Cue Reliability and Re-Weighting in Word Recognition

Wednesday Bushong[1] and T. Florian Jaeger[1,2]

[1]Department of Brain & Cognitive Sciences, University of Rochester [2]Department of Computer Science, University of Rochester

Goals of Study

Listeners integrate top-down and bottom-up cues in speech perception

But cues are distributed differently in different contexts (e.g., between speakers)

Do listeners adaptively change cue weightings given new exposure distributions?

General Approach

Manipulate **acoustic cues (VOT)** and **semantic cues (biasing context)** in a sentence (see [1,2,3])

...the ?ent in the fender/forest...

dent-biasing/tent-biasing semantic context

/d/-like **VOT** /t/-like

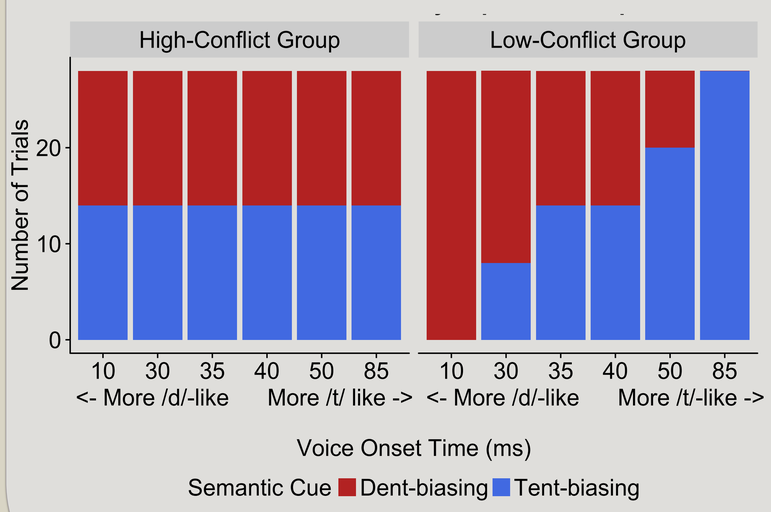
Task: did you hear "tent" or "dent"?

Mechanical Turk subjects (N = 106)
VOTs: 10, 30, 35, 40, 50, 85ms
7 sentence frames repeated for each semantics, distance, & VOT combination = 168 total trials (no fillers)

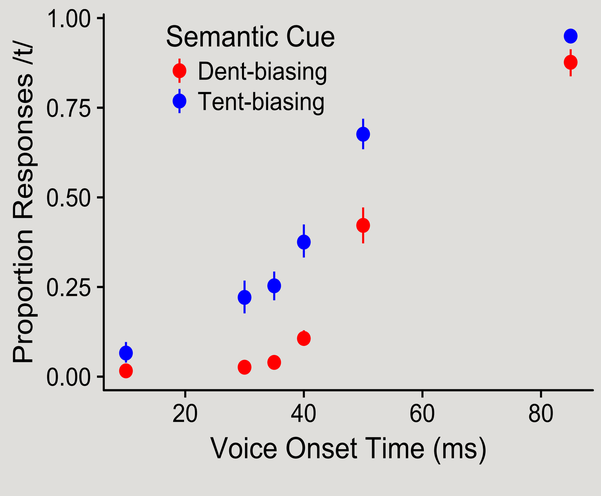
Manipulation

High-Conflict Group: VOT & semantic cues perfectly uncorrelated (i.e., very /d/-like stimuli paired with tent-biasing semantics as much as dent-biasing semantics)

Low-Conflict Group: VOT & semantic cues are correlated in the expected direction

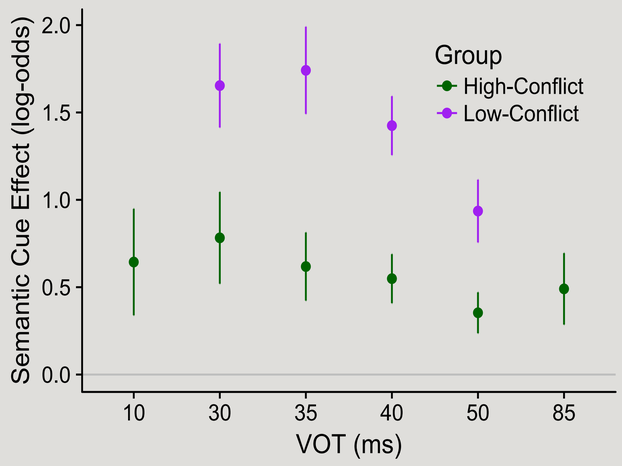


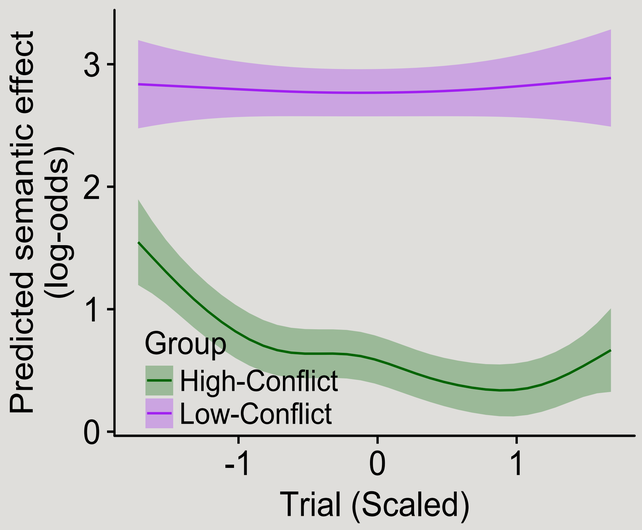
Results



Semantic & acoustic cues are integrated: categorization responses in both groups (collapsed in graph) are sensitive to both VOT and biasing context.

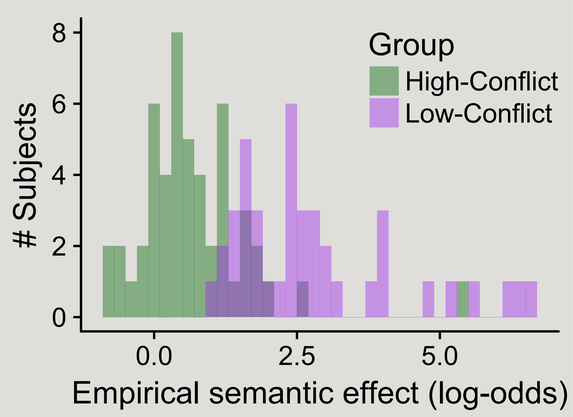
High-Conflict group shows a smaller effect of semantic cue on responses

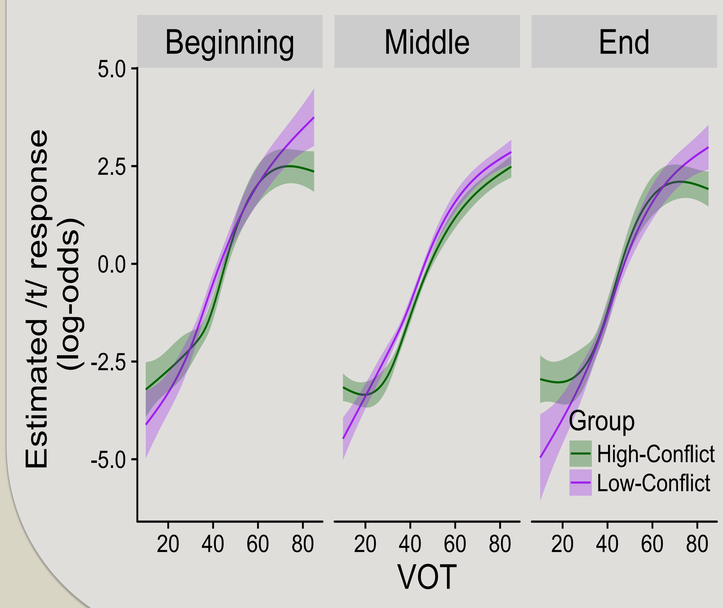




High-Conflict group down-weights effect of semantic cue on their responses over course of experiment while Low-Conflict stays constant

Smaller semantic effect strikingly consistent across subjects





Little change in weighting of VOT over time in either group

Why Do We See This Re-Weighting Pattern?

Listeners could reduce cue conflict by downweighting *either* VOT *or* semantics. Why do listeners downweight semantics?

Use of multiple *acoustic* cues can show similar effects: when correlations between two acoustic cues are perturbed, listeners down-weight the less reliable cue [4]

This could suggest that **listeners might consider semantic information to be less reliable than acoustic features** (at least in word recognition tasks)

Conclusions

Listeners are influenced by the **distributions of cues** in the current input

Listeners can **dynamically re-weight cues** in response

Listeners **selectively re-weight cues** (i.e., don't converge to 50/50 responses)

Important for future cue integration experiments: most standard balanced designs create conflict

Future Work

How can we measure relative reliability of semantic & acoustic features to word recognition?

Do listeners rationally re-weight cues given evidence over time?

References & Acknowledgments

[1] Connine, Blasko & Hall (1991) JML; [2] Szostak & Pitt (2013) APP; [3] Bicknell et al (in revision) [4] Idemaru & Holt (2011) JEP:HPP

This work was partially funded by NSF NRT #1449828 (W.B.) and NICHD R01 HD075797 (T.F.J.).