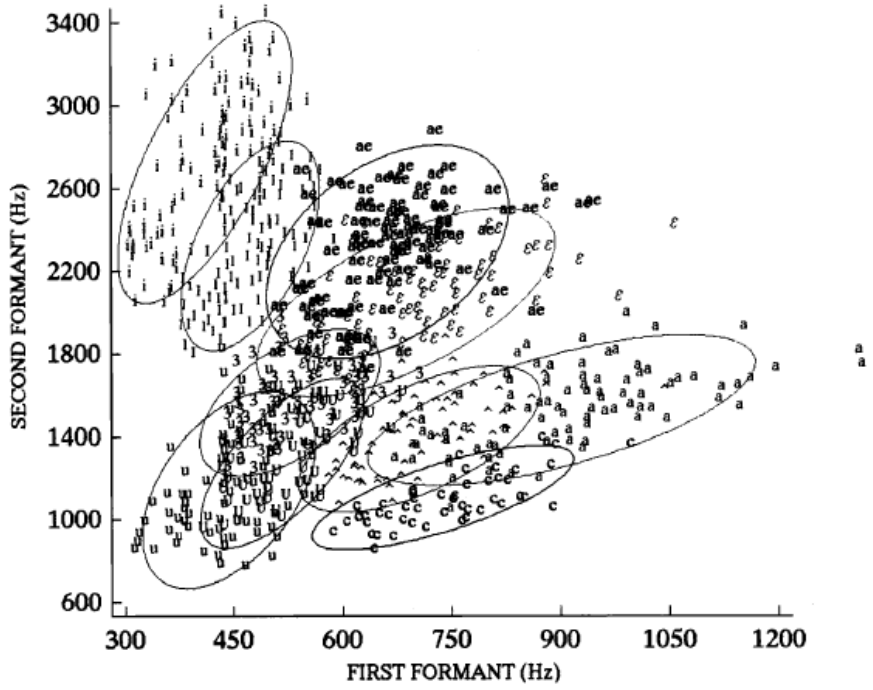
Individual differences in phoneme categorization

Effie Kapnoula, Bob McMurray, Eunjong Kong, Matthew Winn, & Jan Edwards

19th Mid-Continental Phonetics & Phonology Conference

The problem of lack of invariance

- There is no one-to-one relation between a sound (i.e. formant frequencies) and the perceived phoneme



Hillenbrand, Getty, Clark & Wheeler, 1995

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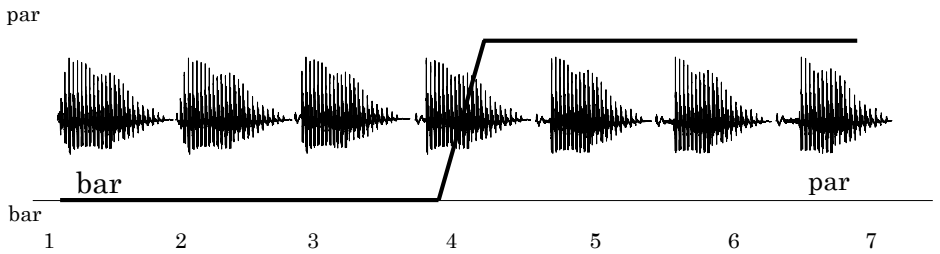

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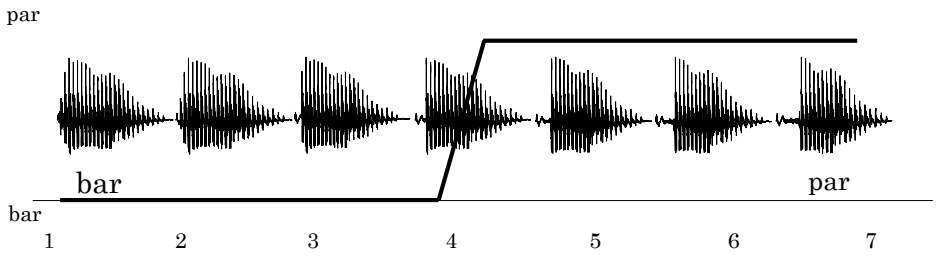
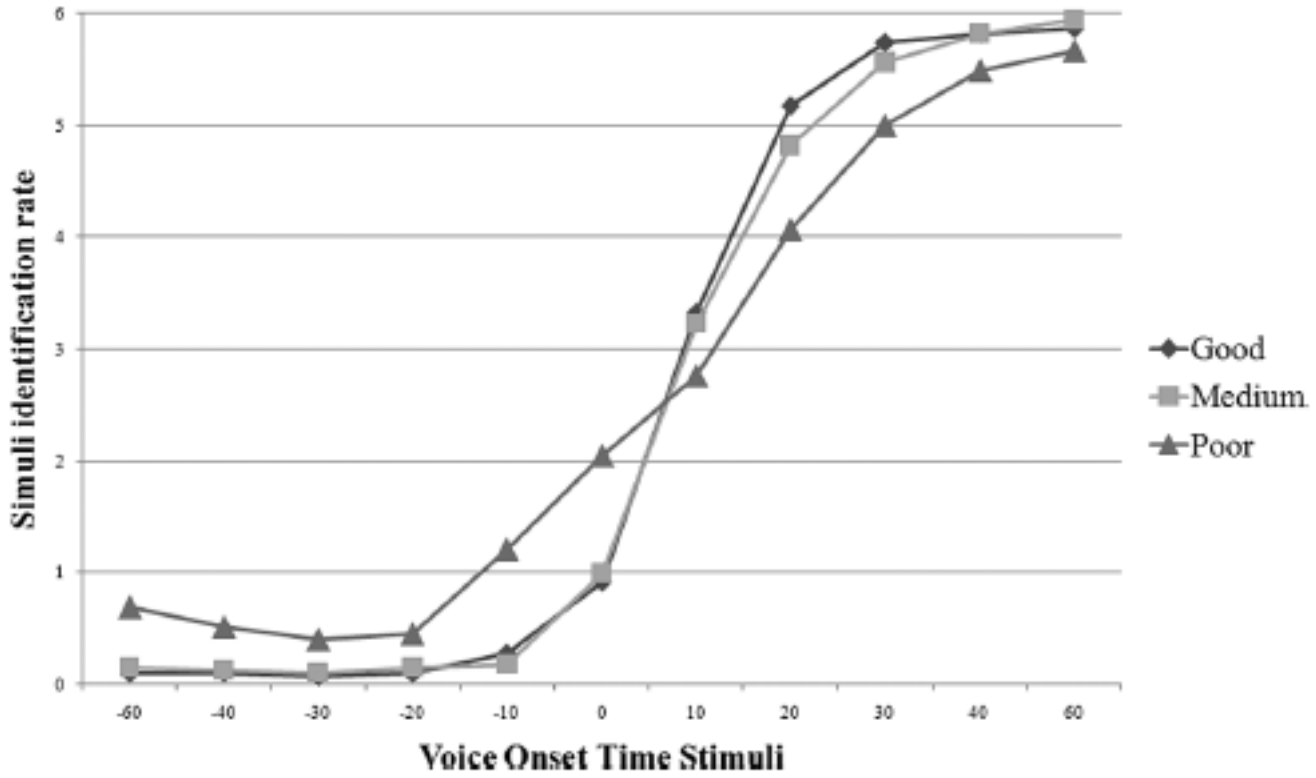
  - +Simple solution
  - +Fast commitment



Two alternative forced choice (2AFC)



Werker & Tees, 1987; Joanisse et al, 2000; López-Zamora et al, 2010

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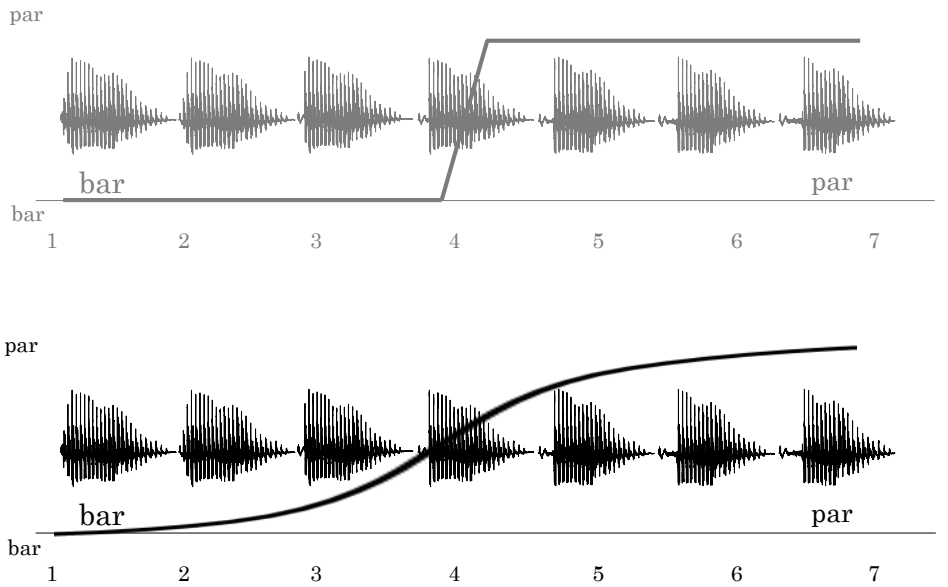

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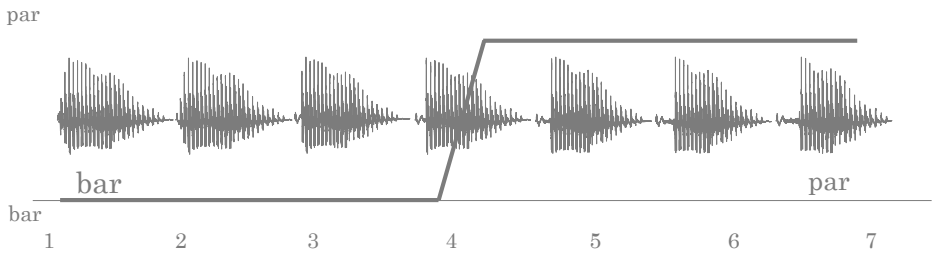
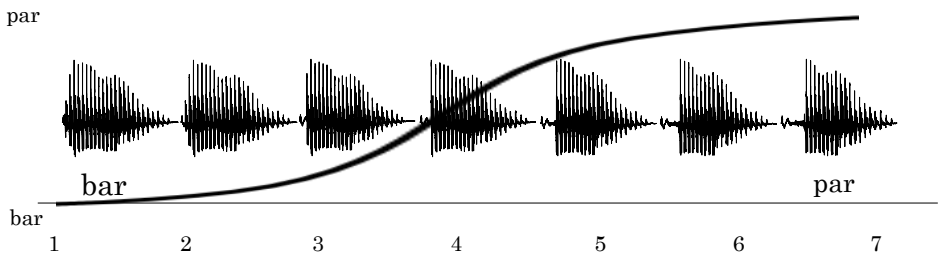
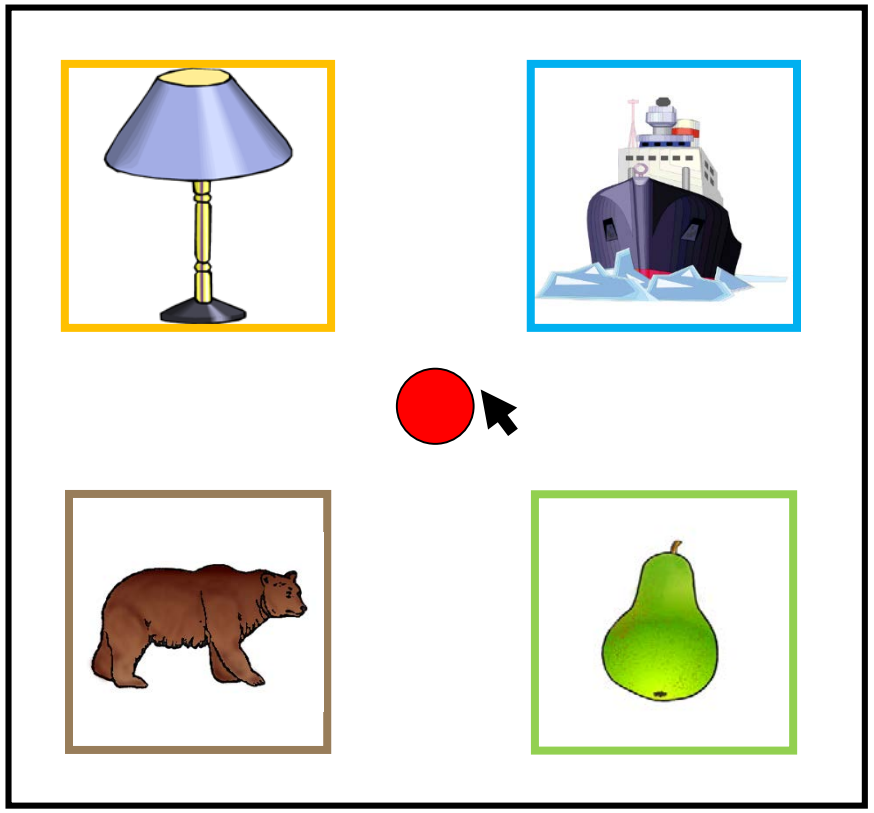


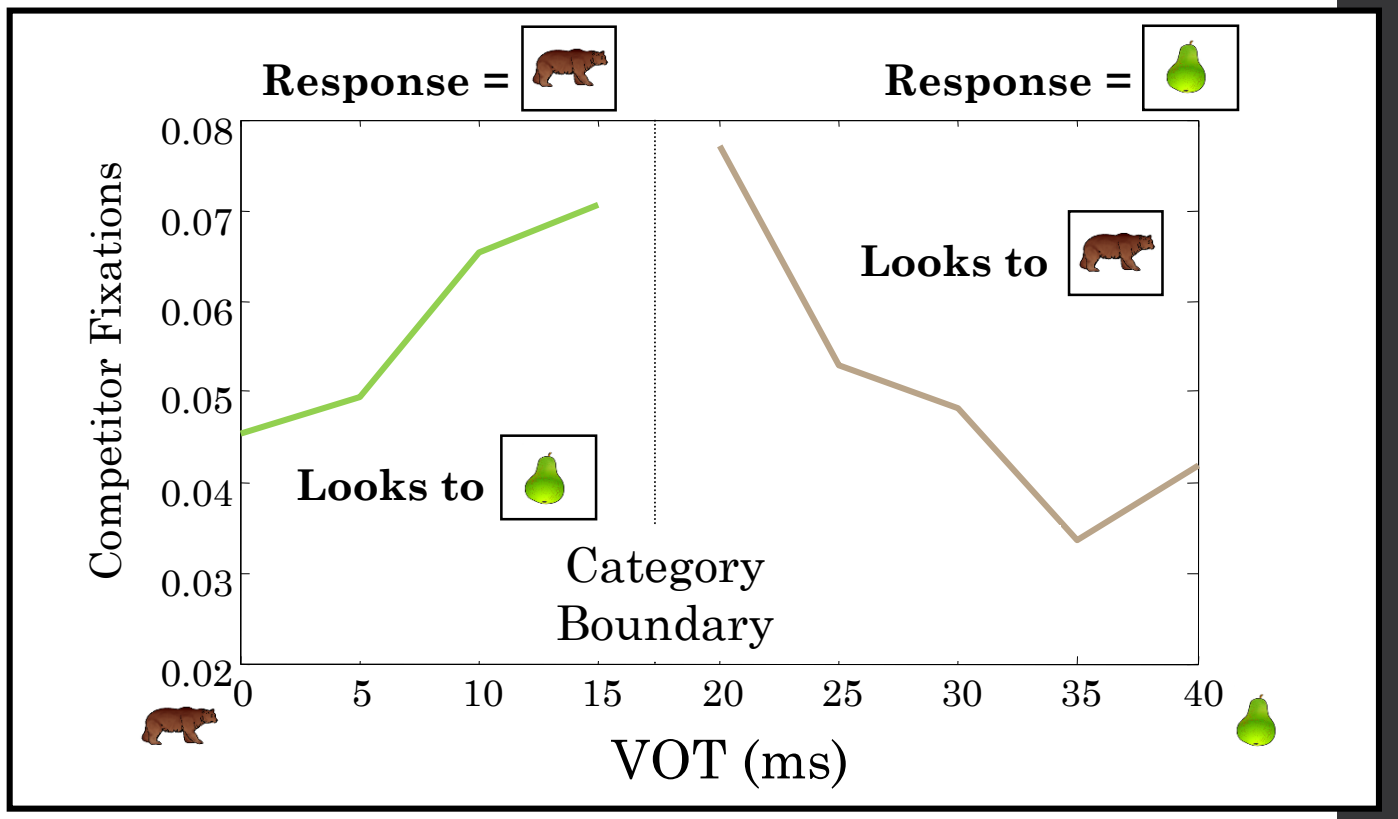
- Alternative: **gradient perception**
  - + Flexibility
  - + Late commitment
  - + Keep useful within-category information



Gradiency in speech perception

- Evidence for gradiency from eye-movements

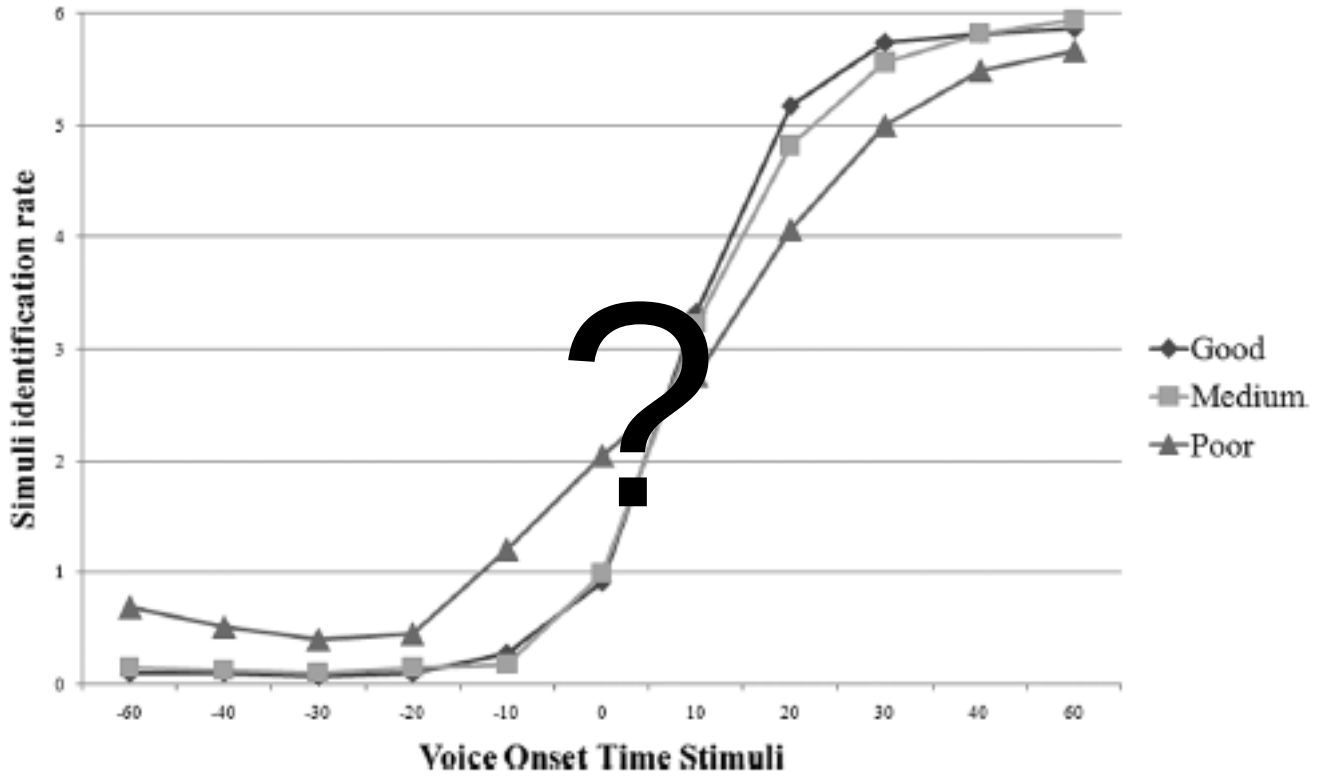




McMurray, Tanenhaus & Aslin (2002)

Two alternative forced choice (2AFC)

- Is gradiency **good** or **bad** for speech perception?



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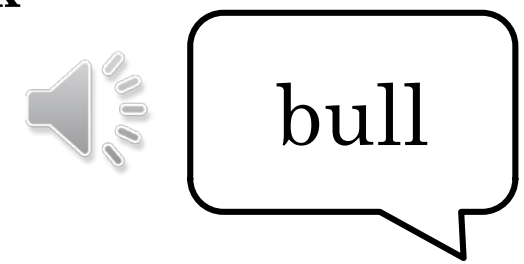
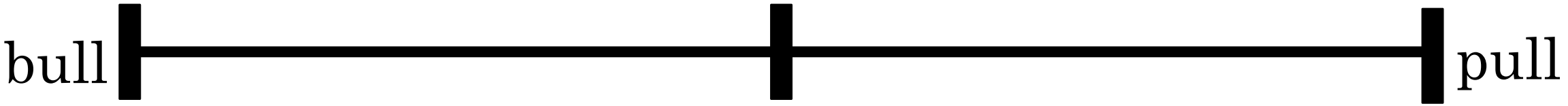
Gradiency in speech perception

- Measuring gradiency: **Visual analog scaling (VAS) task**





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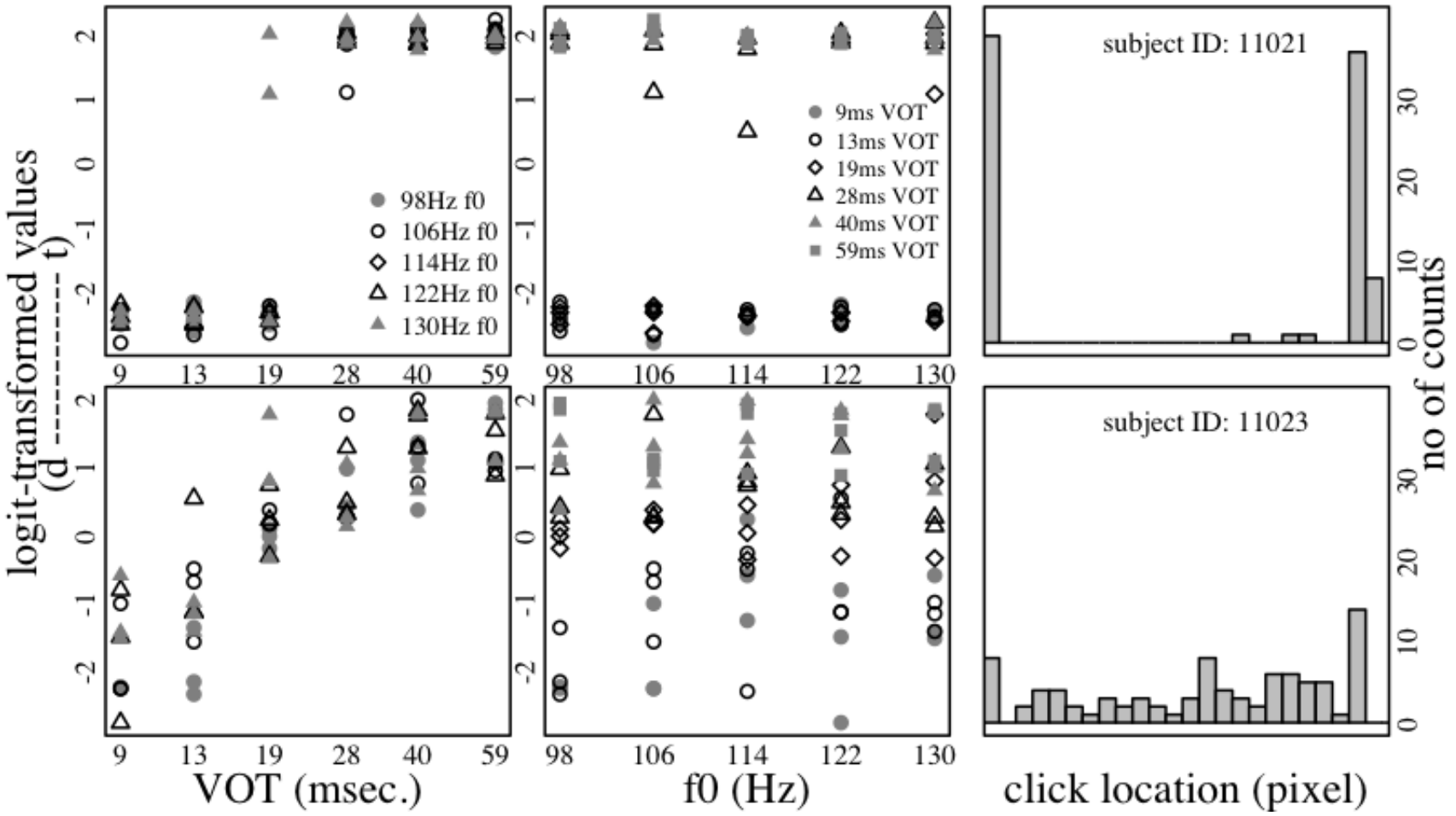
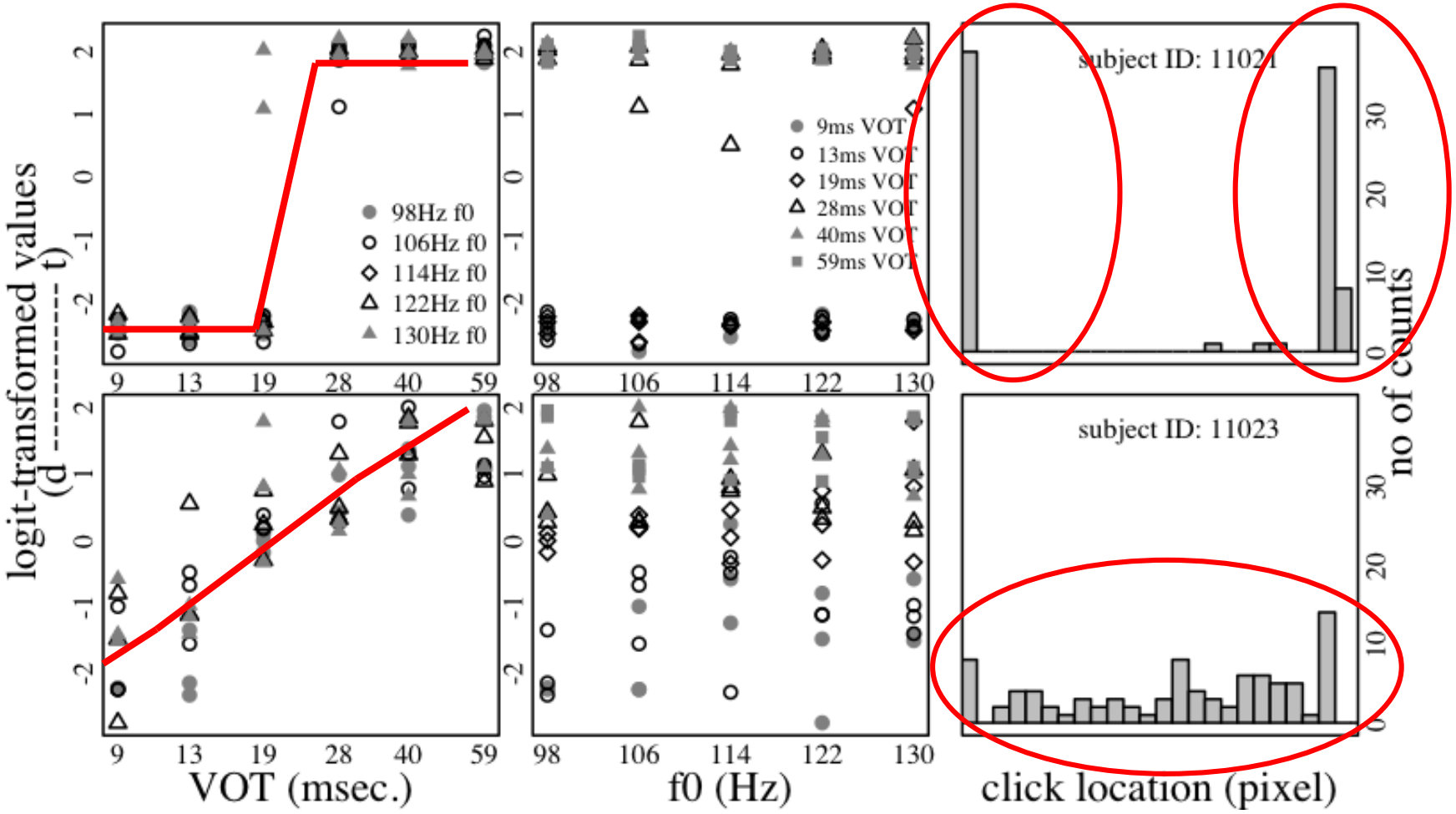


Kong, E. J., & Edwards, J. (2011)

Gradiency in speech perception



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Summary and aims

- Summary points:
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  - Establish a way of **quantifying gradiency** via the VAS task

  1. Investigate possible **sources** of gradiency (e.g. executive function)

  2. Link gradiency to **multiple cue use**

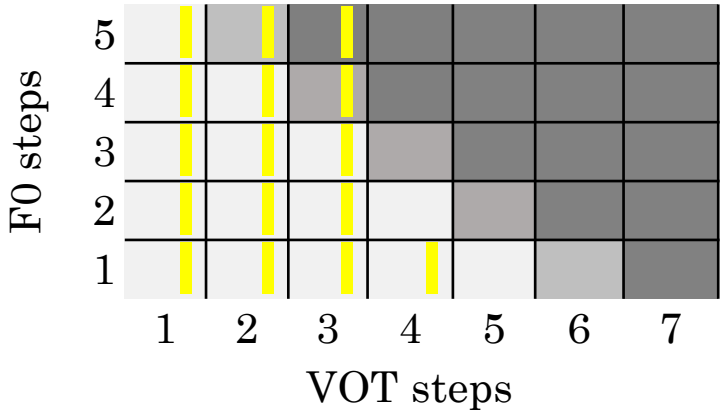
  3. Examine whether gradiency is **good** or **bad** for speech perception

Method

- Stimuli:

	labial	**alveolar**
Real words	bull-pull	den-ten
Nonwords	buv-puv	dev-tev
CVs	buh-puh	deh-teh

  - Seven (7) VOT steps (primary cue) and five (5) F0 steps (secondary cue)



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- Tasks:
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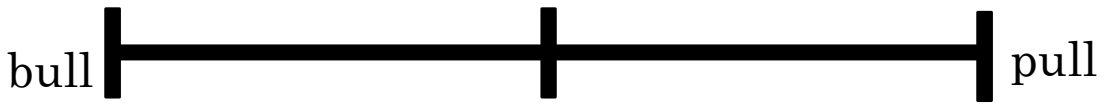

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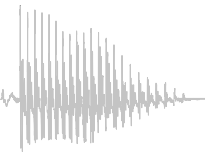
  - AZ-bio (sentences in babbling noise - 1:1 STN ratio)
- Participants: 130 undergraduates at the U of Iowa



Results

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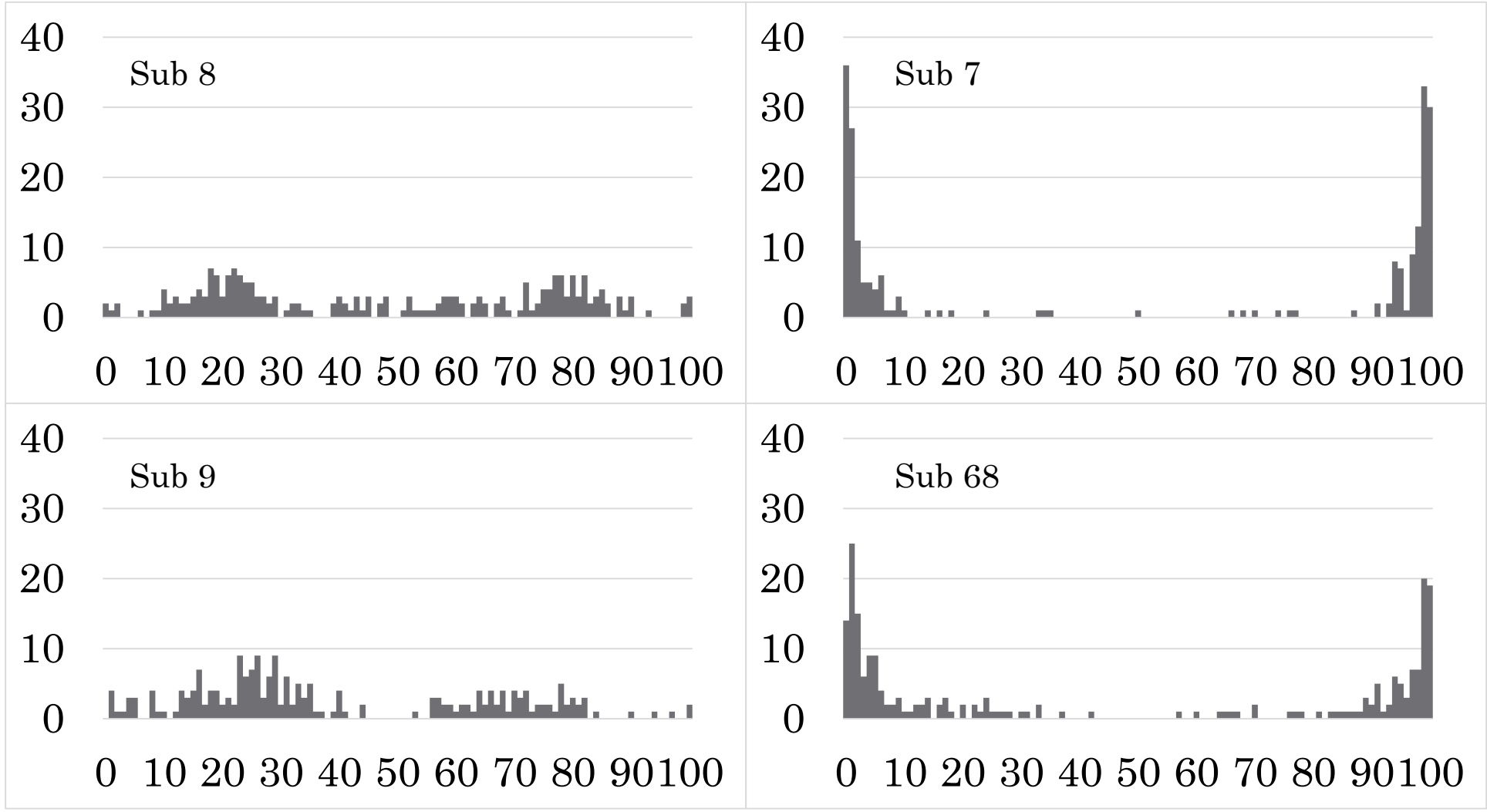
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Results: Quantifying gradiency

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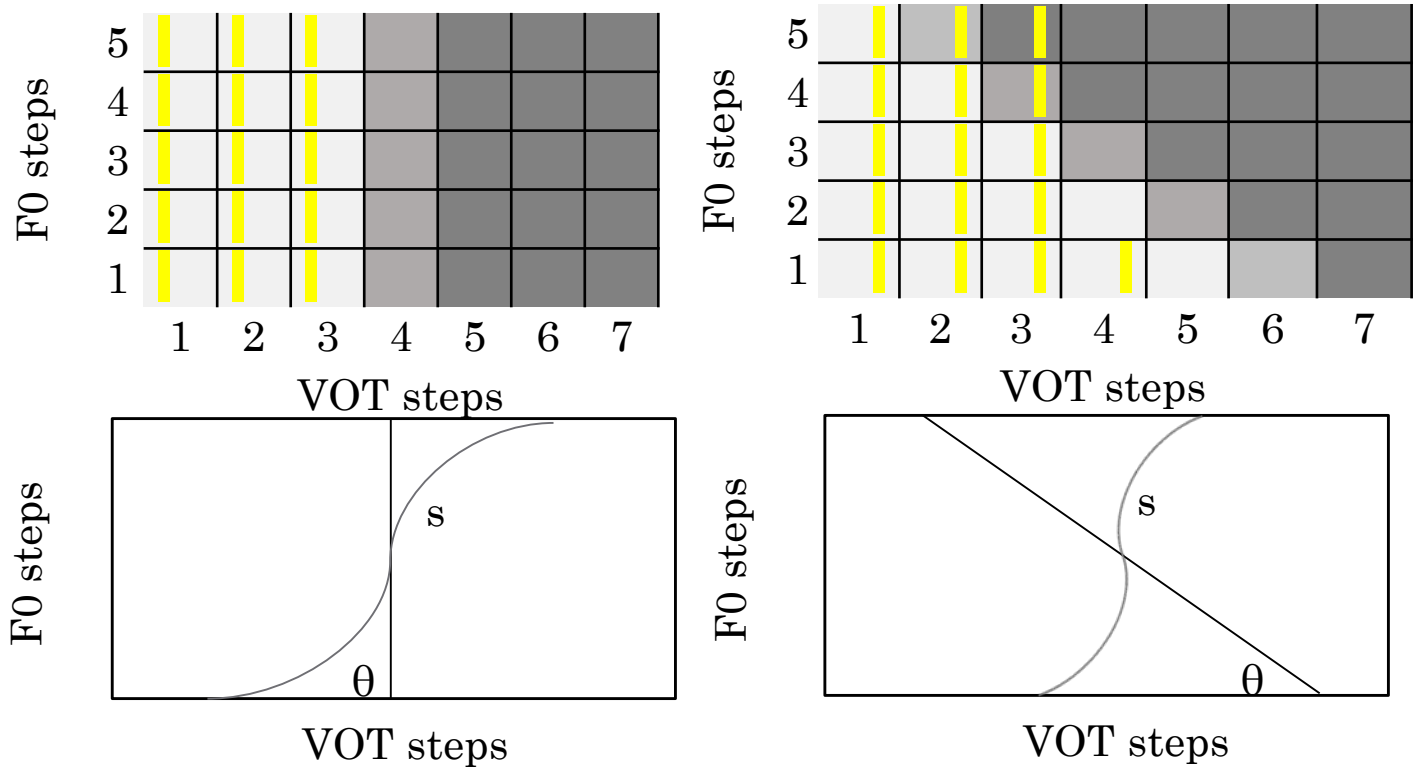
- Extracting gradiency from VAS data



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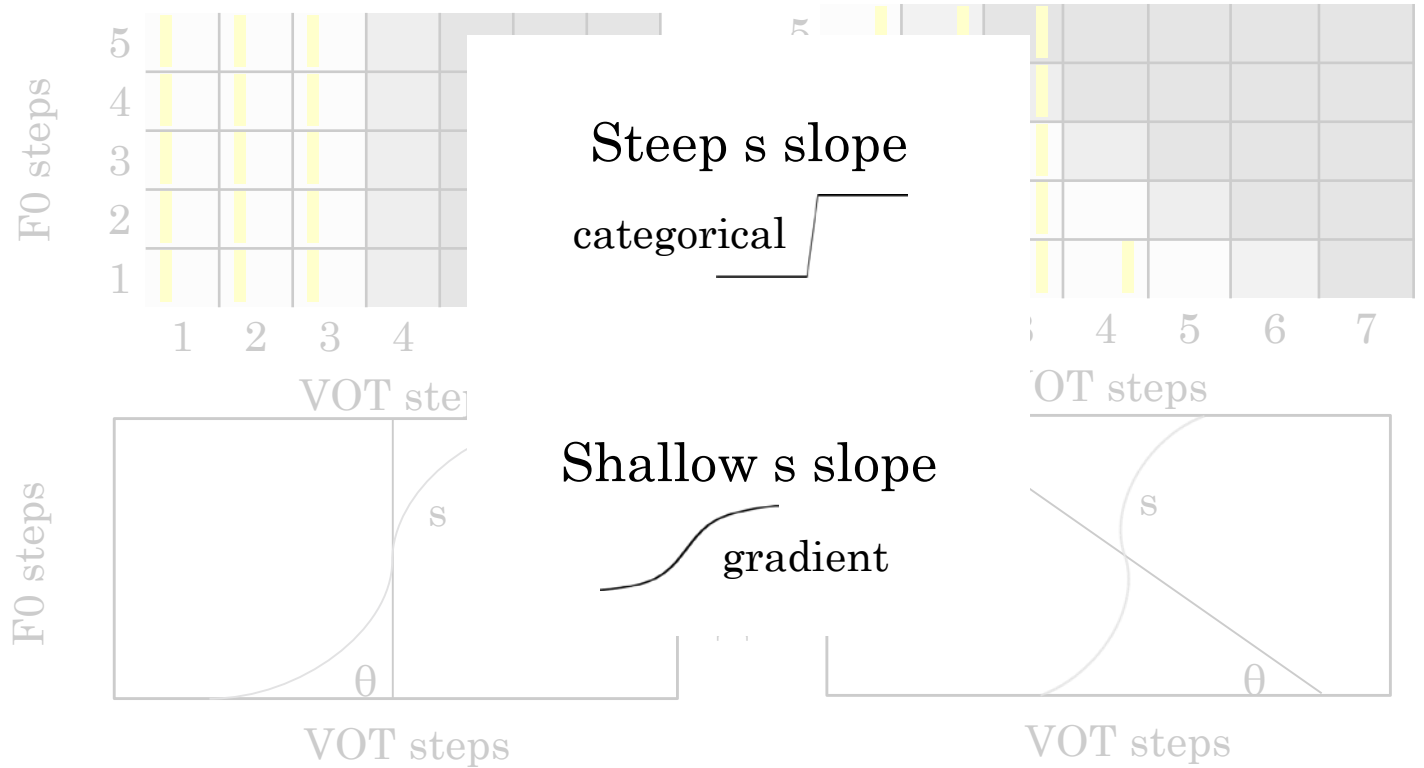

Results: Quantifying secondary cue use

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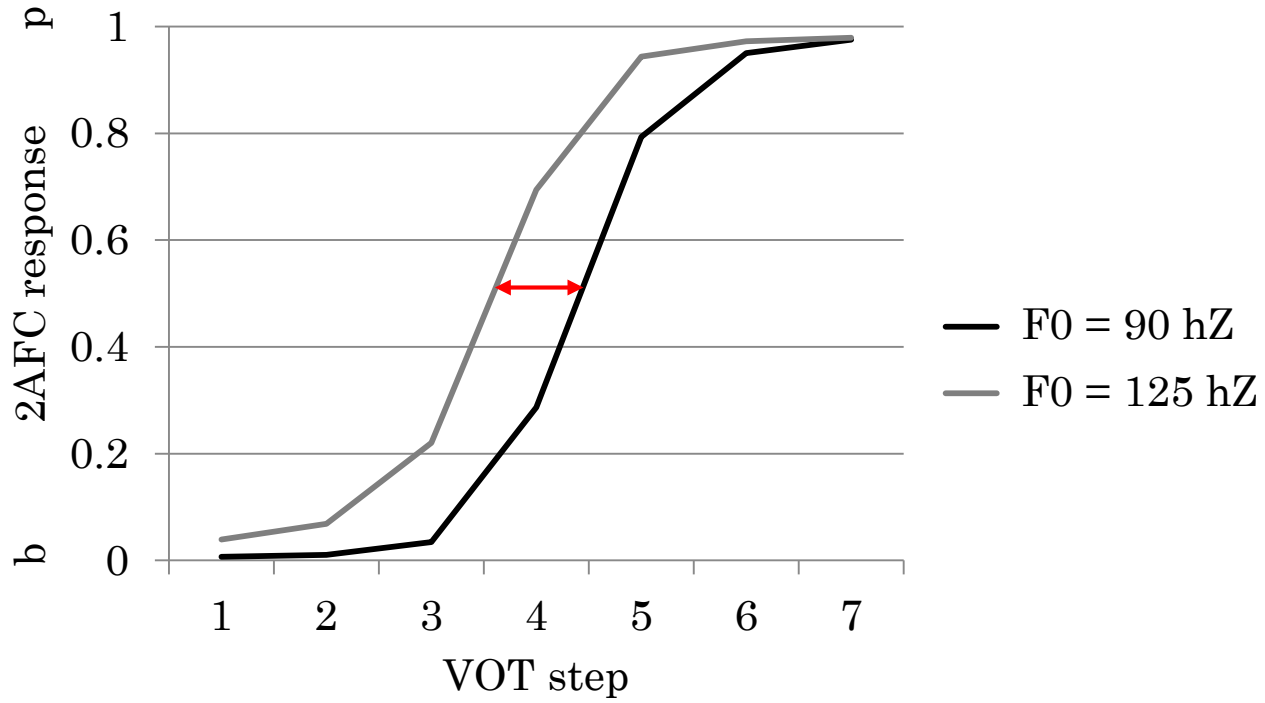

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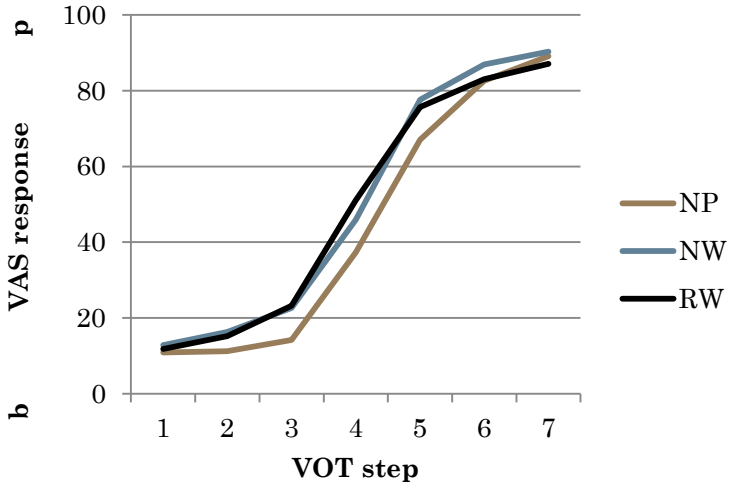
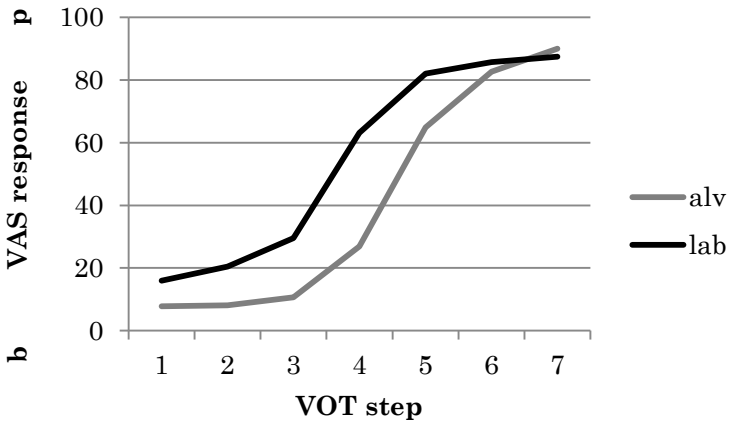
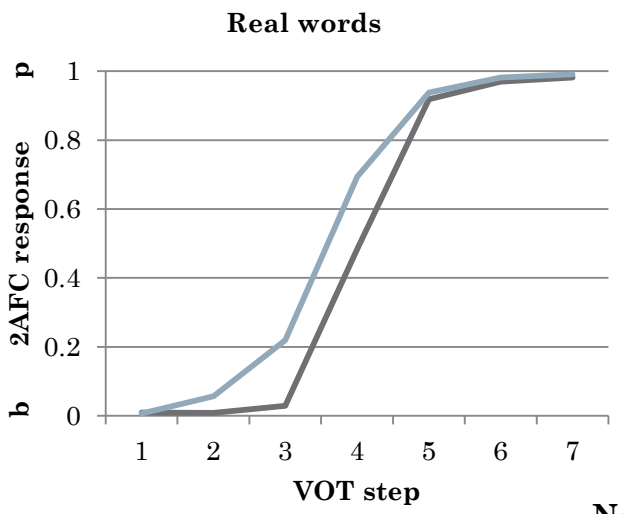
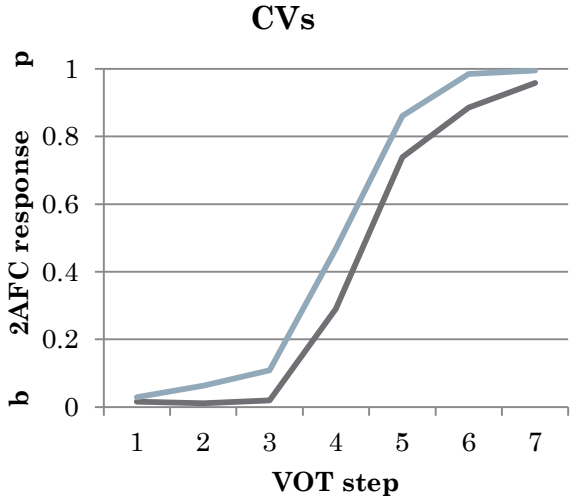
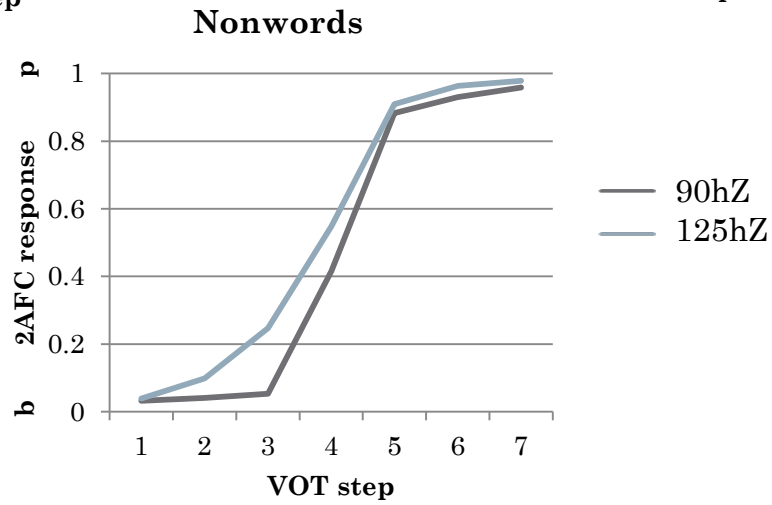
Results: Stimulus and place effects











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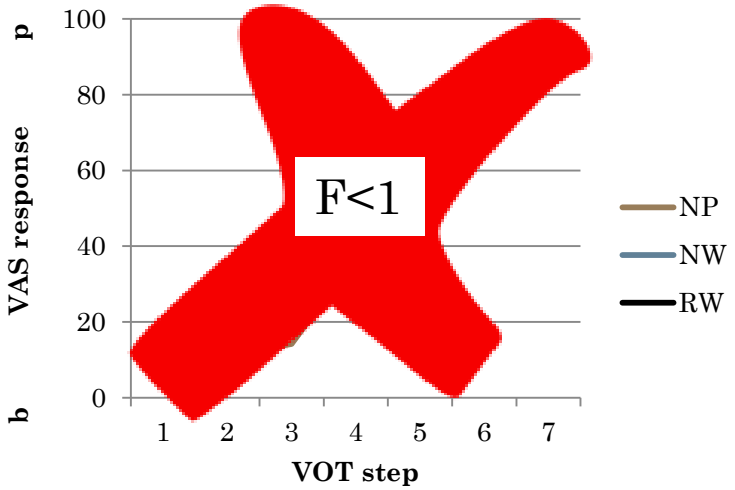
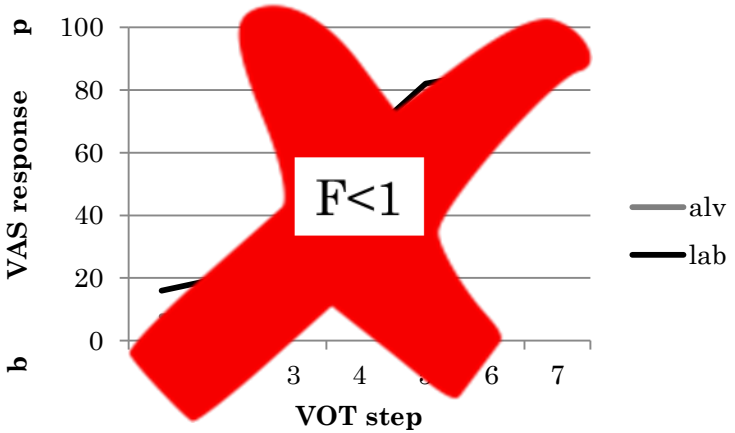
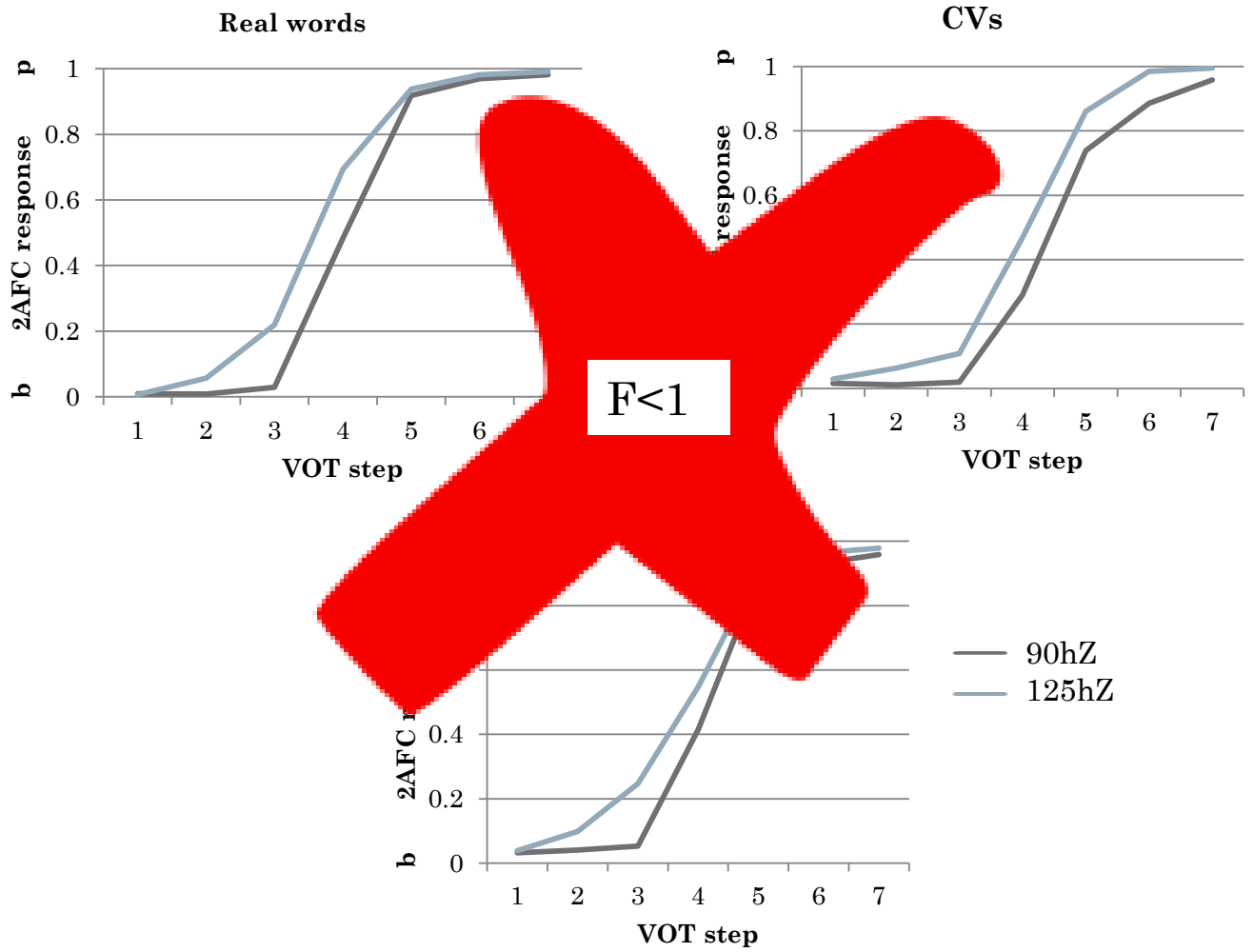
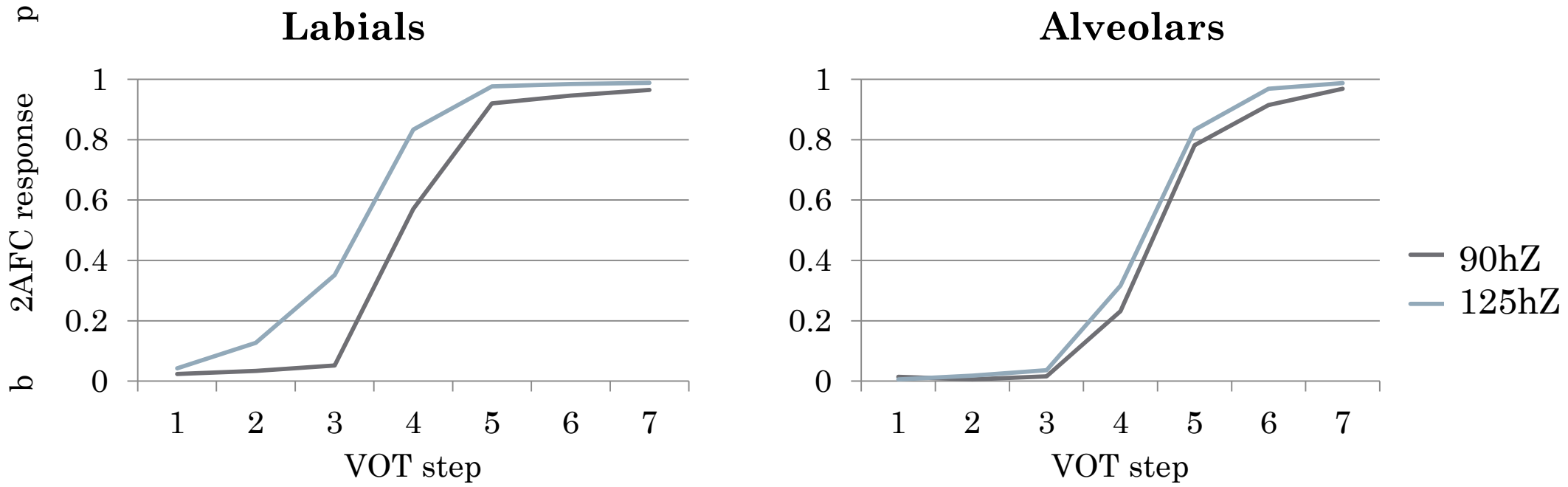






Results: Place differences in F0 use

$F(1,250) = 27.8,\ p < 0.001$



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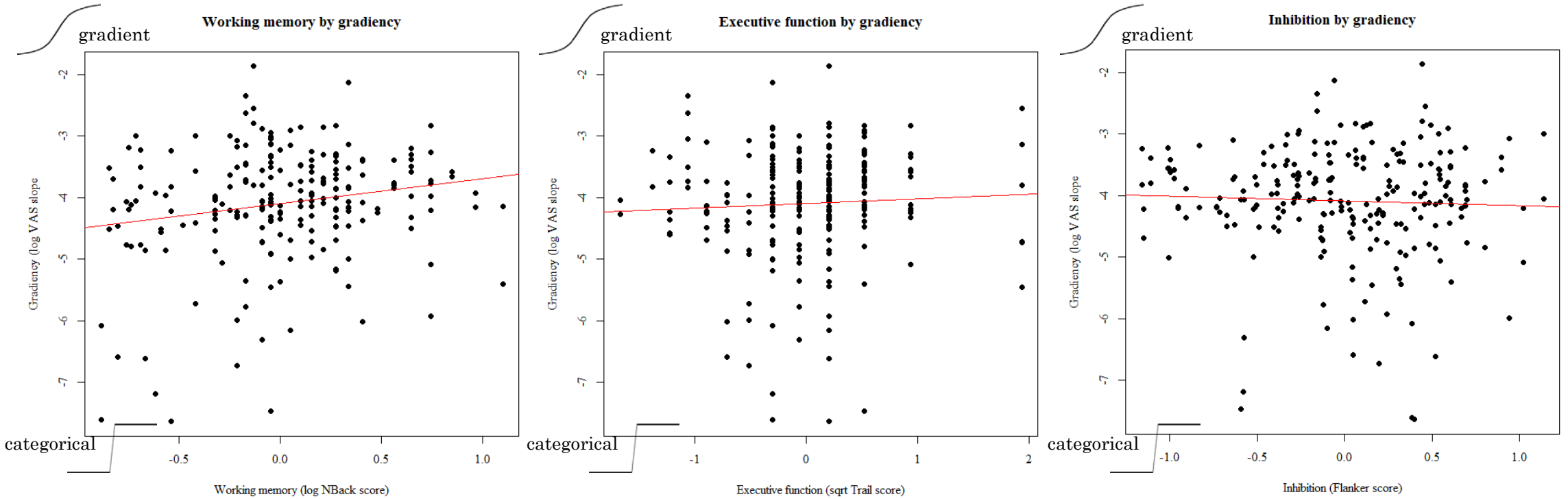

- EF measures did **not** account for a statistically significant amount of variance in VAS slope, $F(3,108)=1.75$, $p=.162$, or F0 use, $F<0$

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   - EF measures did **not** account for a statistically significant amount of variance in VAS slope, $F(3,108)=1.75$, $p=.162$, or F0 use, $F<0$
   - Speech perception processes may be played out on a **different level** of processing than higher cognitive processes, such as working memory

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2. Are individual differences in **gradiency** linked to **multiple cue use**?

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   - **Negative relationship**: Listeners who use more cues have more accurate, sharper boundaries

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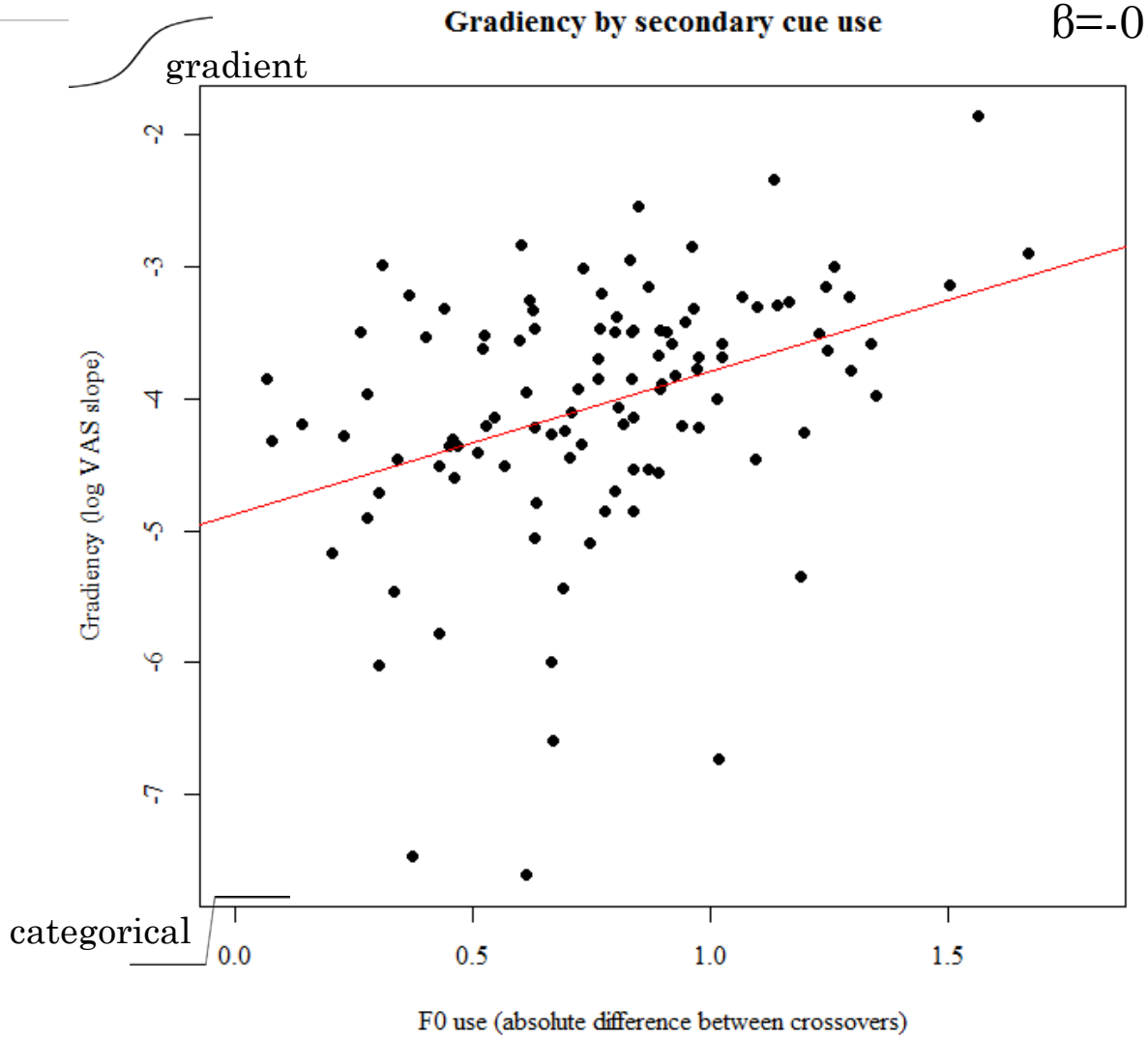

ß=-0.305, t=-3.4, p < 0.01

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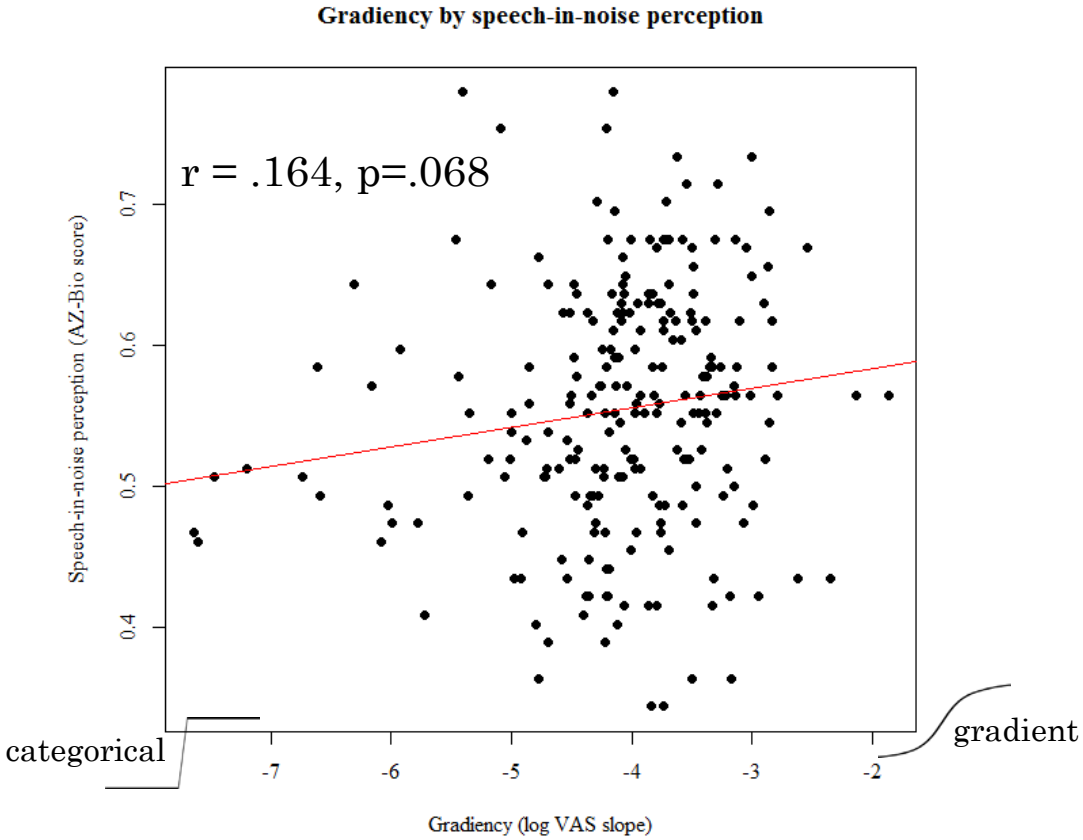
- Gradiency and perception of **speech-in-noise**



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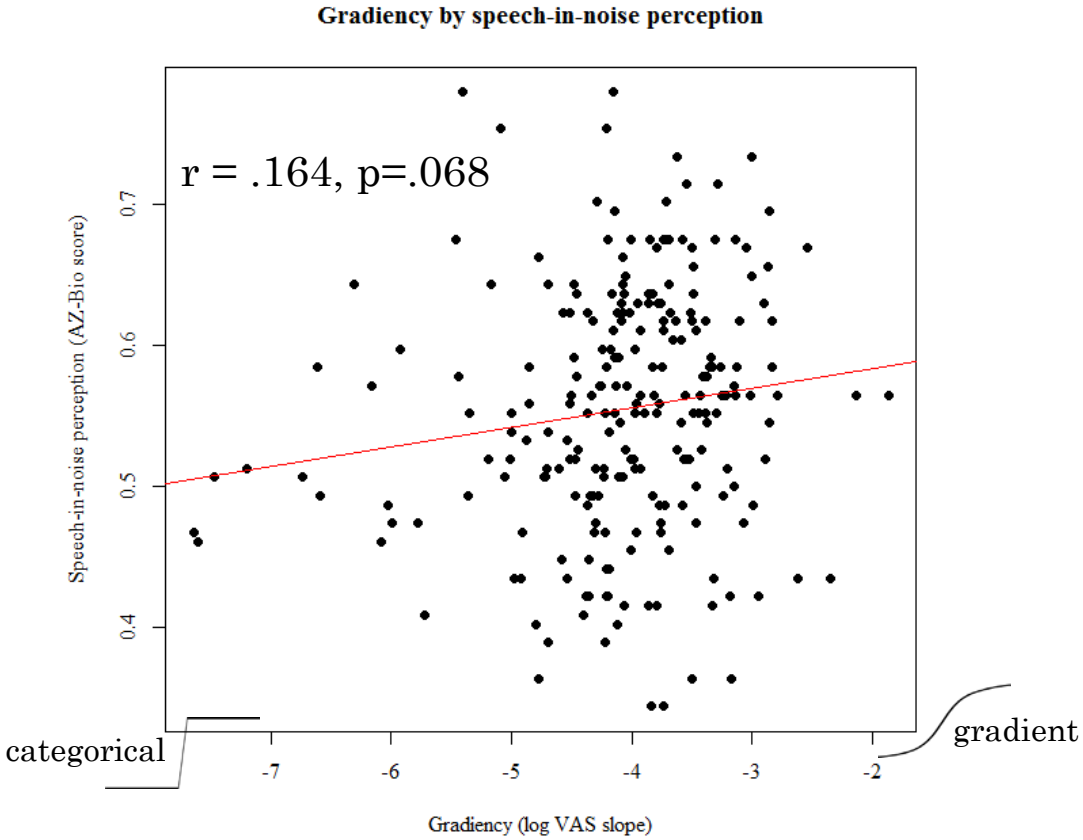

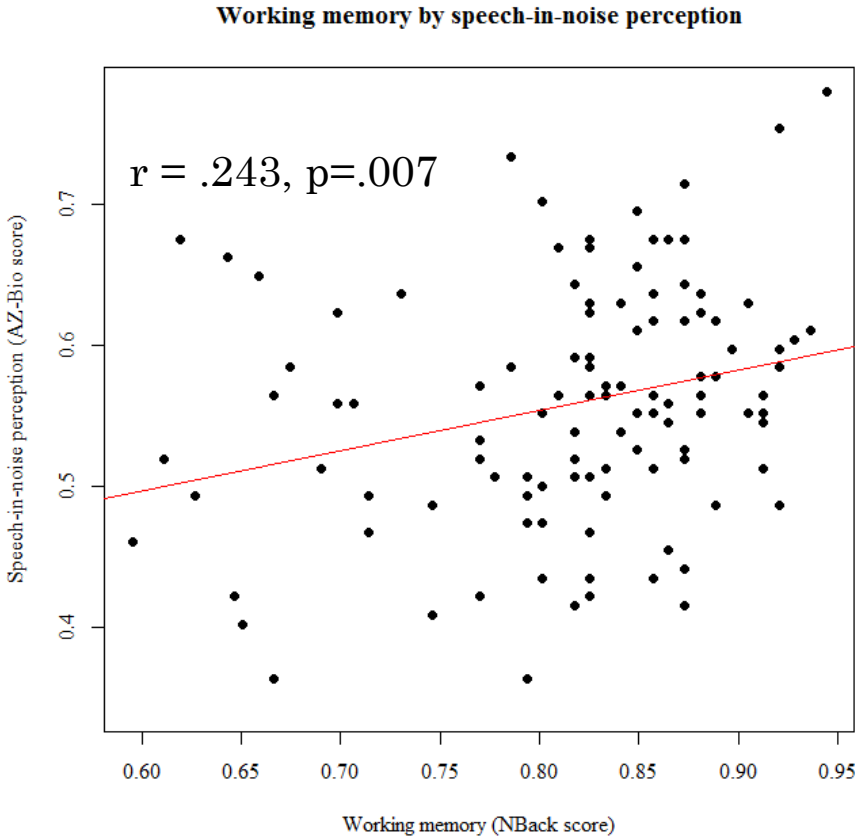

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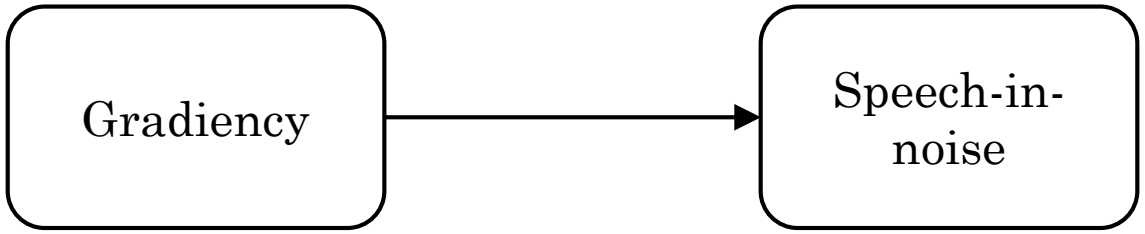

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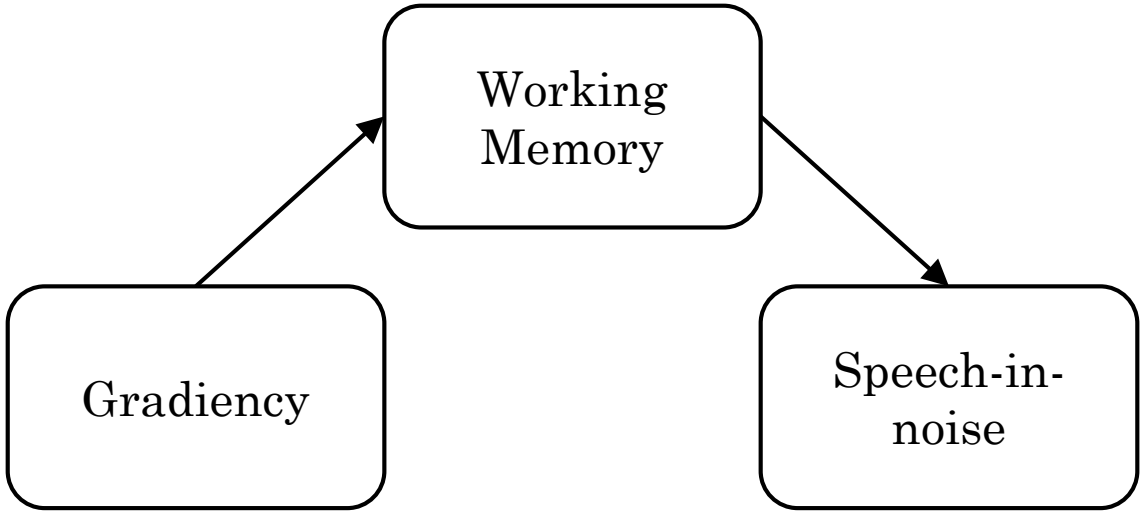

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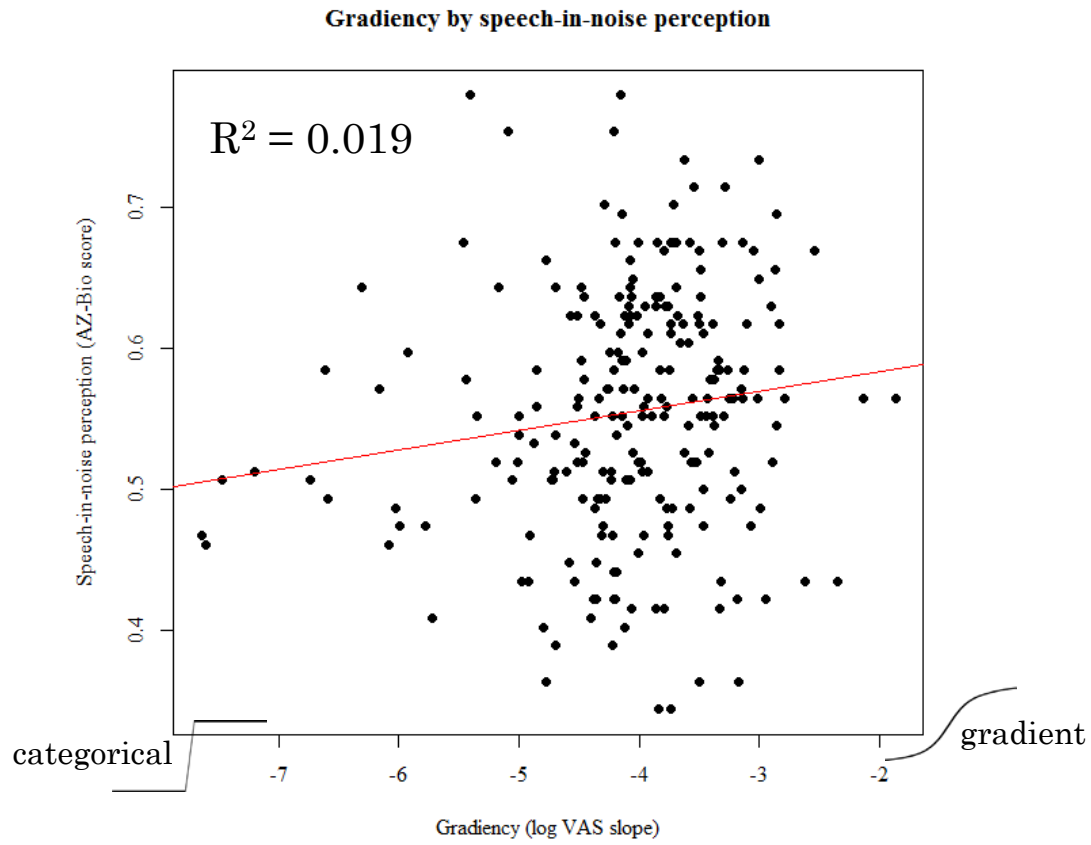

ß=-0.14, t=-1.48, p = .143

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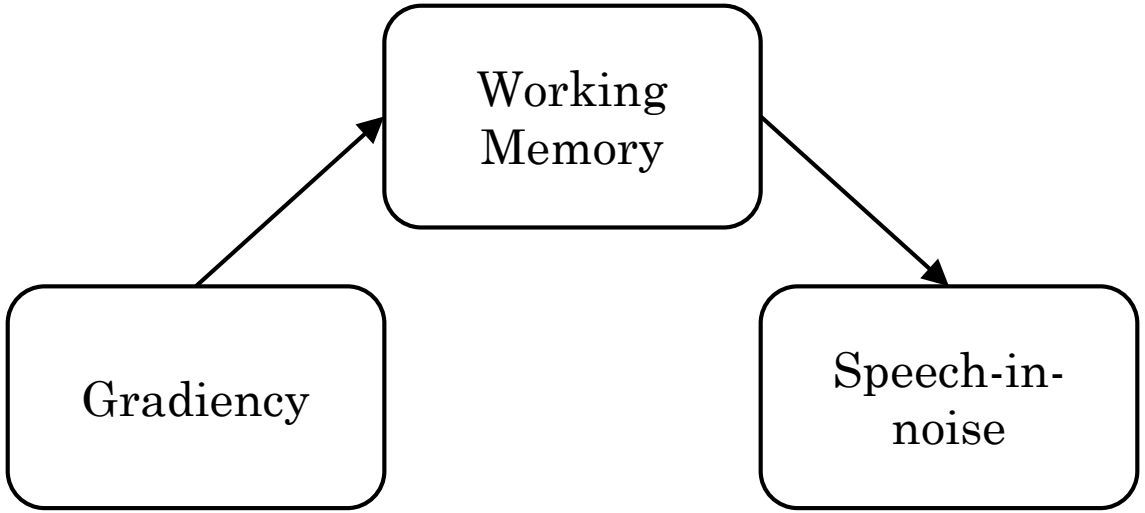
2)



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2. Are individual differences in **gradiency** linked to **multiple cue use**?

3. In what way are these differences important for speech perception?

   - More gradient listeners tend to better perceive speech in noise

Summary and conclusions

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   - And/or more gradient listeners **commit later** to a category.

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3. In what way are these differences important for speech perception?
   - More gradient listeners do a bit better (marginally) in perceiving speech in noise.
   - Gradiency is **not all that bad** - maybe **good** for some things.

Take home messages

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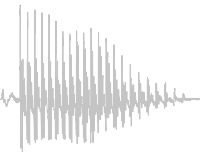
2. Some listeners are **more gradient** than others in categorizing phonemes.
3. This gradiency may be a **good thing**.

Thank you!

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