The Effects of Language Experience and Inhibitory Control on Spoken Word Recognition for Cochlear Implant Users

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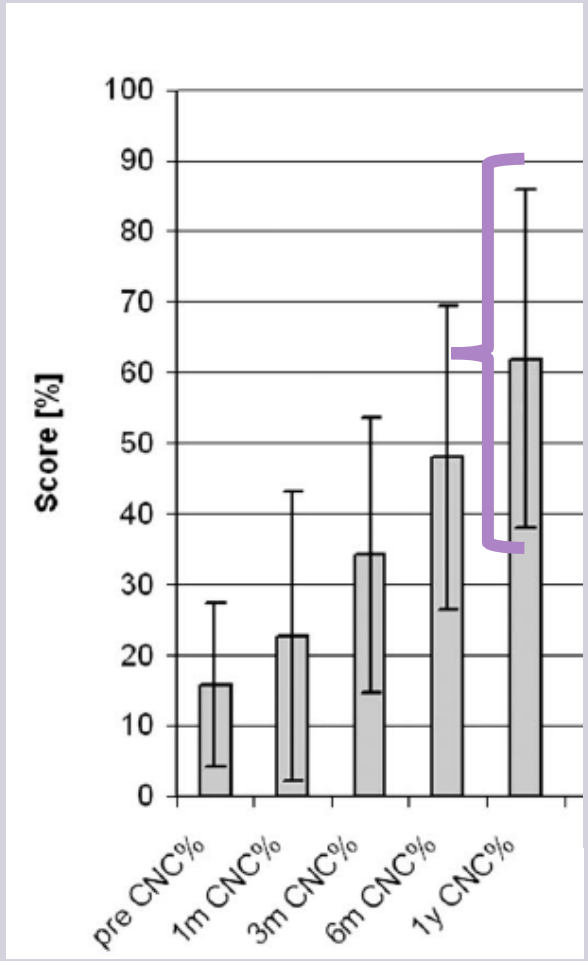
ARO Midwinter Meeting

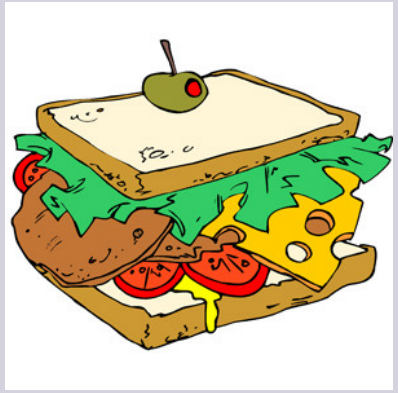
Word Recognition in CI users

- CI users are highly variable in word recognition outcomes
  - Even after 1+ years of experience
- Some variation is likely due to the auditory periphery
  - Device configuration, residual hearing, etc.
- Some is likely due to cognitive processes that help listeners deal with ambiguity in the speech signal
  - Attention
  - Inhibitory control
  - Cue weighting
  - Word recognition!



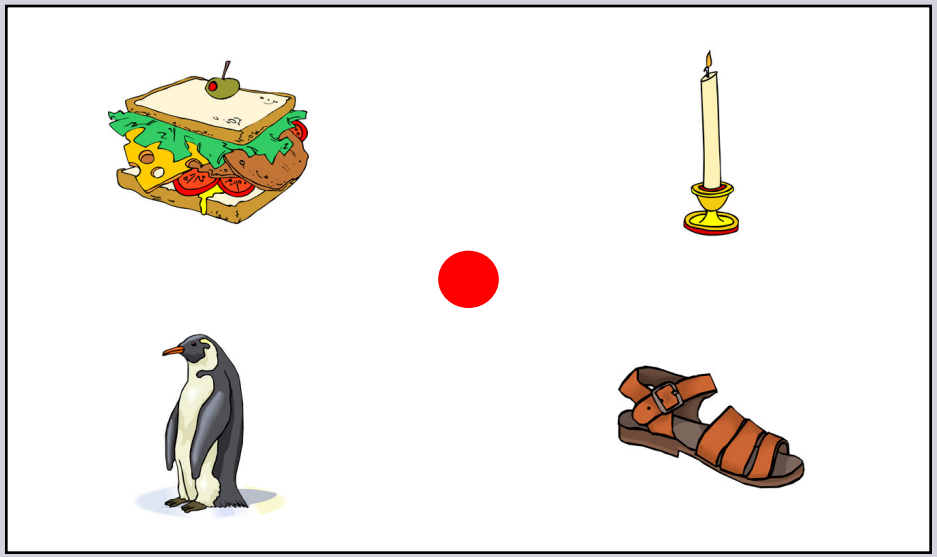
(Cullen et al., 2004)

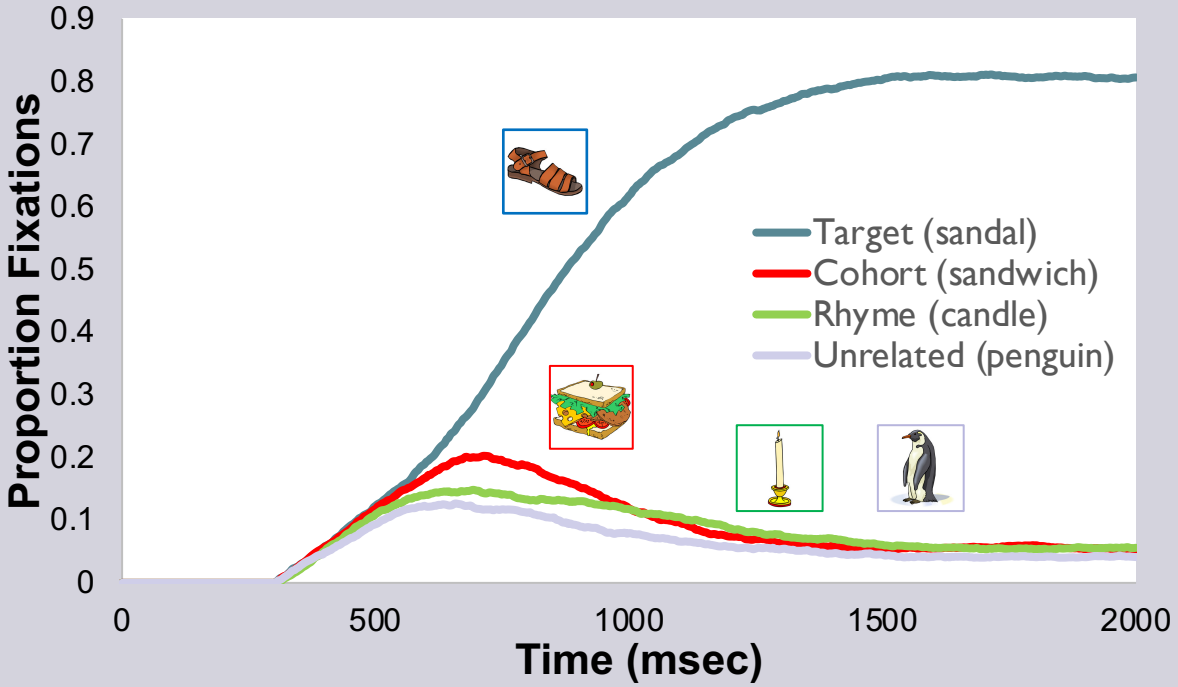
Dynamics of Spoken Word Recognition



“san-”

The Visual World Paradigm





Word recognition presents a competition challenge that must be resolved by the listener

Lexical access in CI users

Lexical access is about dealing with uncertainty, even for NH listeners

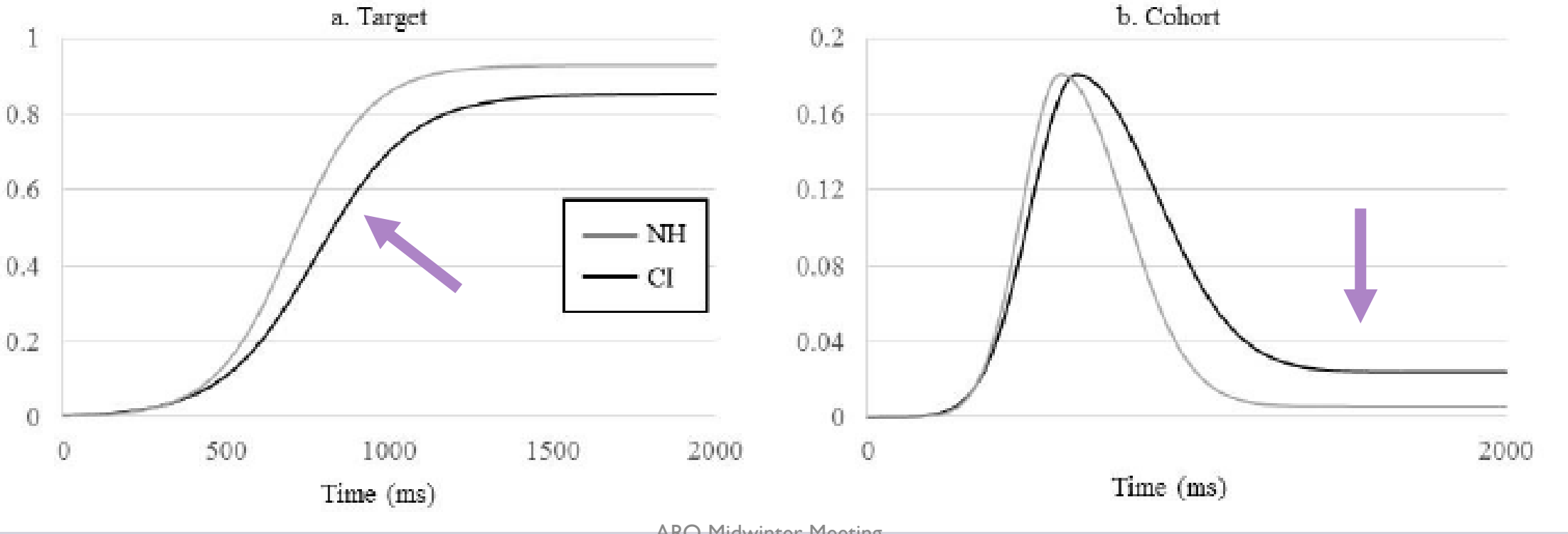
- Does it adapt to signal degradation?

- One strategy could be to avoid a complete commitment

Lexical access in CI users

The dynamics of lexical access differ between normal hearing listeners and cochlear implant users (Farris-Trimble et al., 2014; McMurray et al., 2017)

Normal hearing listeners vs. Postlingual CI users



Lexical access in CI users

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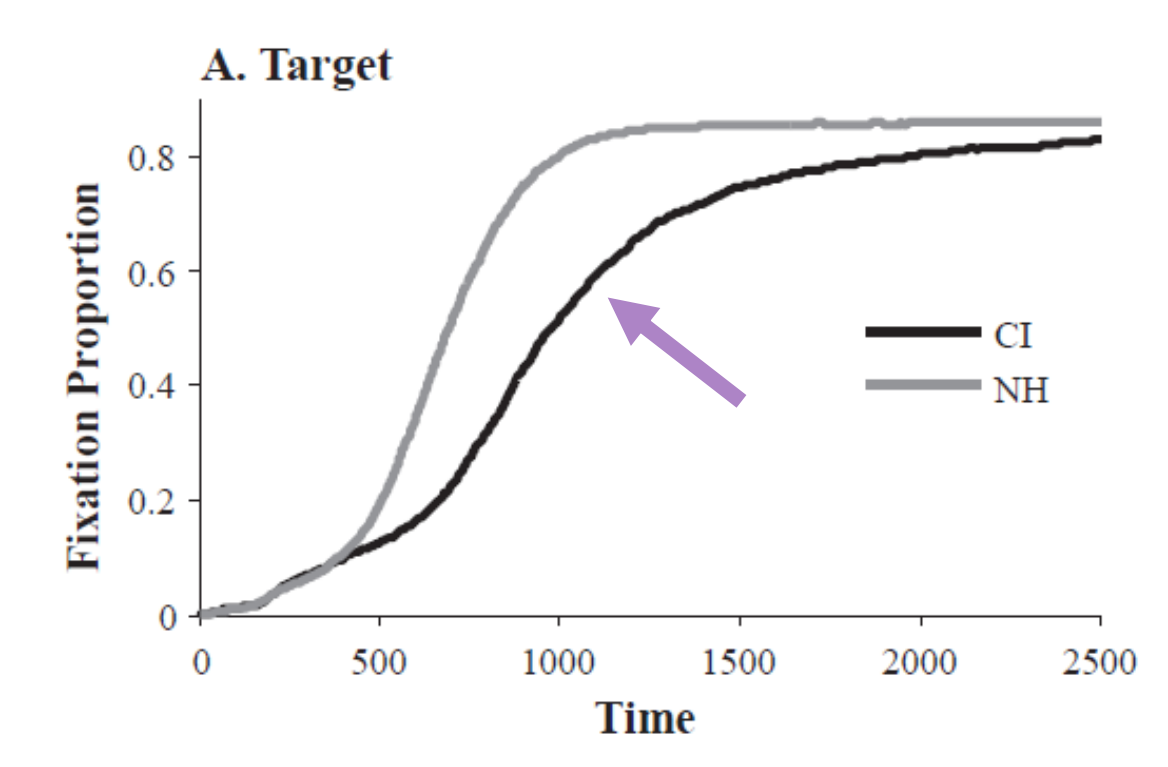
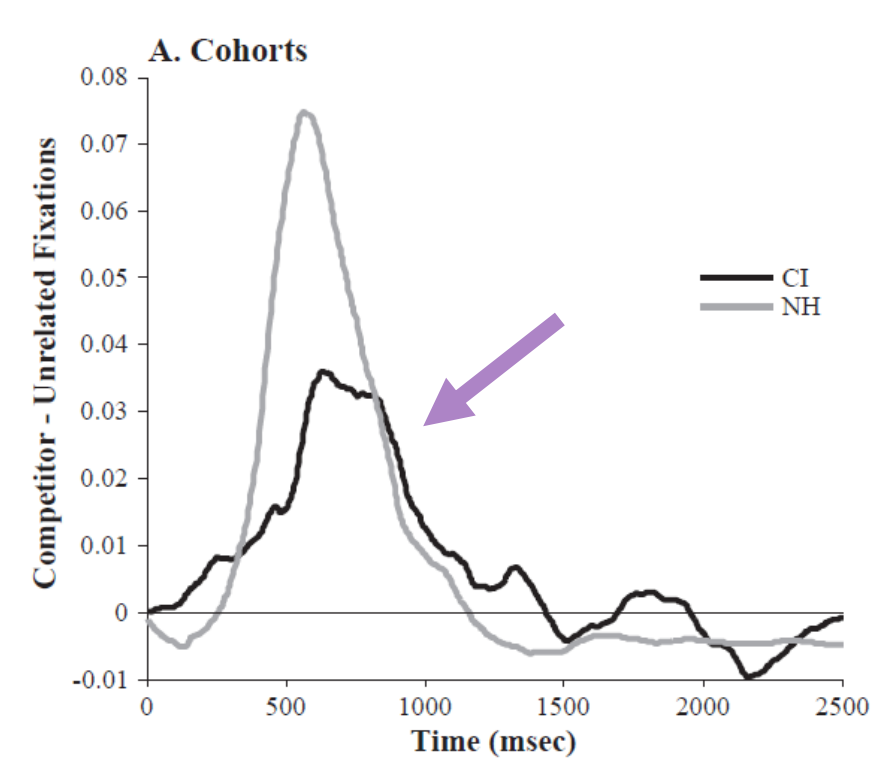
- Does it adapt to signal degradation?

- One strategy could be to avoid a complete commitment: Postlingual CI users
- Another could be to slow down entirely and wait for more information

Lexical Access in CI users

Normal hearing listeners vs. Prelingual CI users





Lexical Access in CI users

Lexical access is about dealing with uncertainty

- Does it adapt to signal degradation?

- One strategy could be to avoid a complete commitment: Postlingual CI users
- Another could be to slow down entirely and wait for more information: Prelingual CI users

- Maybe this is just how words are processed with degraded input

- BUT if this pattern is related to non-auditory cognitive processing, then maybe it's an adaptive strategy

- How can we examine this?

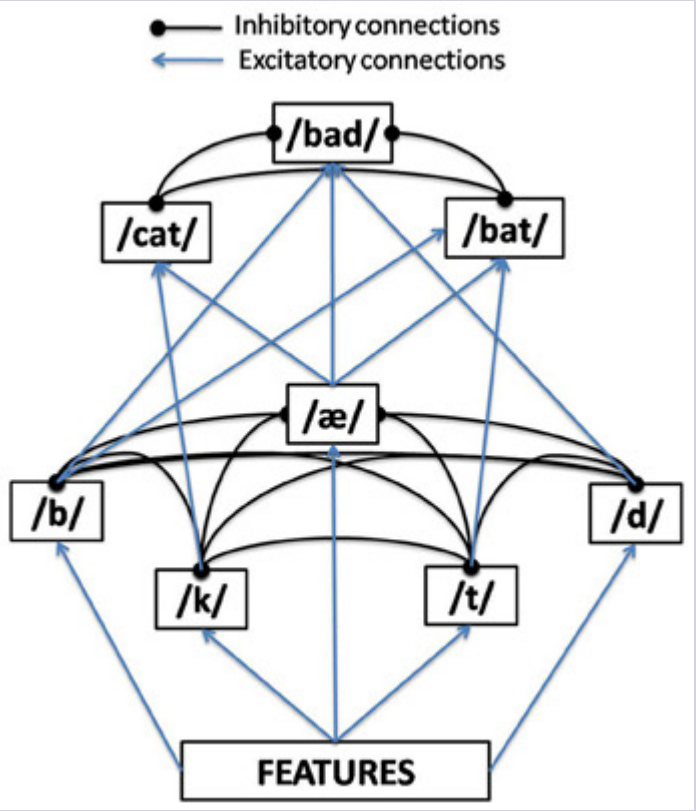
How is lexical competition resolved?

Inhibition between competitors ***within*** the language system

- *sandal* directly inhibits *sandwich*

But competition could also invoke *inhibitory control?*

- flexible domain-general mechanism for decision making



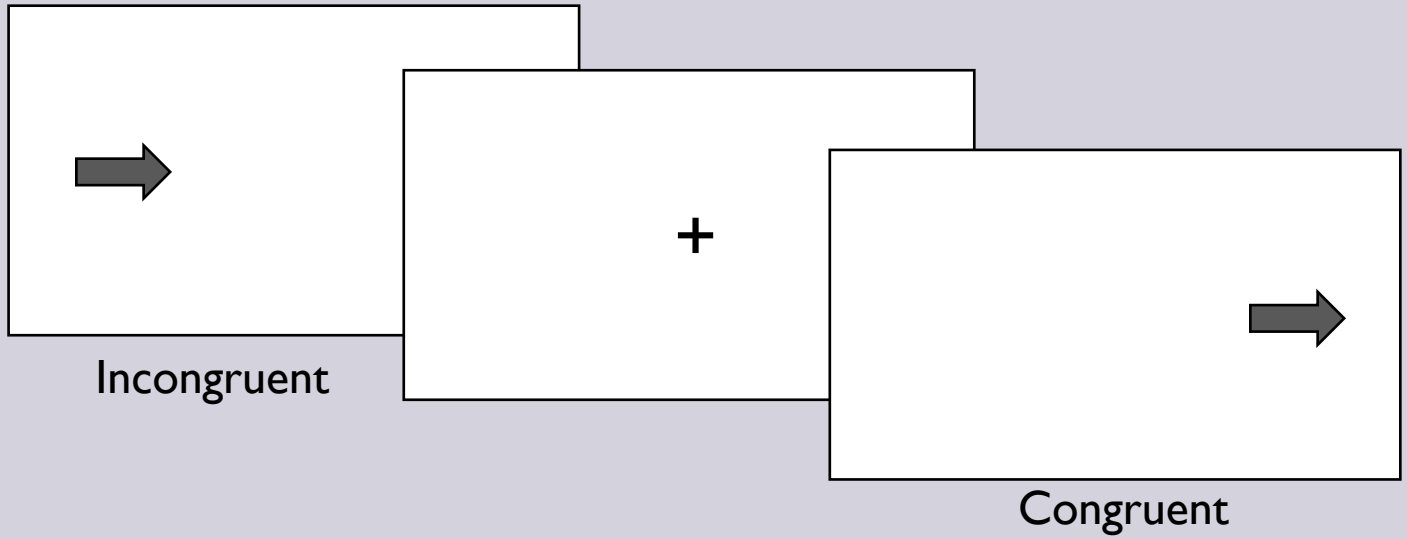
(Hannagan, Magnuson, & Grainger, 2013)

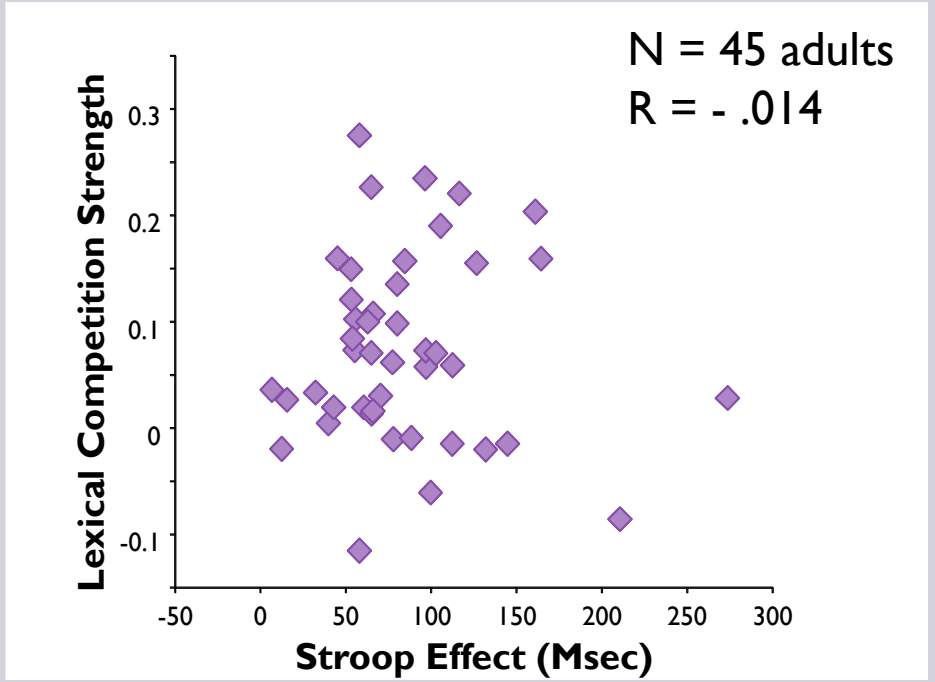
How is lexical competition resolved?

How to measure inhibitory control?

- Spatial Stroop
  - Respond to the direction the arrow is pointing
  - Ignore presentation side

If inhibitory control is involved in word recognition, it would be unexpected





Roembke & McMurray (in prep)

Current project

- Characterize differences in lexical competition in CI users
  - Lexical competition (VWP)

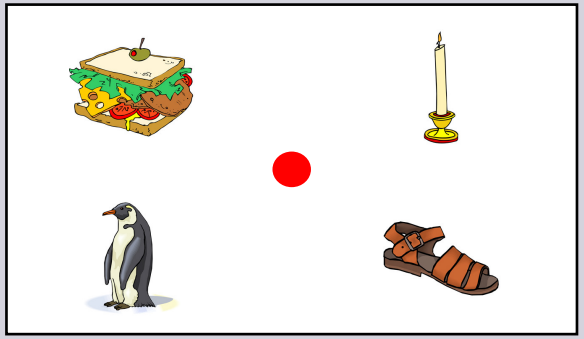
- Factors that might impact lexical competition
  - Inhibitory control
  - Language experience (pre-/postlingual onset of deafness)

Methods & Design

Group	N	Mean Age
Postlingual CI users	**51**	**58.9**
Bilateral	*7*	
Unilateral	*9*	
Hybrid	*19*	
Bimodal	*16*	
Prelingual CI users	**21**	**38.2**
Bilateral	*6*	
Unilateral	*8*	
Hybrid	*5*	
Bimodal	*2*	
Normal hearing	**71**	**52.3**

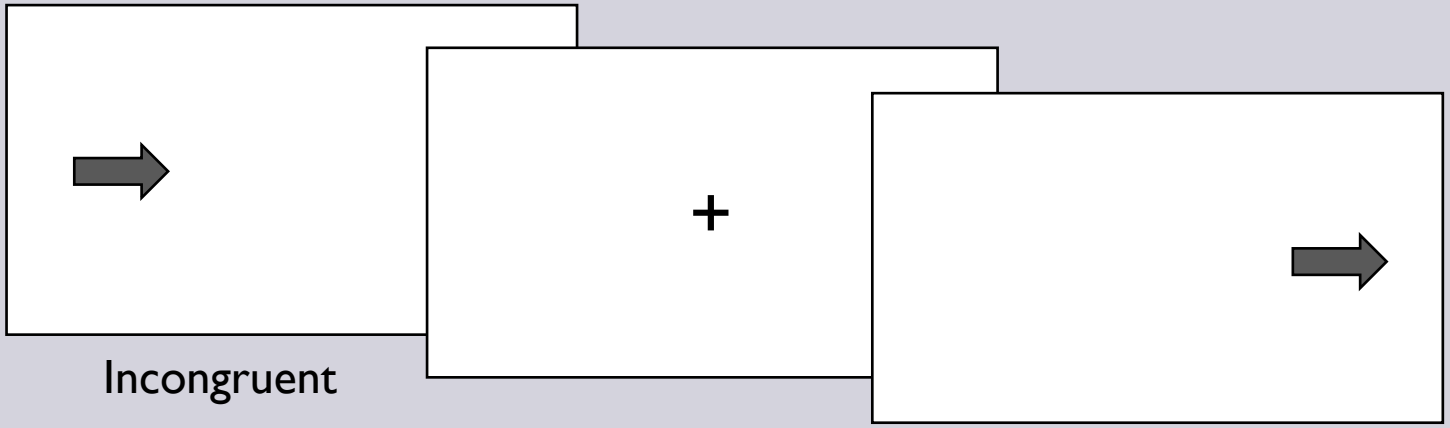
Visual world paradigm

- 300 trials
- Target, cohort, rhyme, unrelated

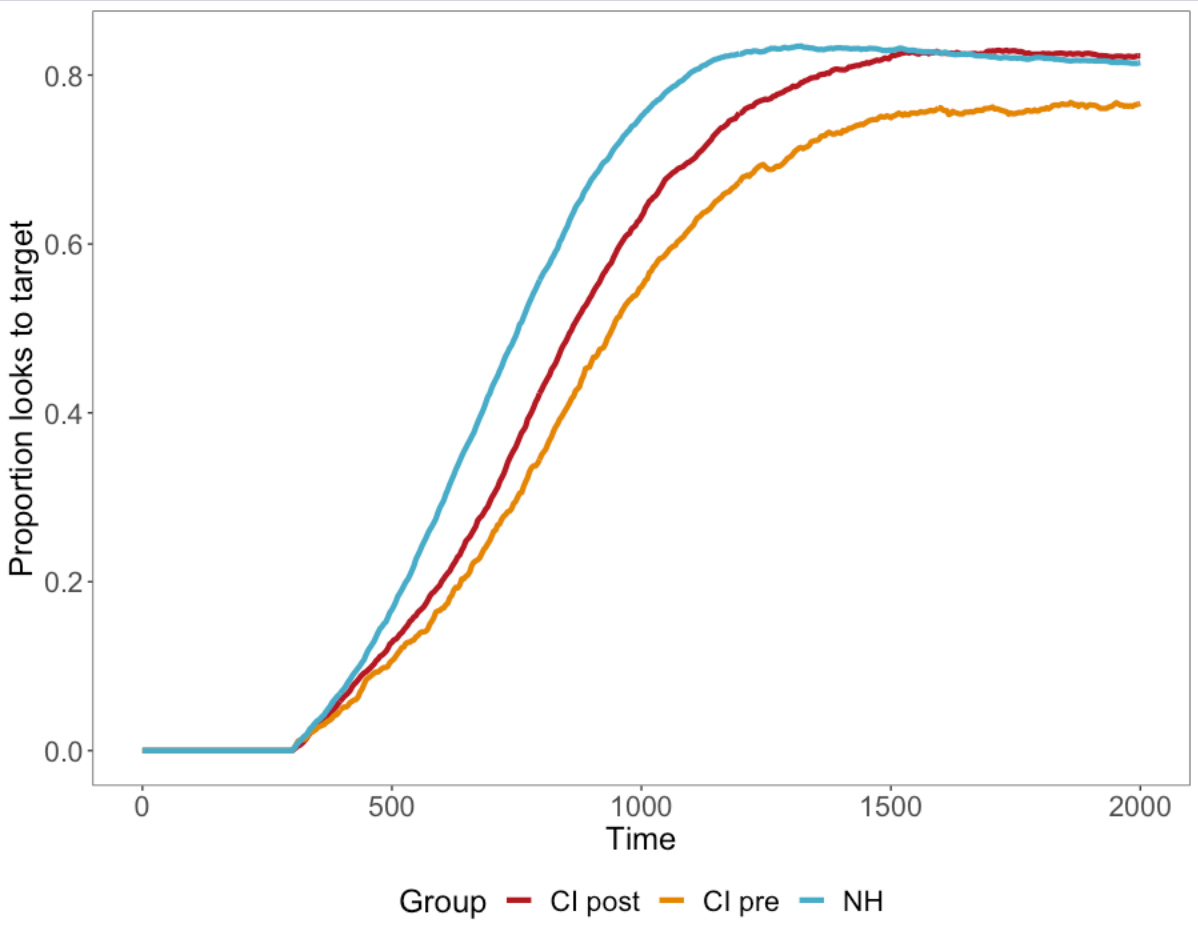


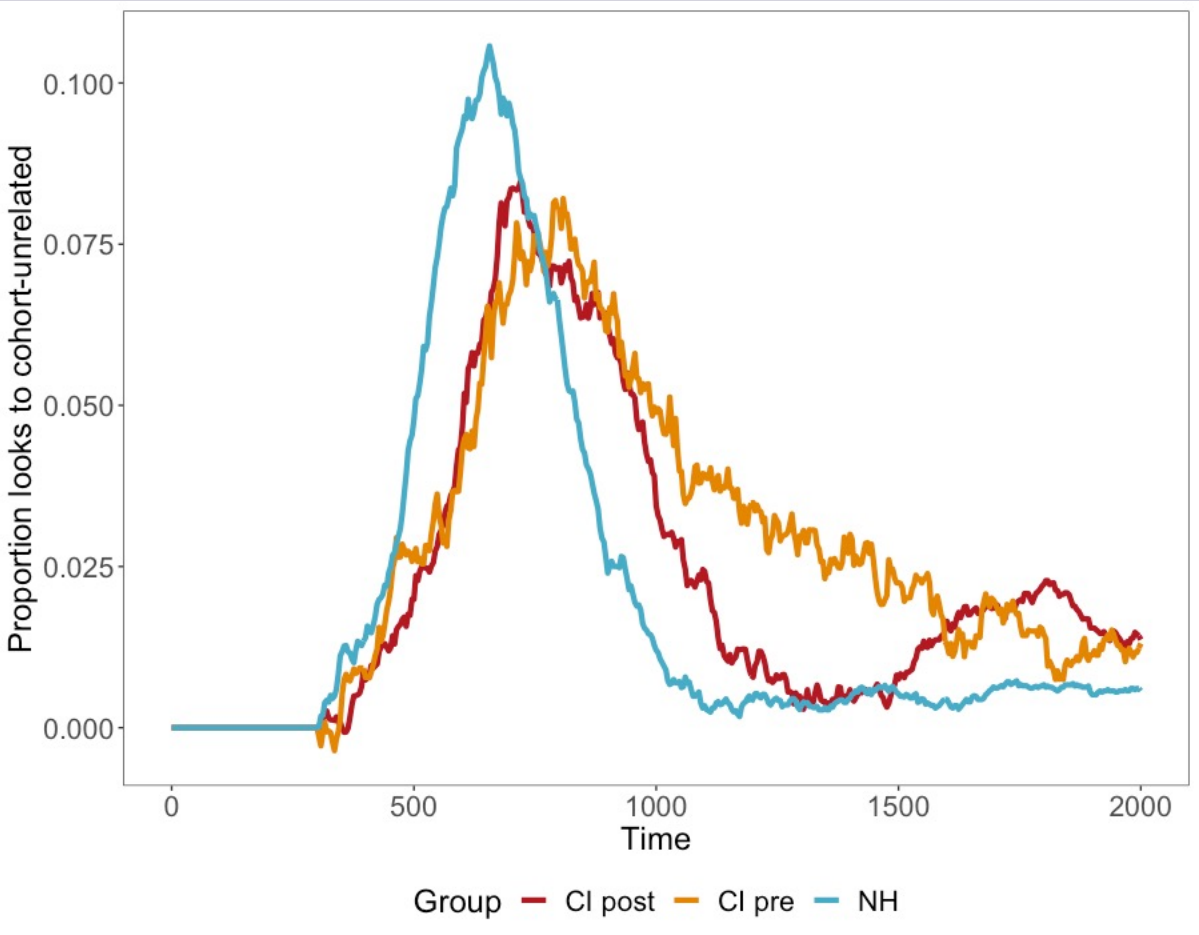
Spatial Stroop (Inhibitory control)

- 64 congruent, 32 incongruent trials
- Respond to direction of arrow on screen

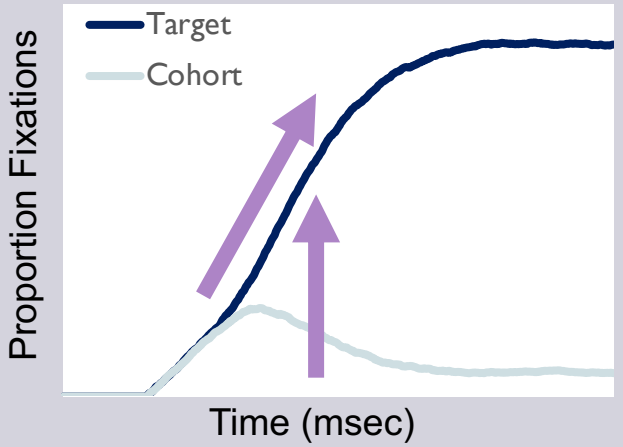


Differences in lexical competition

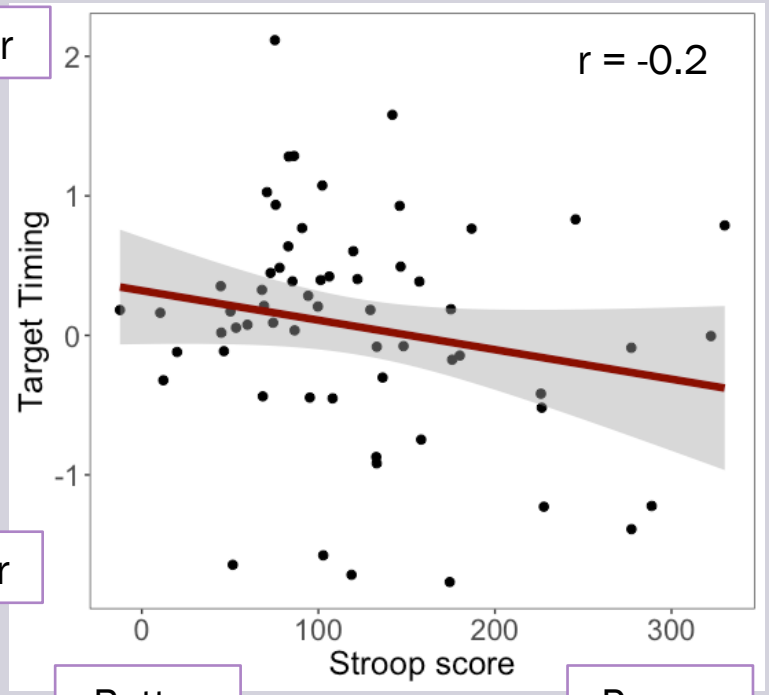




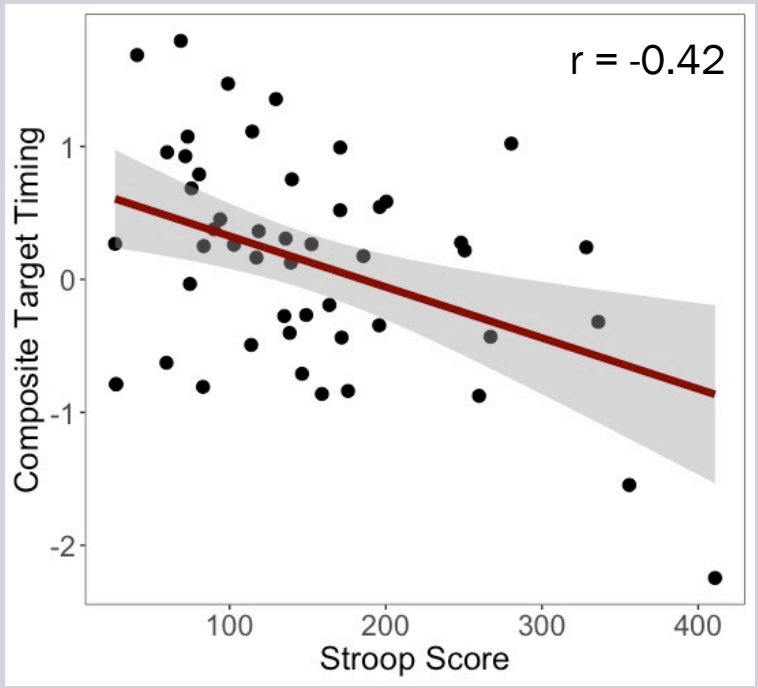
Target timing



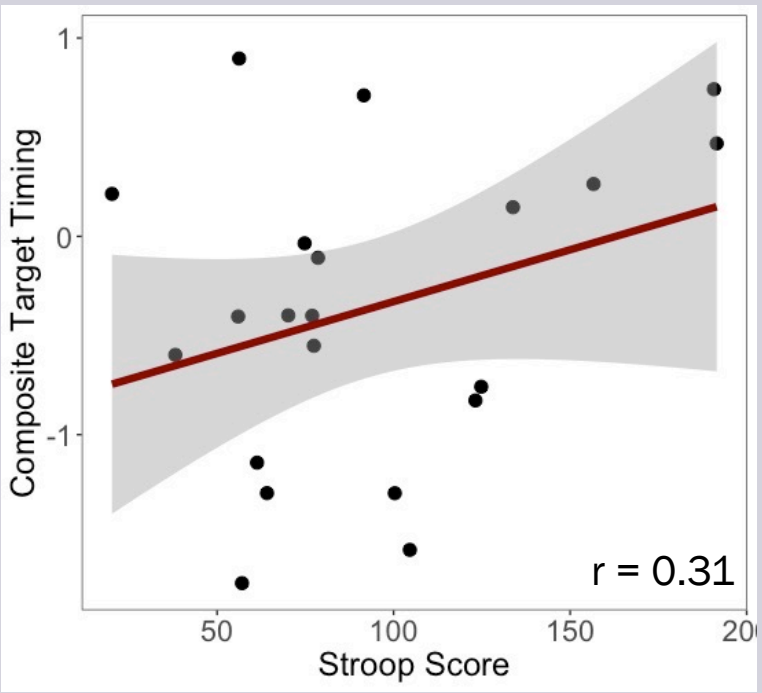
NH listeners n=71



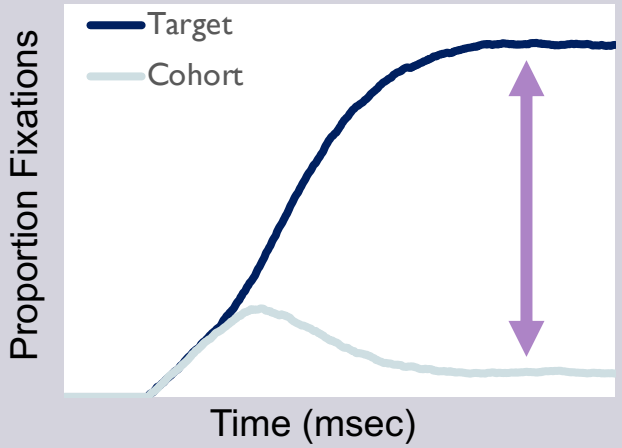
Postlingual CI users n=50



Prelingual CI users n=21



Cohort Resolution



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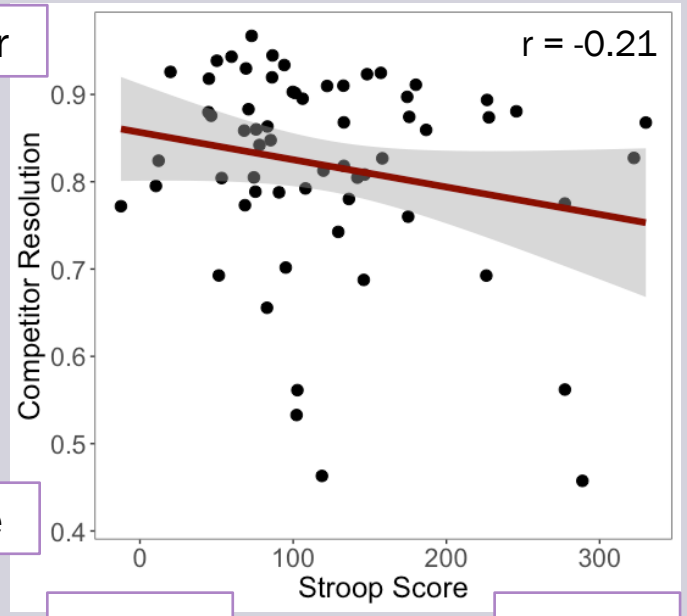

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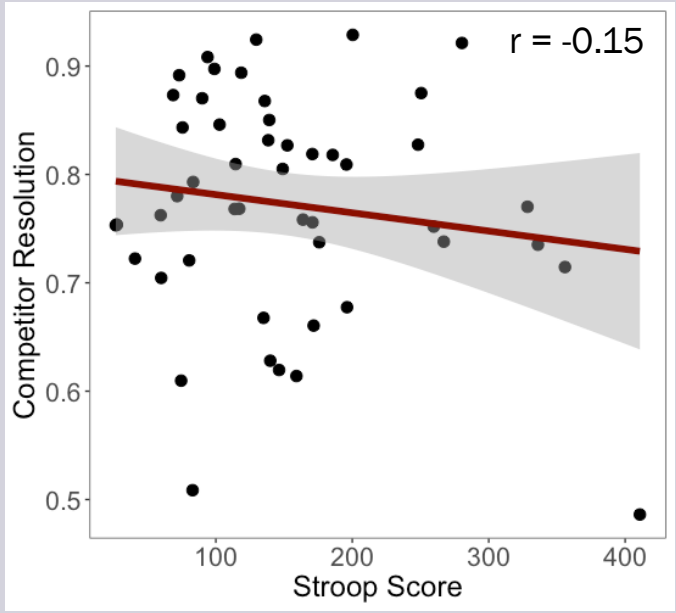

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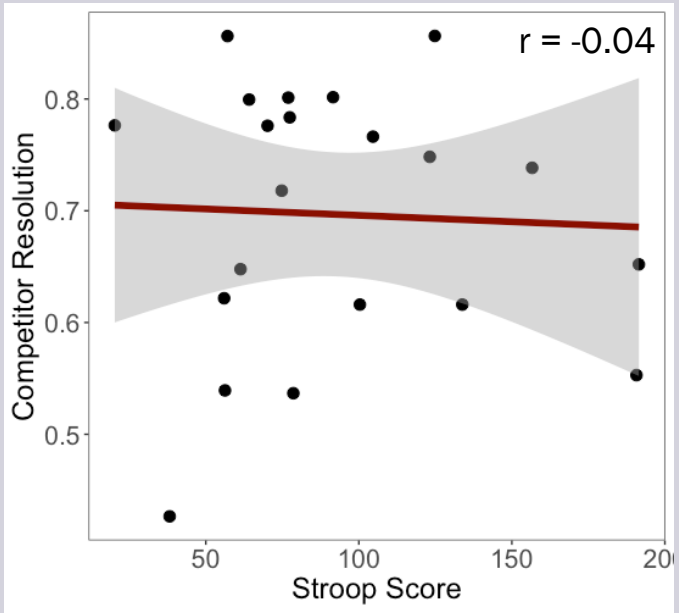

Better

Worse

Better inhib.

Poorer inhib.

Summary

- CI users show less incremental processing while recognizing words

- Cognitive control matters for lexical competition, but it plays a different role depending on language experience
  - Impacts initial/early activation
  - Pre- vs. post-lingual: moderated by language development
  - Suggests the competition differences between the two CI groups are distinct cognitive strategies
    - Postlinguals are more like normal hearing listeners
    - Prelinguals are trying to be more wait-and-see

Thank you!

Thanks to members of MAClab/CI language lab

Evita Woolsey

Camila Morales

Alyssa Bonelli

Sarah Plock

Abby Simon

UIHC Otolaryngology

Camille Dunn

Bruce Gantz

Marlan Hansen