Accessing mental representations of speech in face of signal degradation

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MARIE CURIE **ACTIONS**

How does signal degradation affect lexical access?

CI users understand speech but listening is more effortful.

Goal: To relate processing of degraded speech with processing of native and non-native speech.

The way from sound to meaning

We are looking at the early stages of speech processing, such as segmentation and lexical competition

Lexical competition

Listeners' selection of the intended meaning is facilitated by expectations, based on the signal and context.

Speech perception is easy

… in optimal (native) situations

Thanks to native language specialization

- Language specific perception of vowels starts within the first 6 months

(e.g. Kuhl, 1993, 2000)

- Language specific perception of consonants starts around 9 months

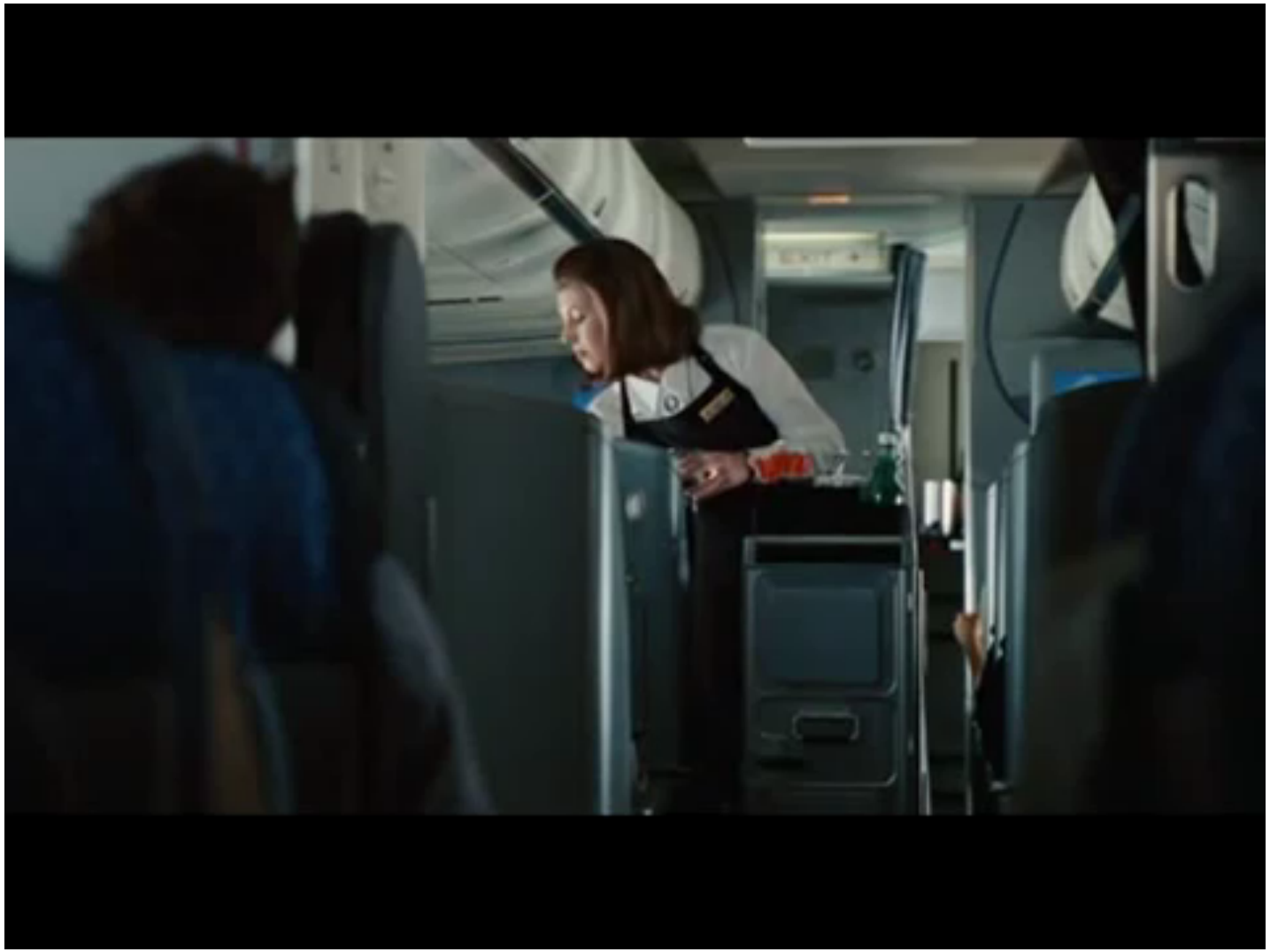
(e.g. Werker & Tees, 1984)

- No exposure to stress leads to “stress deafness”

(e.g. Peperkamp & Dupoux, 2002)

- Early learning about probabilities of co-occurrences of sounds, words, words in phrases

→ makes native speech processing effortless, fast and automatic



Lexical competition

candle
candy
kangaroo
canard
candid
canna
candelabra

cannot
cancel
Canada
cancer

mechanic

ashcan
toucan

block and tackle
black and blue
can sir

Listeners can
…make use of semantic context, but this needs to be heard and processed as well
…make use of fine phonetic details, but these details are lost in degraded or CI signal

CI users can understand speech, but listening is more effortful, and it is not automatic

Question: Is processing of CI speech similar to native or non-native speech perception?

Is processing of the CI signal like native or non-native perception?

Questions:

- Can listeners use their native strategies when listening to degraded speech?
- Can experience with CI alone adjust the use of cues?
- Can listeners build up lexical expectations in real time?

Approach:

Effects of degradation after minimal exposure

→ Normal hearing listeners in optimal and degraded situations

Effect of exposure to degraded speech

→ To compare these with successful CI users

Overview

1.) Use of durational cues during lexical competition.

Design analog *to Salverda, Dahan & McQueen, 2004*

→ *can* is longer in can than in cancer

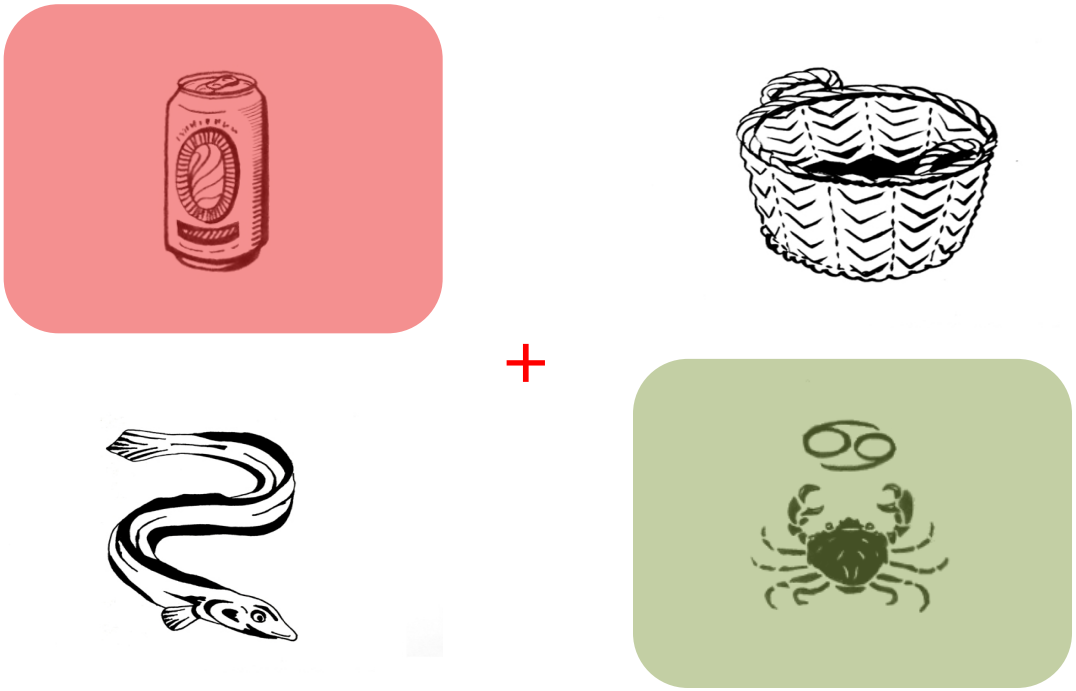
- normal hearing listeners use of cues
- normal hearing degraded speech
- experienced CI users

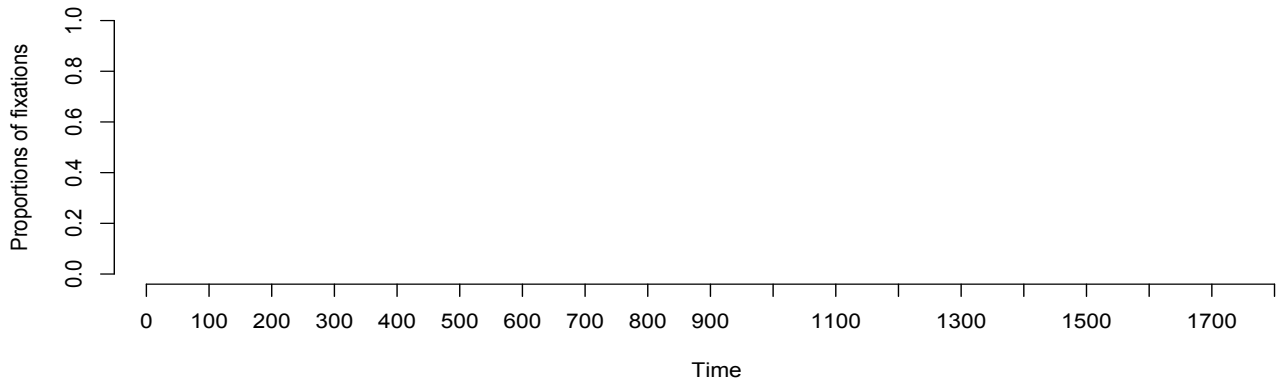
Eye fixations
Eye size pupil dilation data

2.) Preliminary data on the integration of semantic information on lexical competition by normal hearing listeners with degraded speech

Based on *Dahan & Tanenhaus, JEPLMC 2004*

Would you like the cancer





Would you like the cancer?

Would you like the can**cer?**

Would you like the can sir?

Target matching duration ___

Target mis-matching duration ___ longer (~65ms)

Analog to Salverda, Dahan & McQueen, 2004

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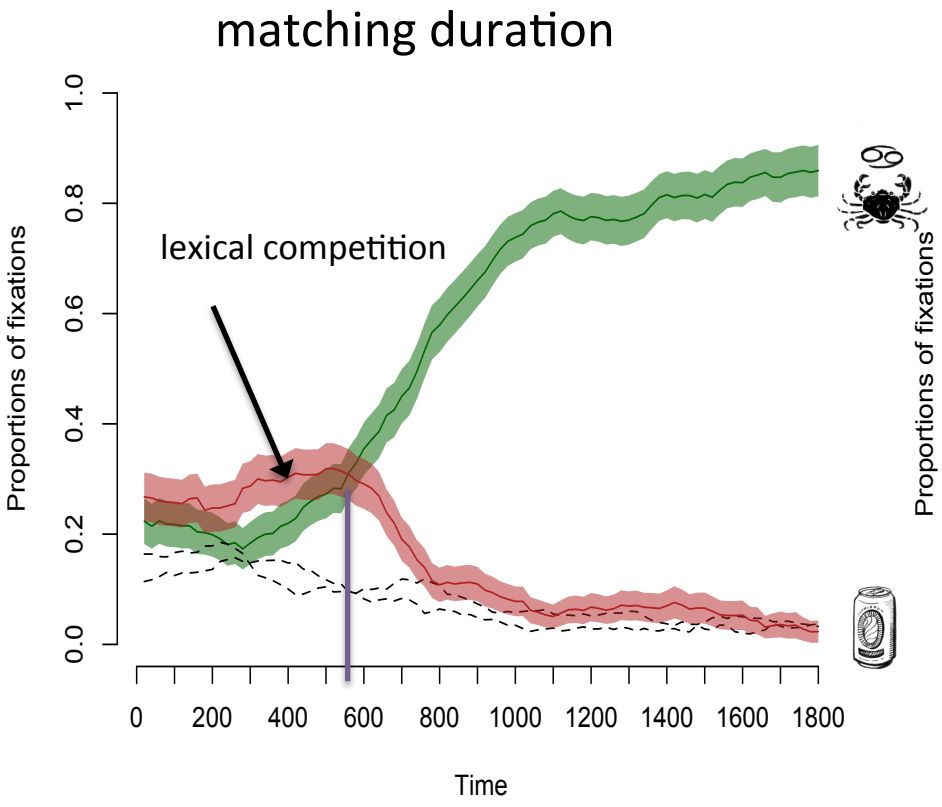
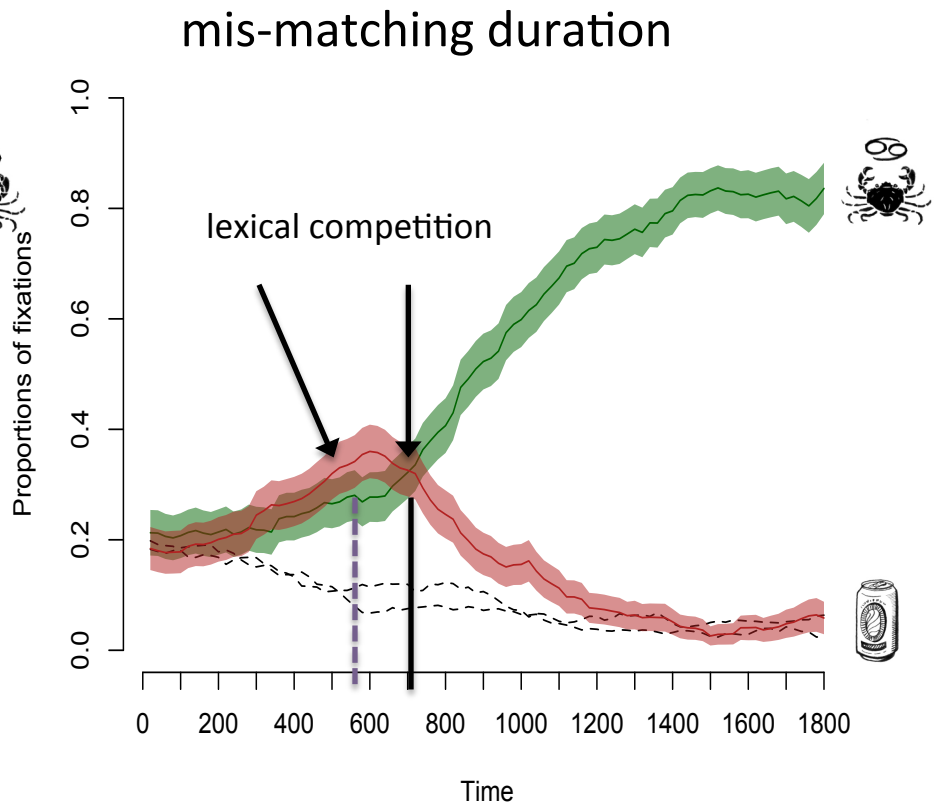
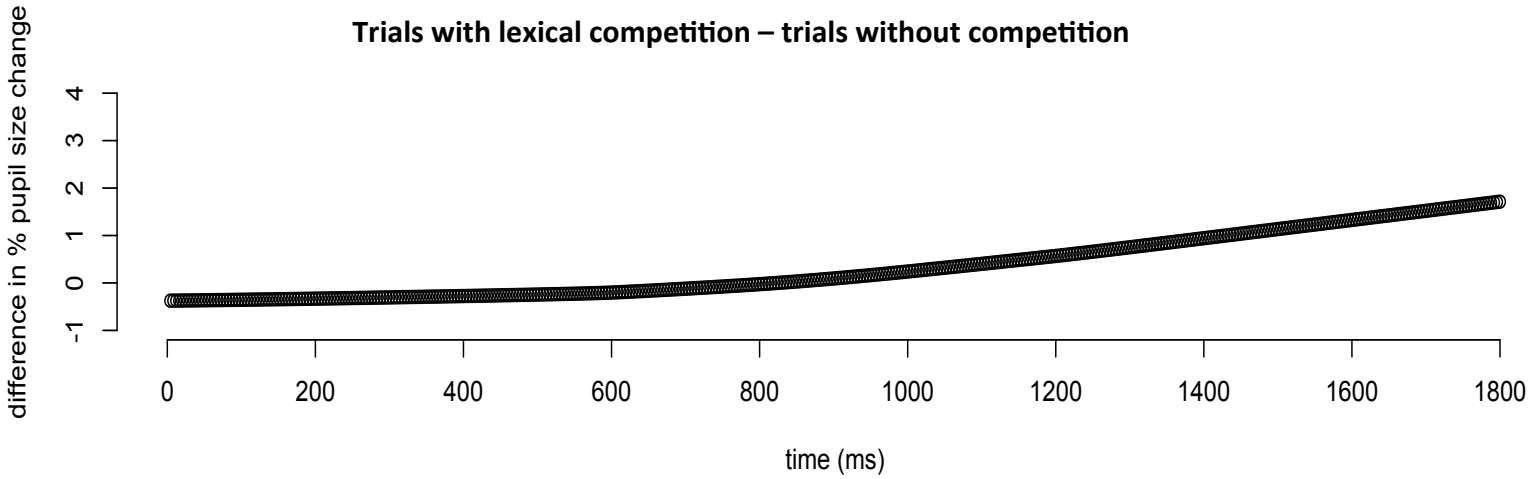
Normal hearing listening to normal speech



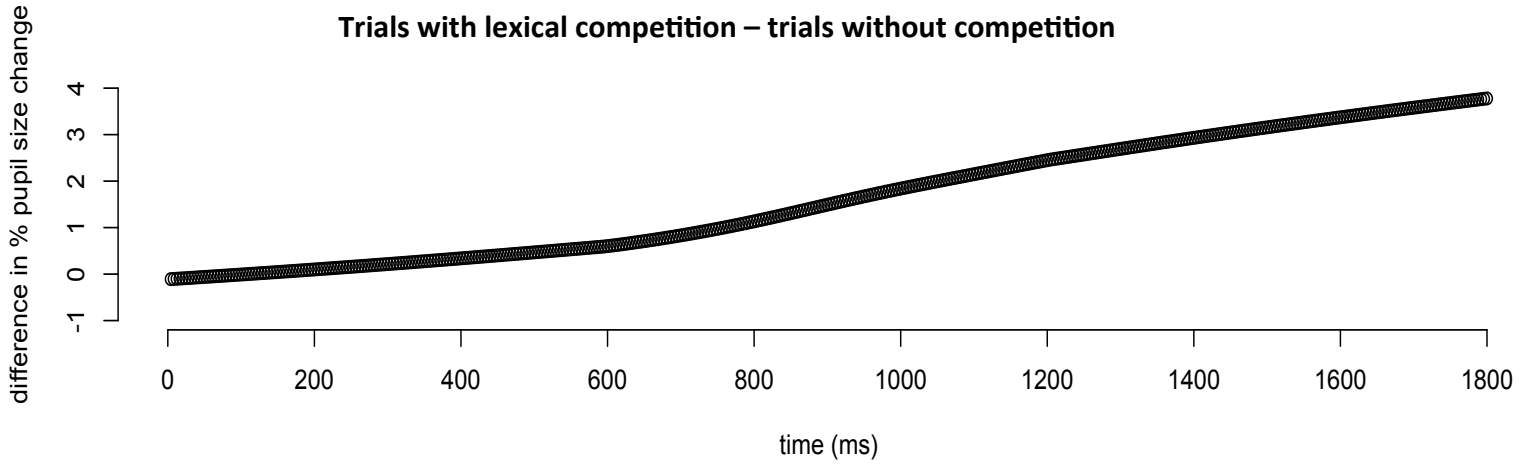


Lexical competition increases processing effort

matching duration



mis-matching duration



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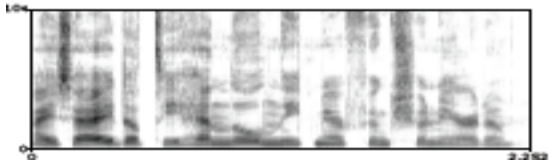
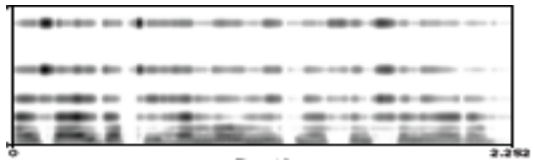
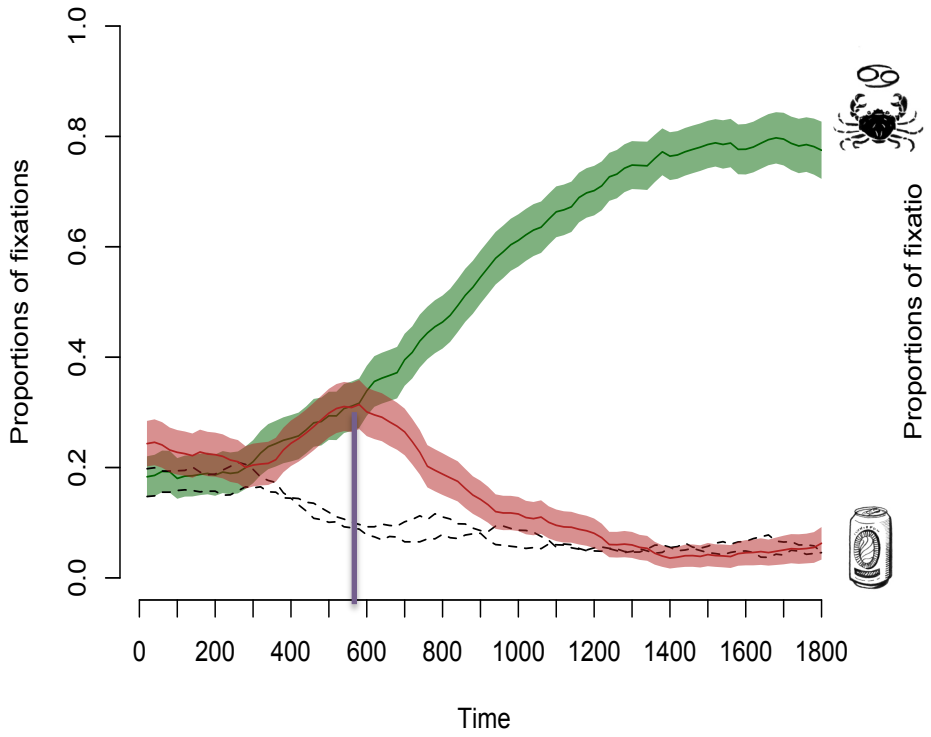
Normal hearing listening to degraded speech

Materials:

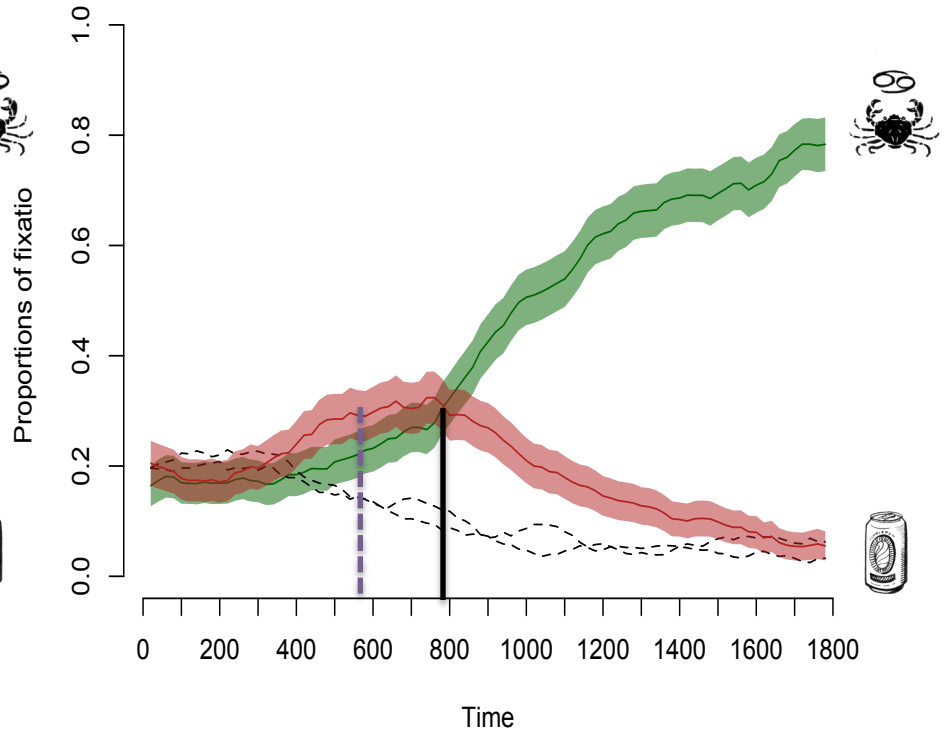




matching duration



mis-matching duration



Degradation obscures the durational cues, and prolongs lexical competition

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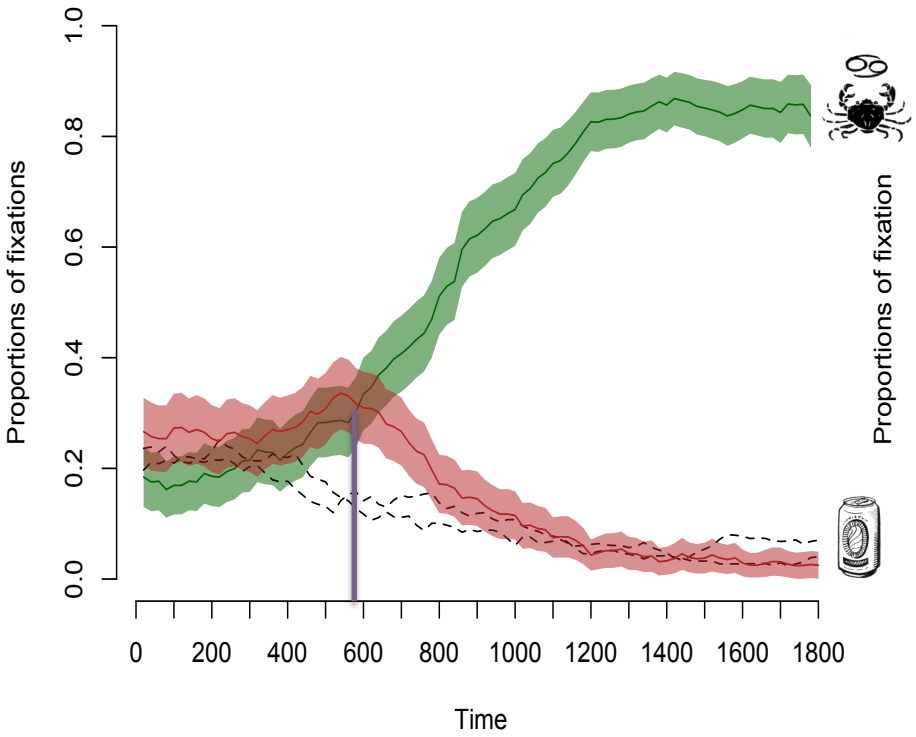
CI users

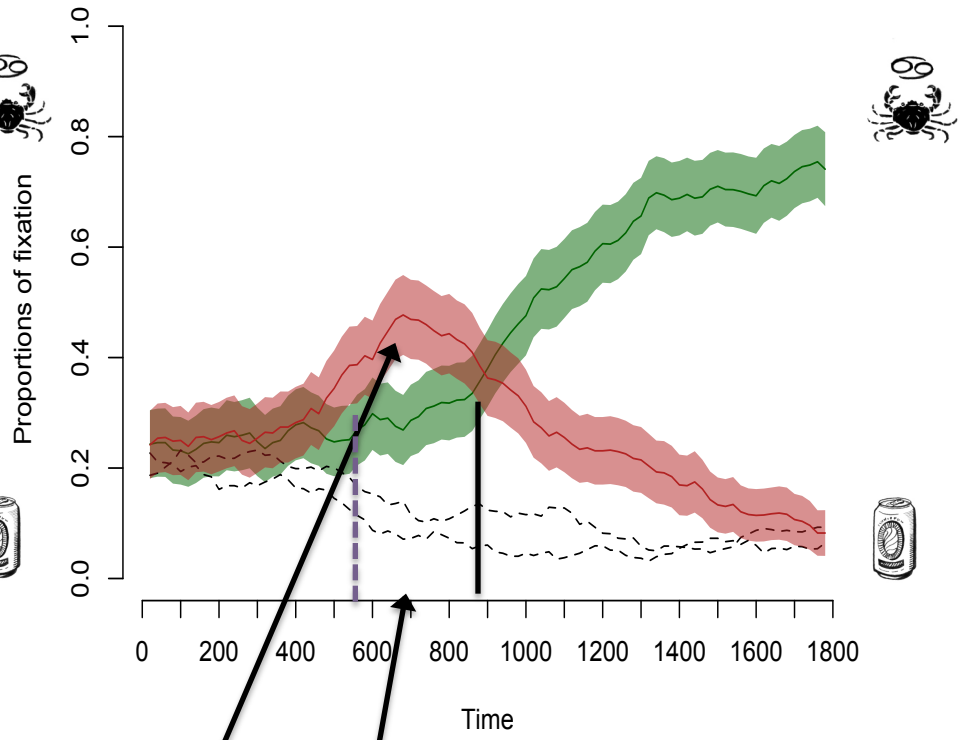
N = 24

CI experience = 1 + +

matching duration



mis-matching duration



High sensitivity to durational cues

Prolonged lexical competition

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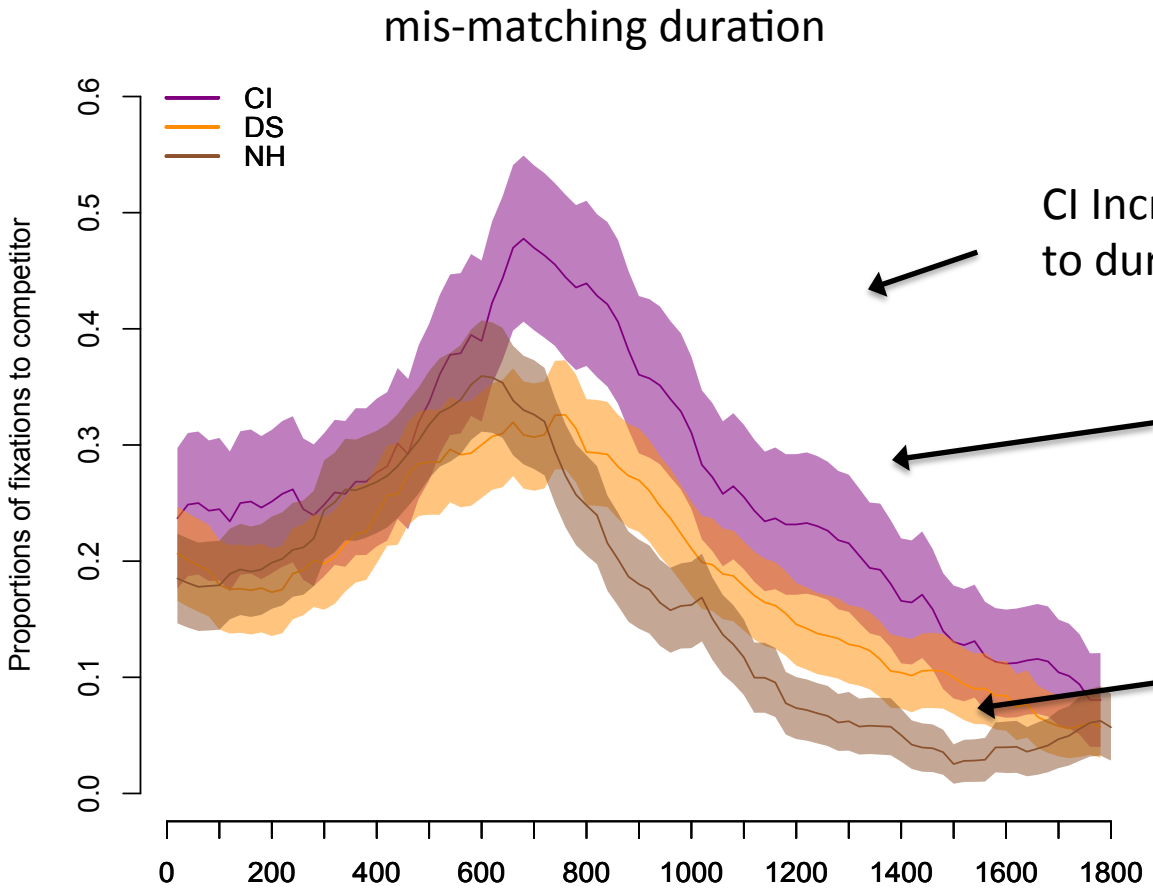
Fixation to competitor in mismatching condition among groups



CI Increased sensitivity to duration

CI Faster release from competition

CI Release from competition slower than NH

Degradation hampers the uptake of durational cues

Experience with CI sharpens listeners' reliance on duration as cue

Individual variation in the uptake of duration among CI users

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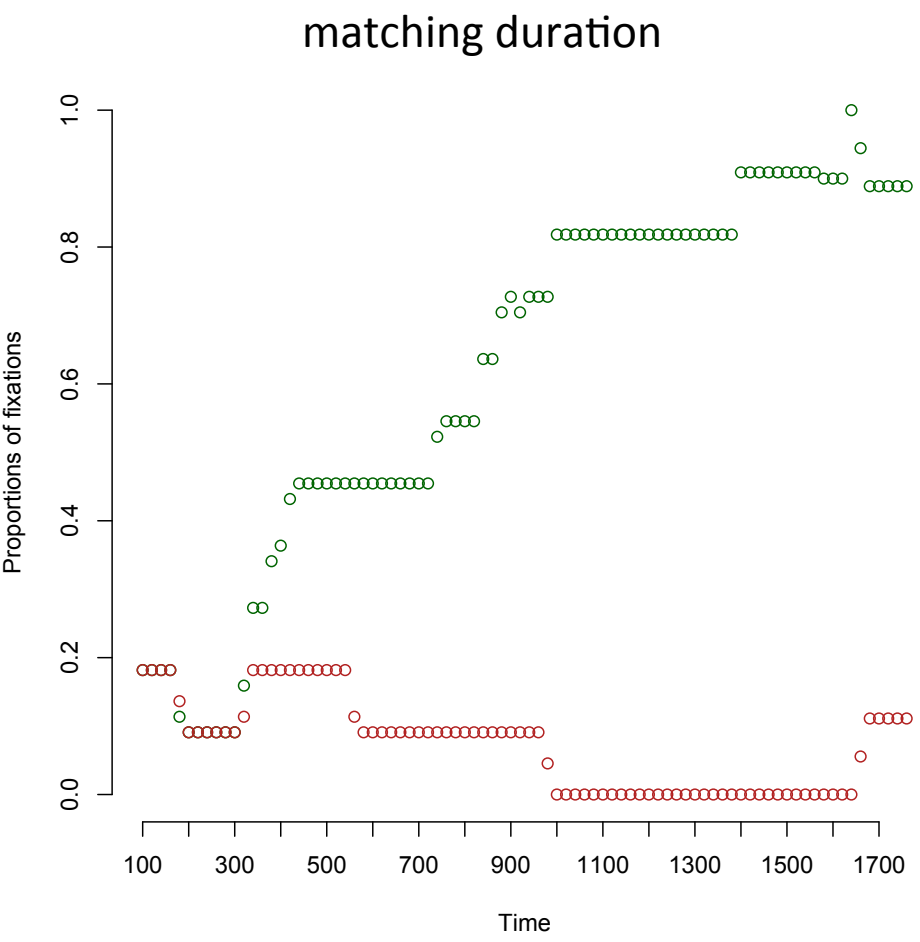
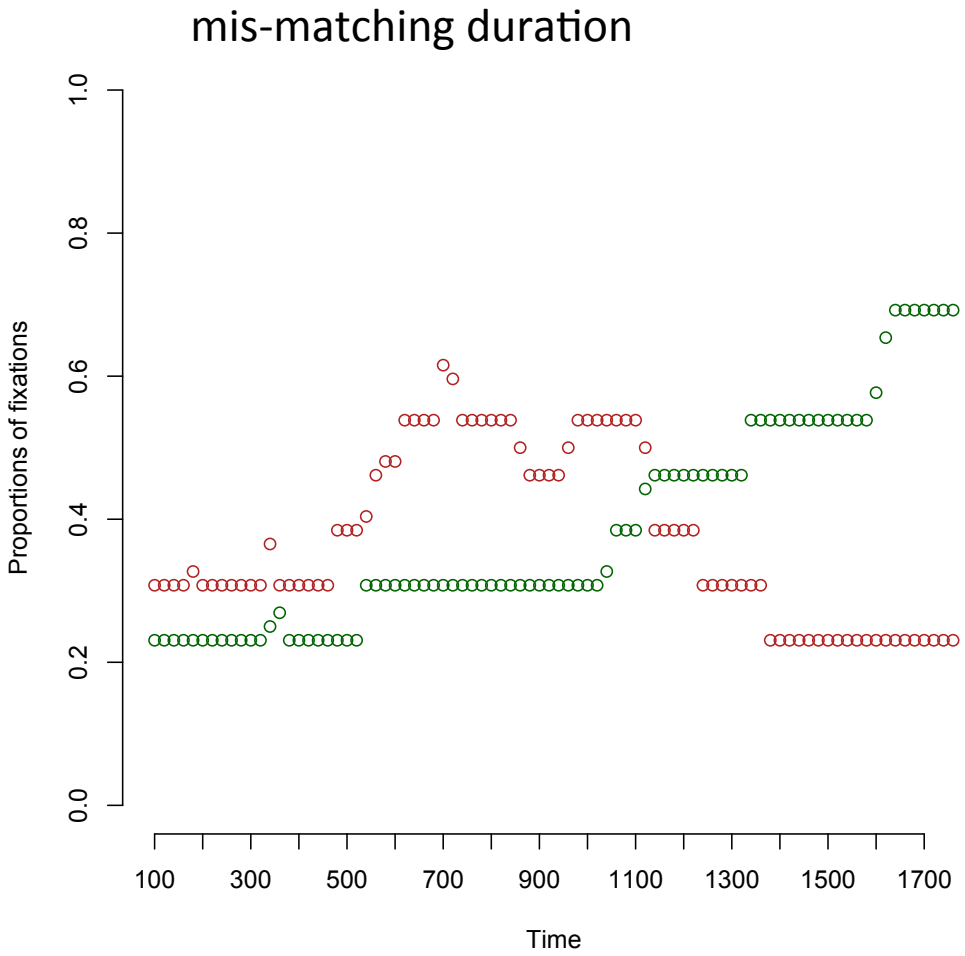
Individual data

Participant A

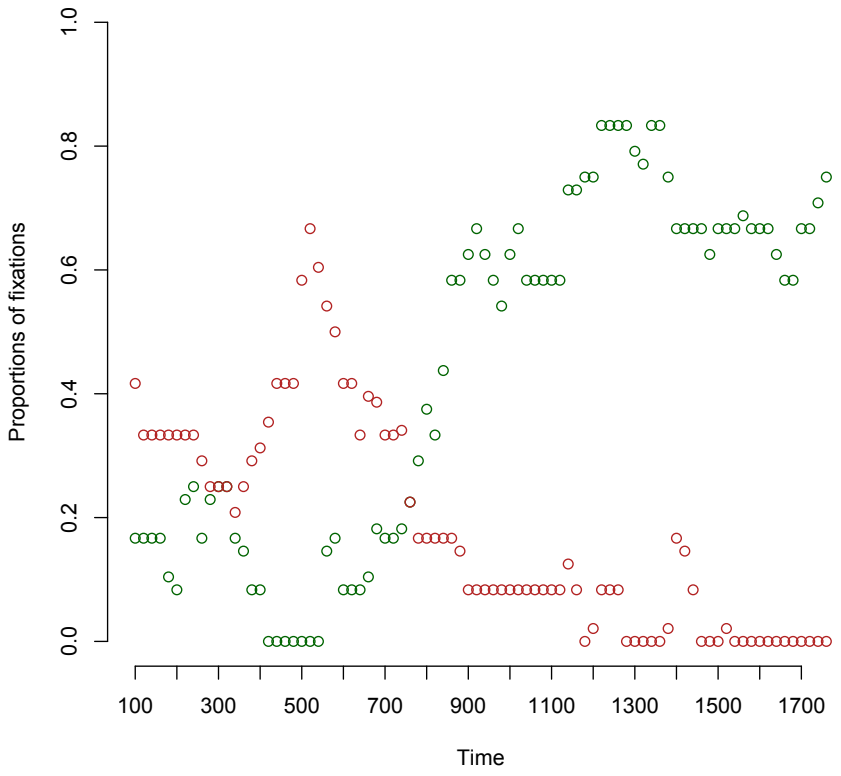




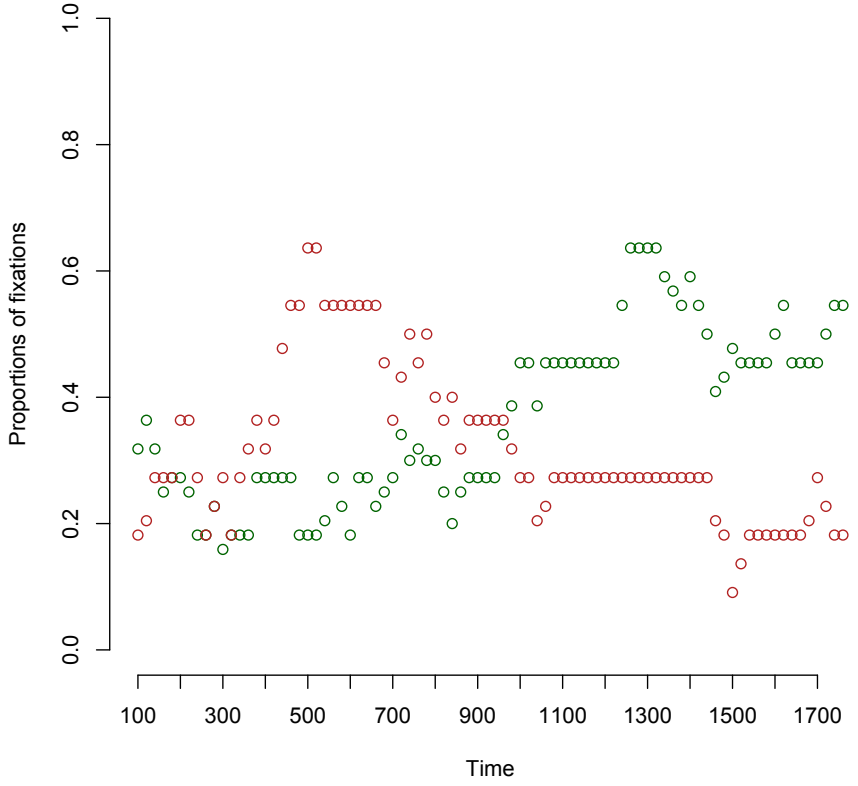
Individual data

Participant B

matching duration



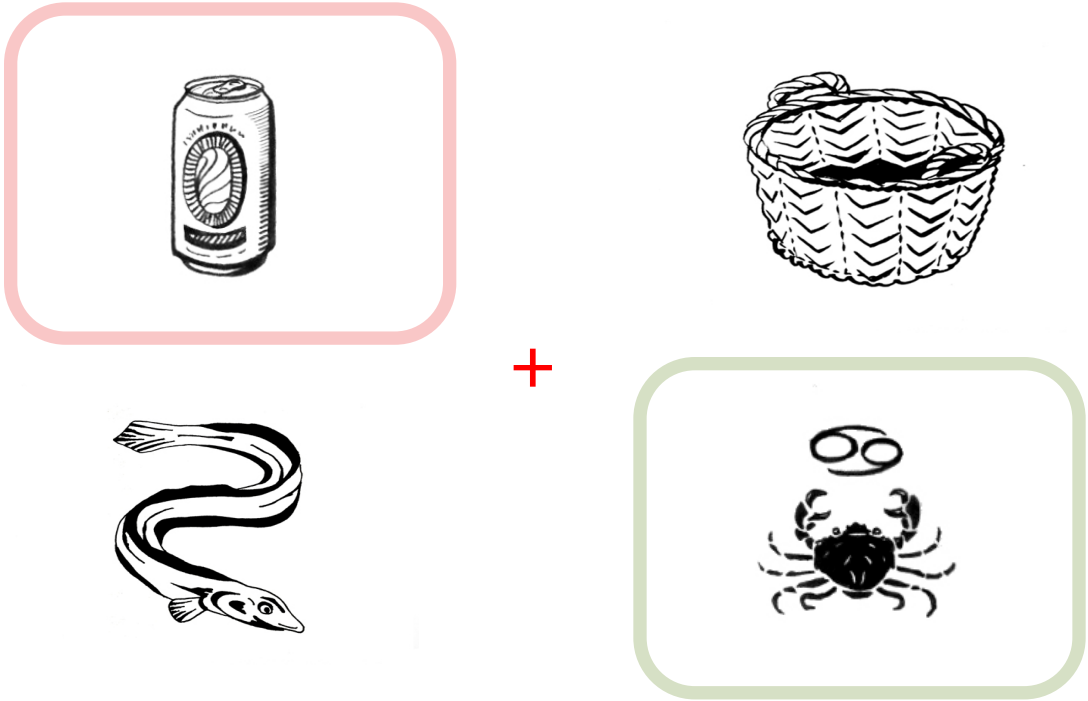
mis-matching duration

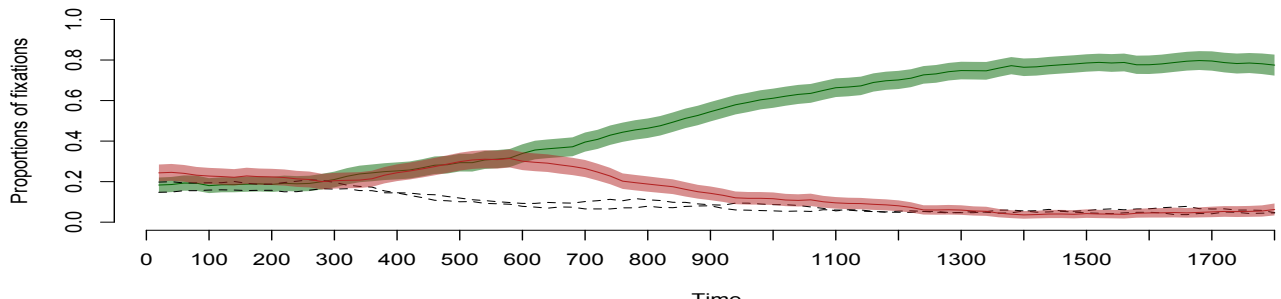


Semantic integration for lexical disambiguation

People born under the astrological sign of cancer

She said something that sounded to him like





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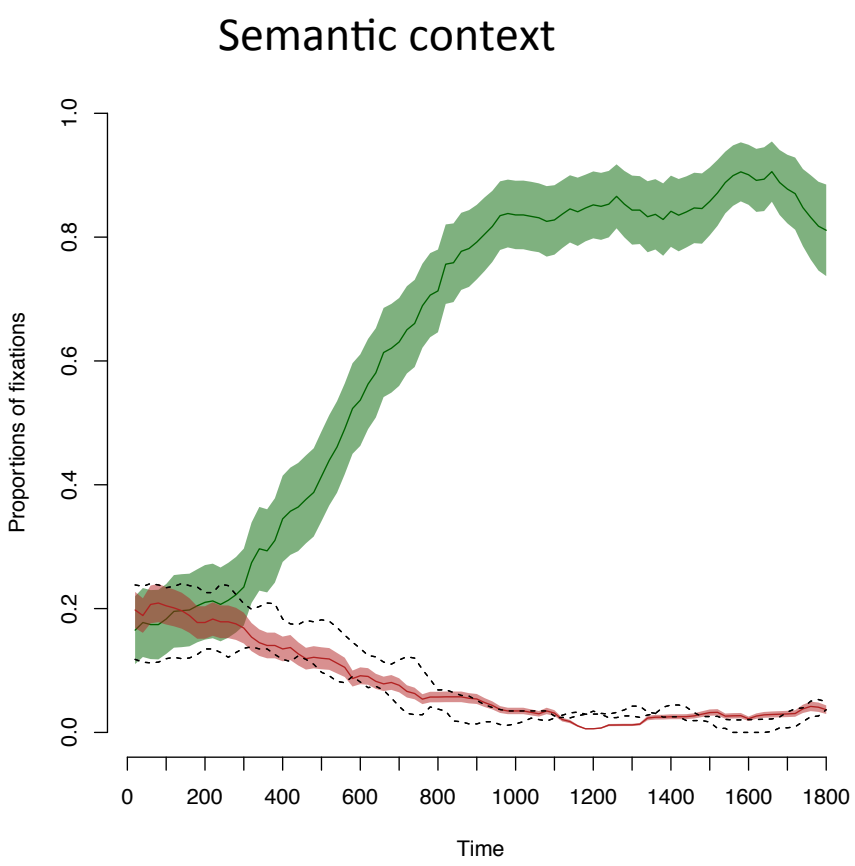
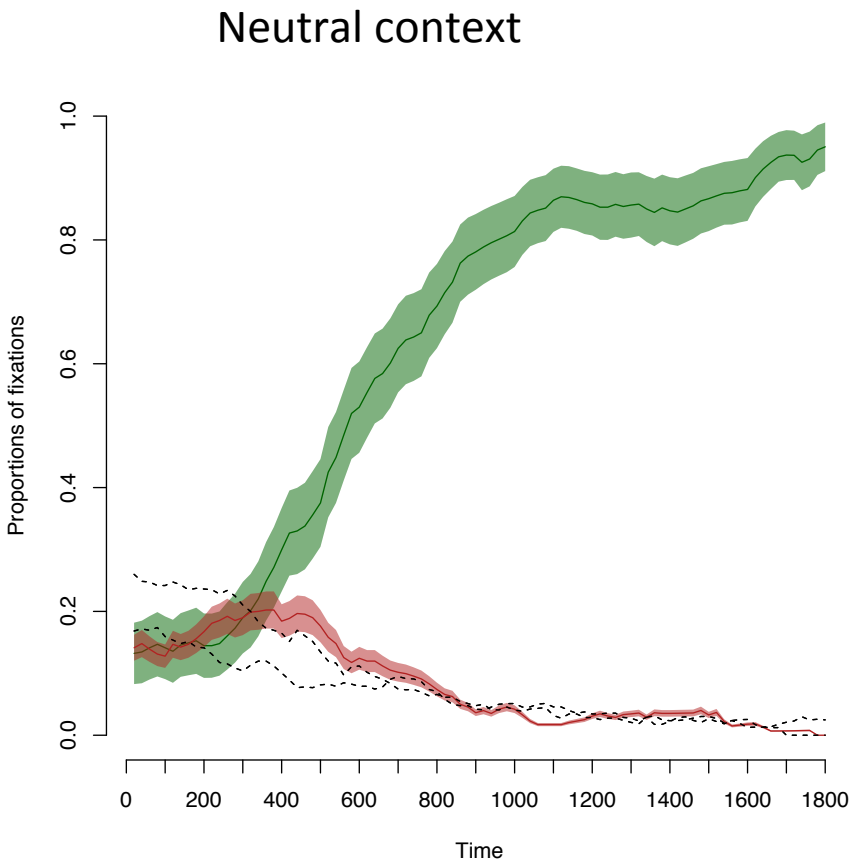
Normal hearing listening to normal speech





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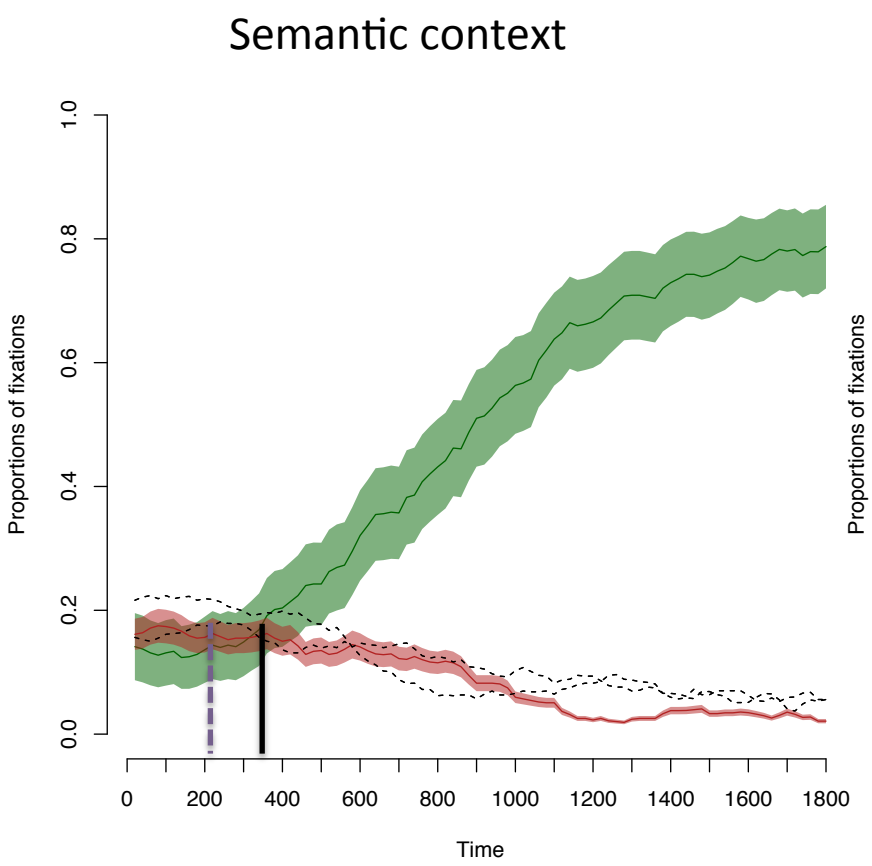
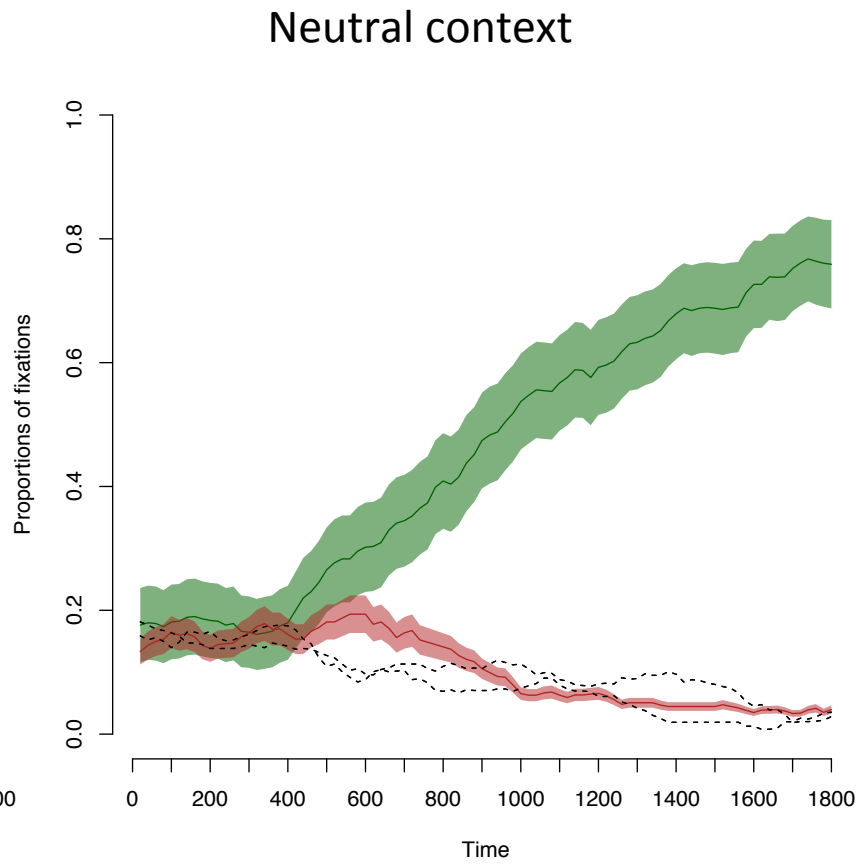
Normal hearing listening to degraded speech





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Sum up

Degradation obscures the uptake of durational cues
- delays and prolongs lexical competition
- decreases certainty about lexical decision

Experience with CI sharpens listeners' reliance on duration as cue
- but lexical competition is still longer

Individual variation in the uptake of duration among CI users
- not all CI users adjusted their use of this reliable cue

Degradation also delays the integration of semantic information

-> CI listeners may have to re-learn to use semantic source in real time

Question: Can this delay at early stages be compensated for?

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