significant Sentposition*Style (p<.05)
- Pairwise comparisons: higher recall of sentences in CL at the beginning of the block than CO (p values between <.05 and <.001)

⇒ Last sentence better recalled regardless of style (recency effect)
⇒ Sentences at the beginning of the block better recalled in CL than CO

5 Summary

1. CL improves speech improves **recognition memory** AND **recall**.
2. Retention of spoken information was enhanced for both **native and non-native listeners** when hearing CL sentences.

⇒ More cognitive resources remained available for storing information in memory during processing of easier-to-understand clearly produced sentences

3. Non-native listeners performed worse than native listeners in cross-modal condition (Exp.2)

⇒ Evidence of **cognitive effort in second language speech processing**

4. Sentences heard at the beginning of the list were better recalled in CL than CO. No effect of CL on the easier short-term memory rehearsal (i.e., last few sentences of a block).

⇒ Benefit of CL for retention of spoken information in long-term memory

6 References

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Contact: keerstock@utexas.edu & rajka@austin.utexas.edu & https://utsoundlab.wordpress.com/