Acoustic Cues Used by Learners of English

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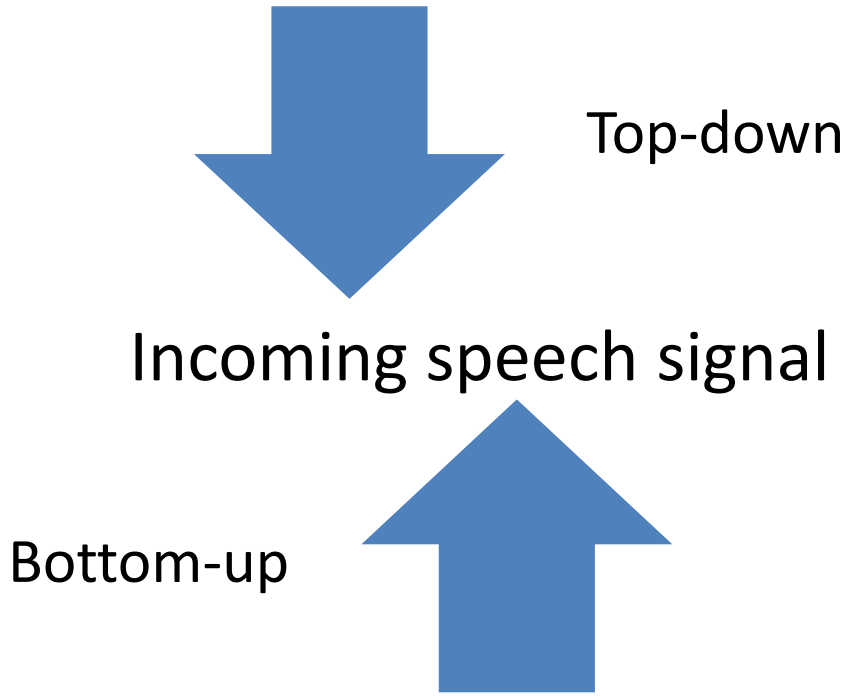
Background

Speech Segmentation Cues

- Top-down
  - Pragmatics
  - Syntactic structure
  - Semantics
- Bottom-up
  - Metrical prosody
  - Phonotactic constraints
  - Transitional Probabilities
  - Allophonic processes
  - Fine-grained phonetic cues



- In L2 acquisition learners try to adapt L1 bottom-up cues into the L2

Segmentation of English sC clusters

- Cross-boundary clusters
  - [ðɪskʰeɪl] - *‘this **k**ale’*
  - Shorter /s/-duration
  - Environment for allophonic aspiration

Input:	**[ð]**	**[ɪ]**
candidates:	that then these they this …	this thither ~~that~~ ~~thus~~ ~~then~~ …

- Word-initial clusters
  - [ðɪsːkeɪl] - *‘this **sc**ale’*
  - Longer /s/-duration
  - No environment for allophonic aspiration

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Input:	**[ð]**	**[ɪ]**	**[s]**	
candidates:	that then these they this …	this thither ~~that~~ ~~thus~~ ~~then~~ …	this	sand soap sign stop school …

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candidates:	that then these they this …	this thither ~~that~~ ~~thus~~ ~~then~~ …	this	sand soap sign stop school …	cat kale could ~~soap~~ ~~stop~~ …

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candidates:	that then these they this …	this thither ~~that~~ ~~thus~~ ~~then~~ …	this	sand soap sign stop school …	cat kale could ~~soap~~ ~~stop~~ …	kale cable cane ~~could~~ ~~cat~~ …	kale ~~cable~~ ~~cane~~ …

L2 segmentation of sC clusters

- Cue adaptation leads to better L2 segmentation than cue learning (Altenberg, 2005; Ito & Strange, 2009; Shoemaker, 2014)

Cross-boundary: Loose pills

Word-initial: Lou spills

aspiration contrast	no aspiration contrast
✓	x

Current Study

Research Questions

- Using measures of online processing, in what way do the phonological properties of a first language influence segmentation abilities in a second language?
    - How is a phonemic contrast not used for word boundary identification adapted as a word boundary cue in a second language?
    - How do learners acquire new word boundary cues in a second language?

Languages of Interest

- Mandarin
  - Phonemic aspiration
  - Duration is not a systematic boundary cue
  - No possible word-initial or cross-boundary sC clusters
  - Phonemic → allophonic

Aspirated stop: $[p^ha]_{51}$ ‘to fear’

Unaspirated stop: $[pa]_{51}$ ‘father’

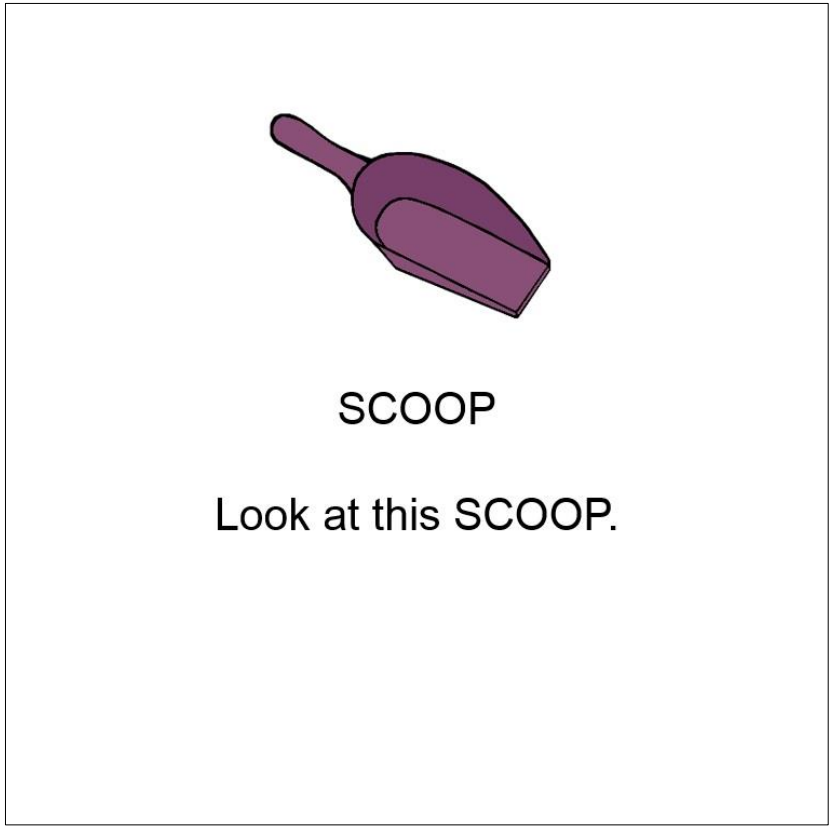
- French
  - No systematic aspiration
  - Some level of duration cue used in word-boundary segmentation
  - Both word-initial and cross-boundary sC clusters are possible
  - No contrast → allophonic

Word-initial: [spɔrtif] ‘athletic’

Cross-boundary: [sis pjɛs] ‘six pieces’

Procedure

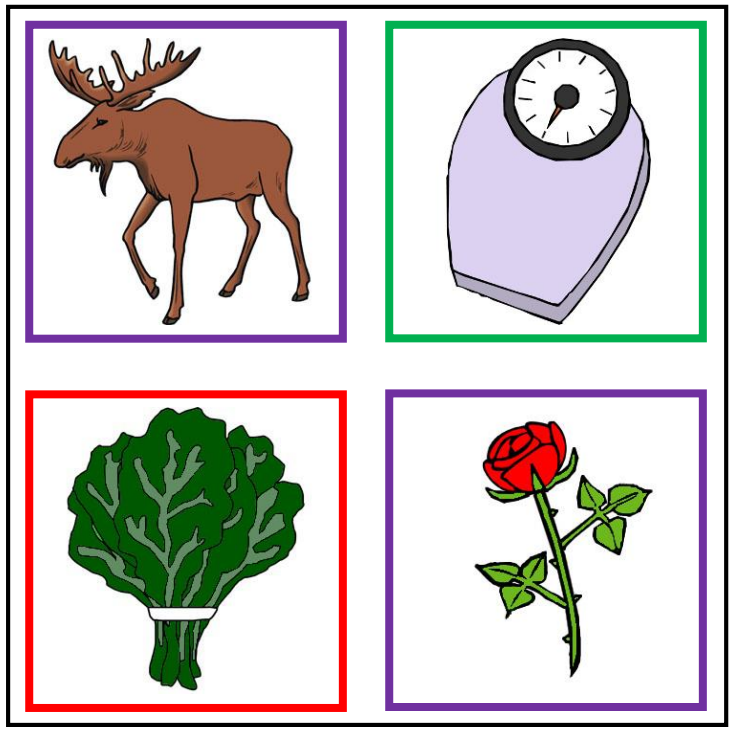
- Proficiency task
  - Results not reported in this talk
- Production task
  - Familiarize participants with word-picture pairings
  - Collect acoustic data to compare to perception
- Eye-tracking task
  - Used the visual world paradigm
  - Heard words presented in the frame “click on this”



Eye-tracking in the visual world paradigm

- Participants hear spoken language and manipulate objects in a visual world
- Visual world includes a set of object with interesting linguistic properties
- Eye-movements to each object are monitored throughout the task

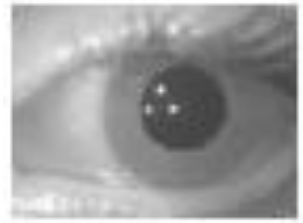
a moose



this scale

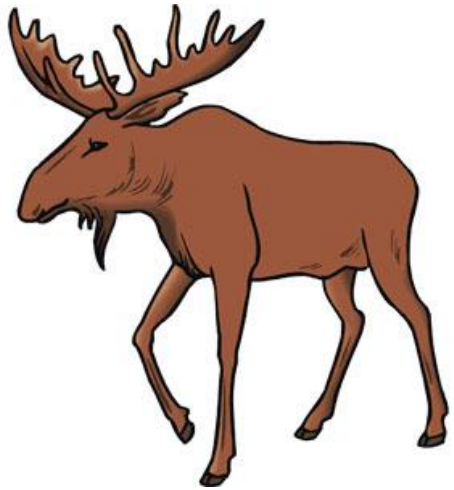
this kale

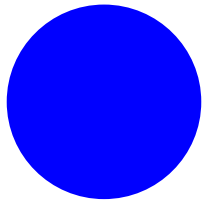
a rose

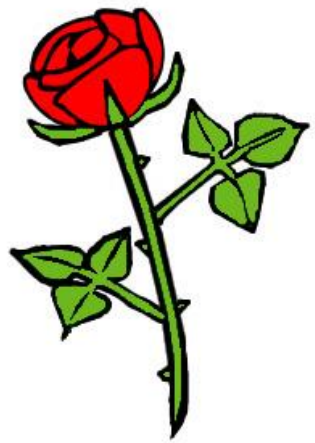


Why use eye-movements and the visual world paradigm?

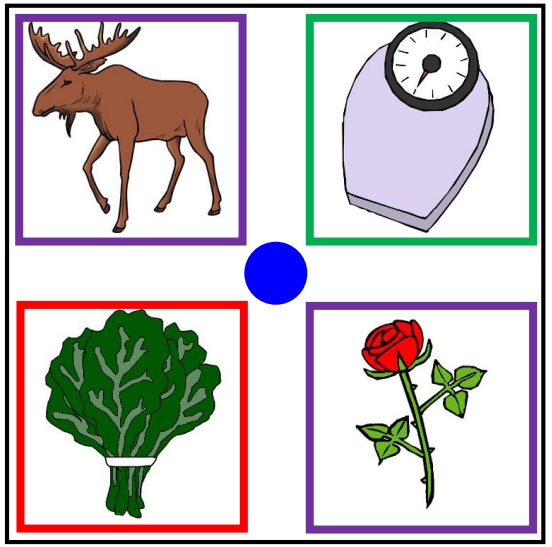
- Relatively natural task
- Eye movements generated very fast (within 200ms of stimulus onset)
- Eye movements time-locked to speech
- Subjects are not aware of eye movements
- Fixation probability maps onto lexical activation



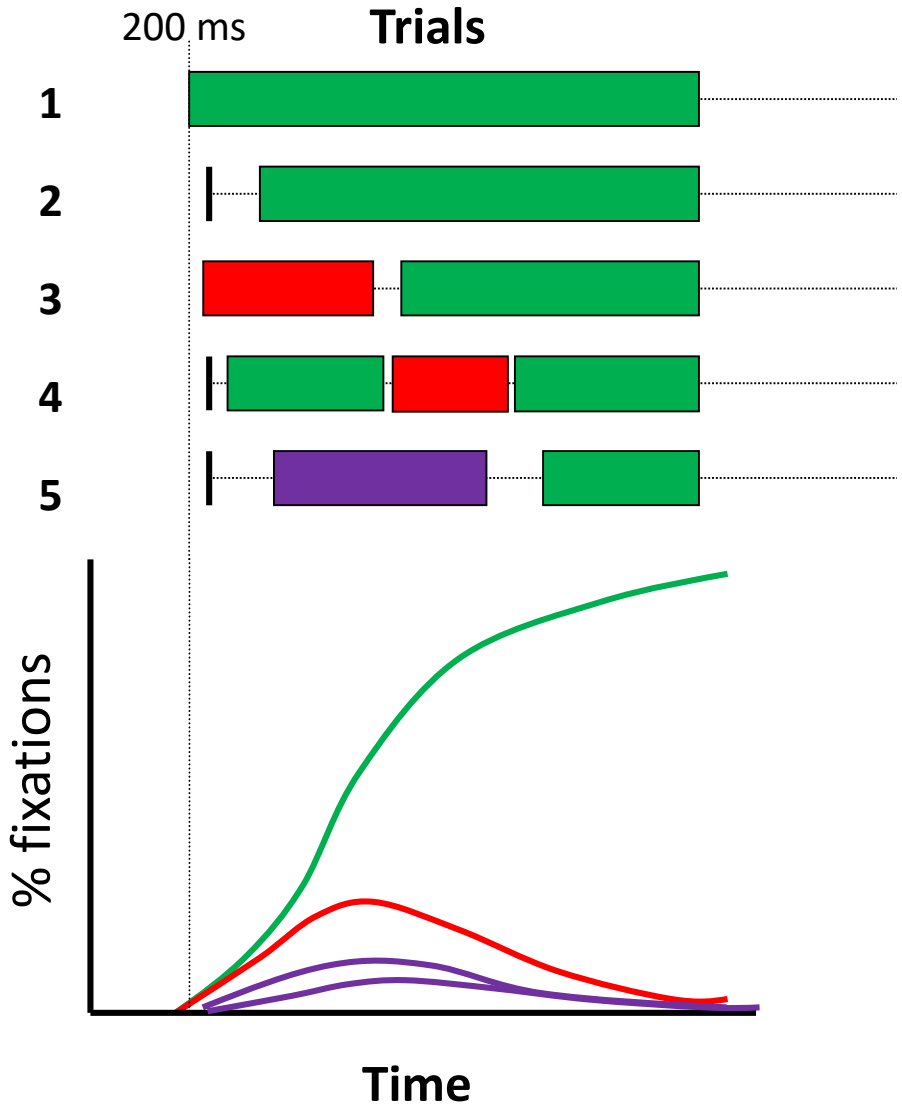




Eye-movement analysis

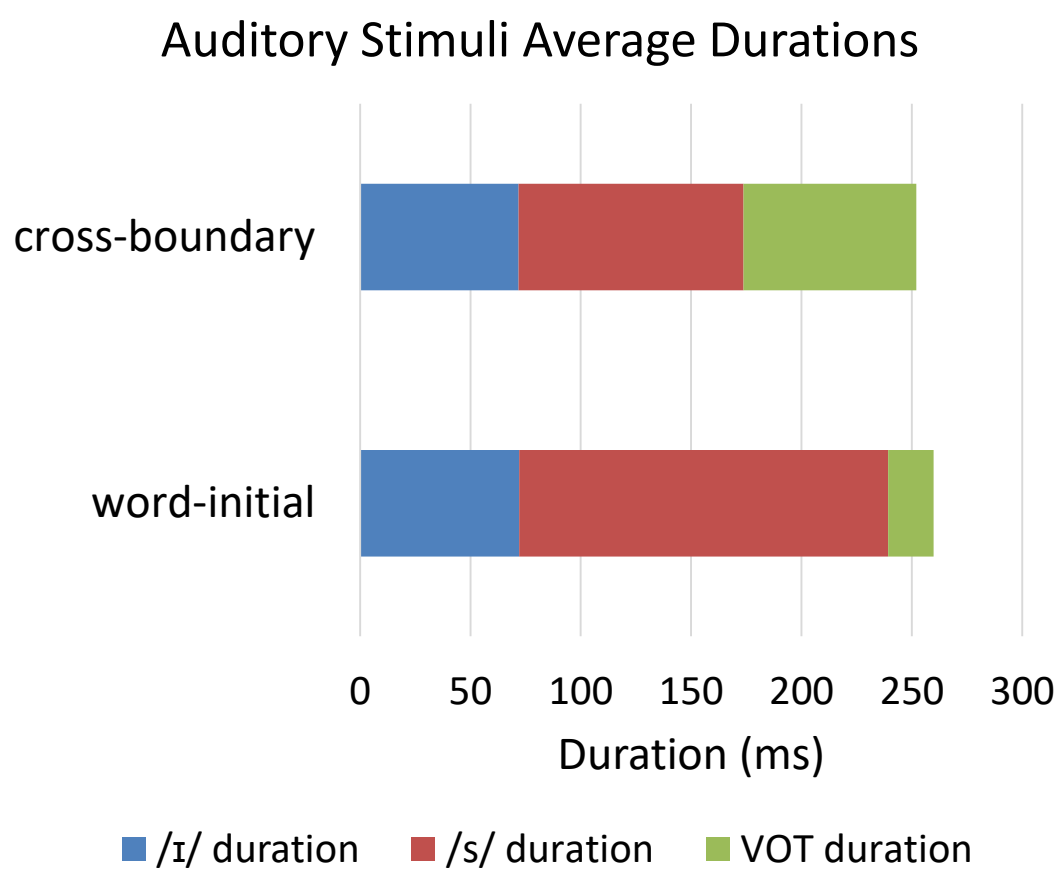


- Target: this scale
- Competitor: this kale
- Filler: a rose
- Filler: a moose



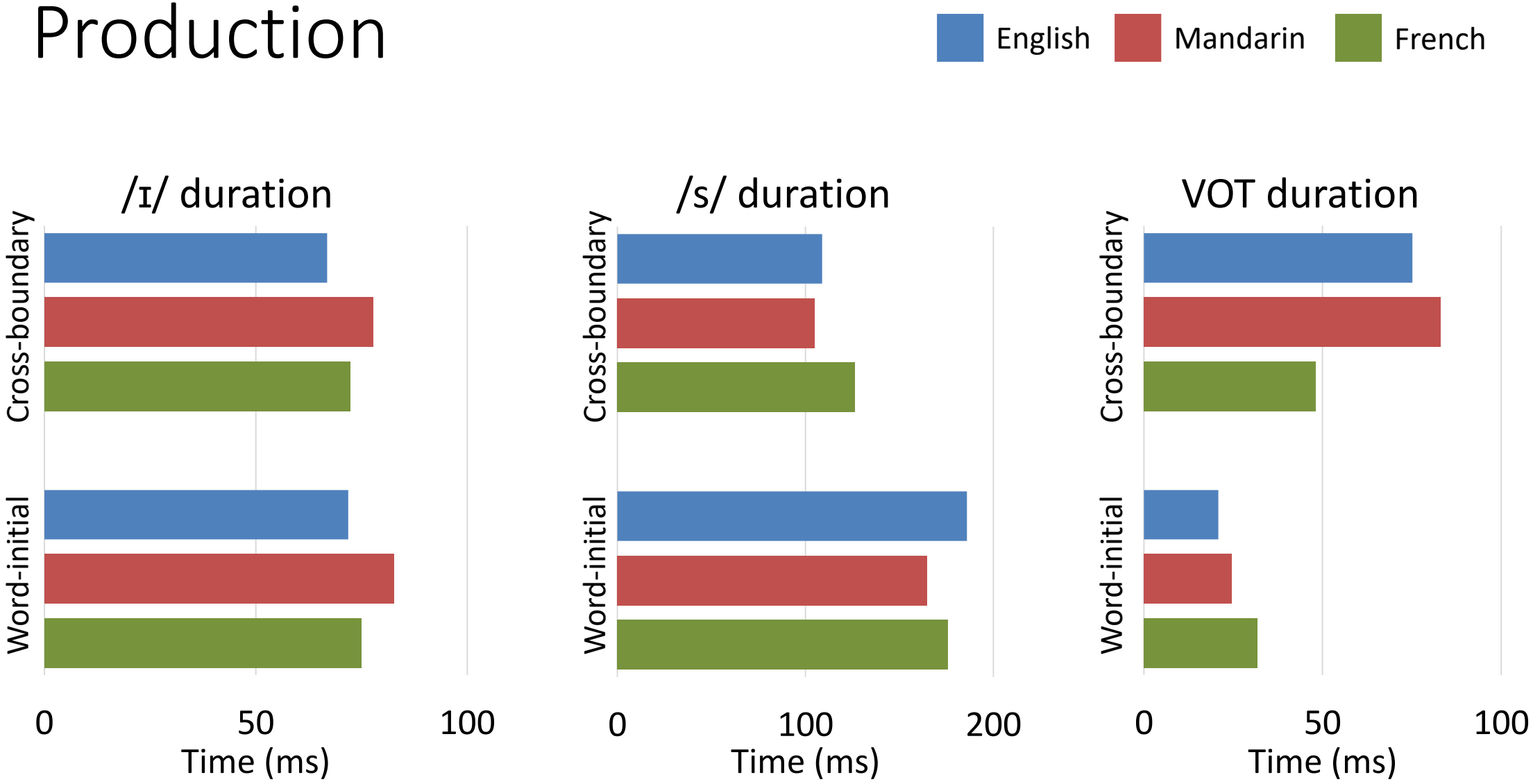
Experimental Design

- Auditory Stimuli
  - Balanced for frequency
  - 10 *table/stable* pairs per place of articulation
  - 60 phonologically unrelated filler items
- Participants
  - 21 native English speakers
  - 20 native Mandarin speakers
  - 7 native French speakers

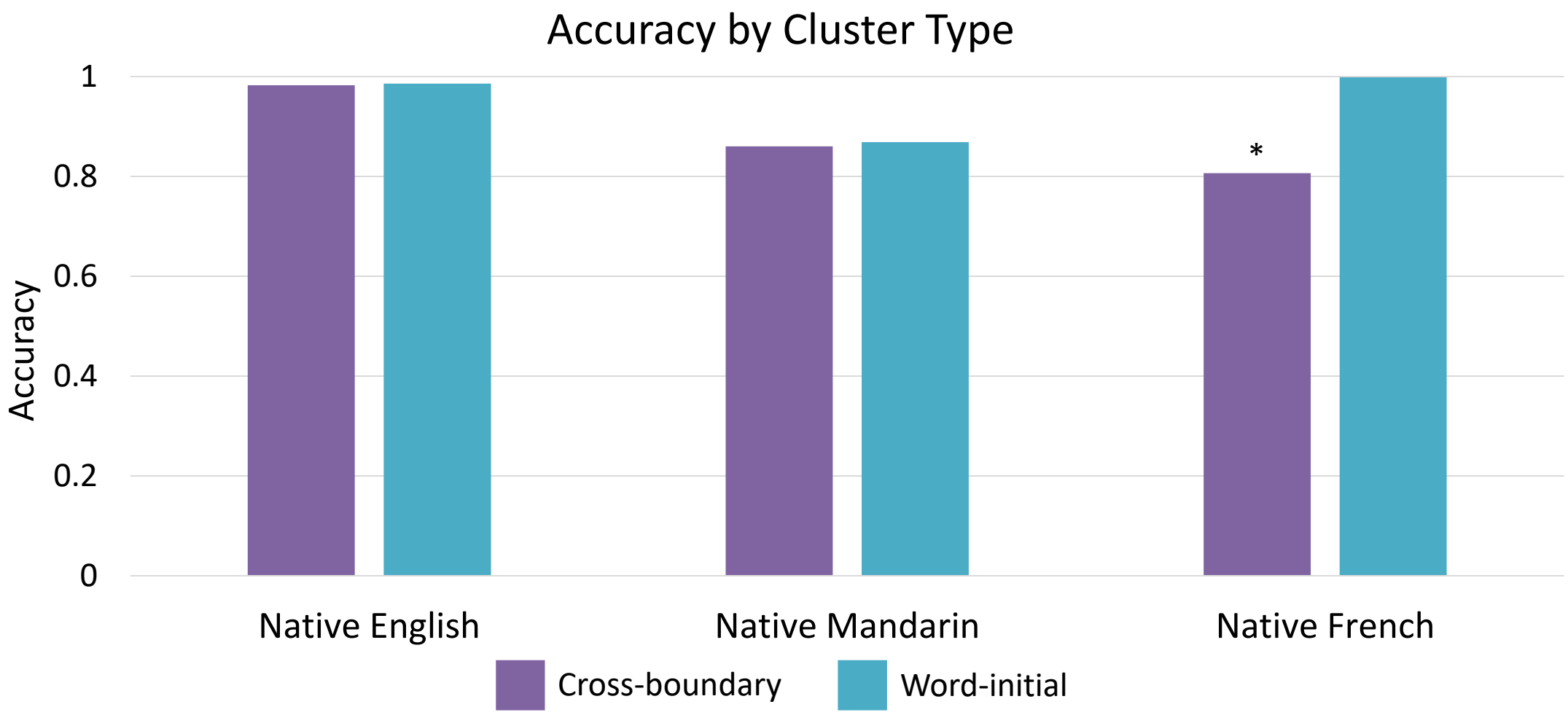


Results

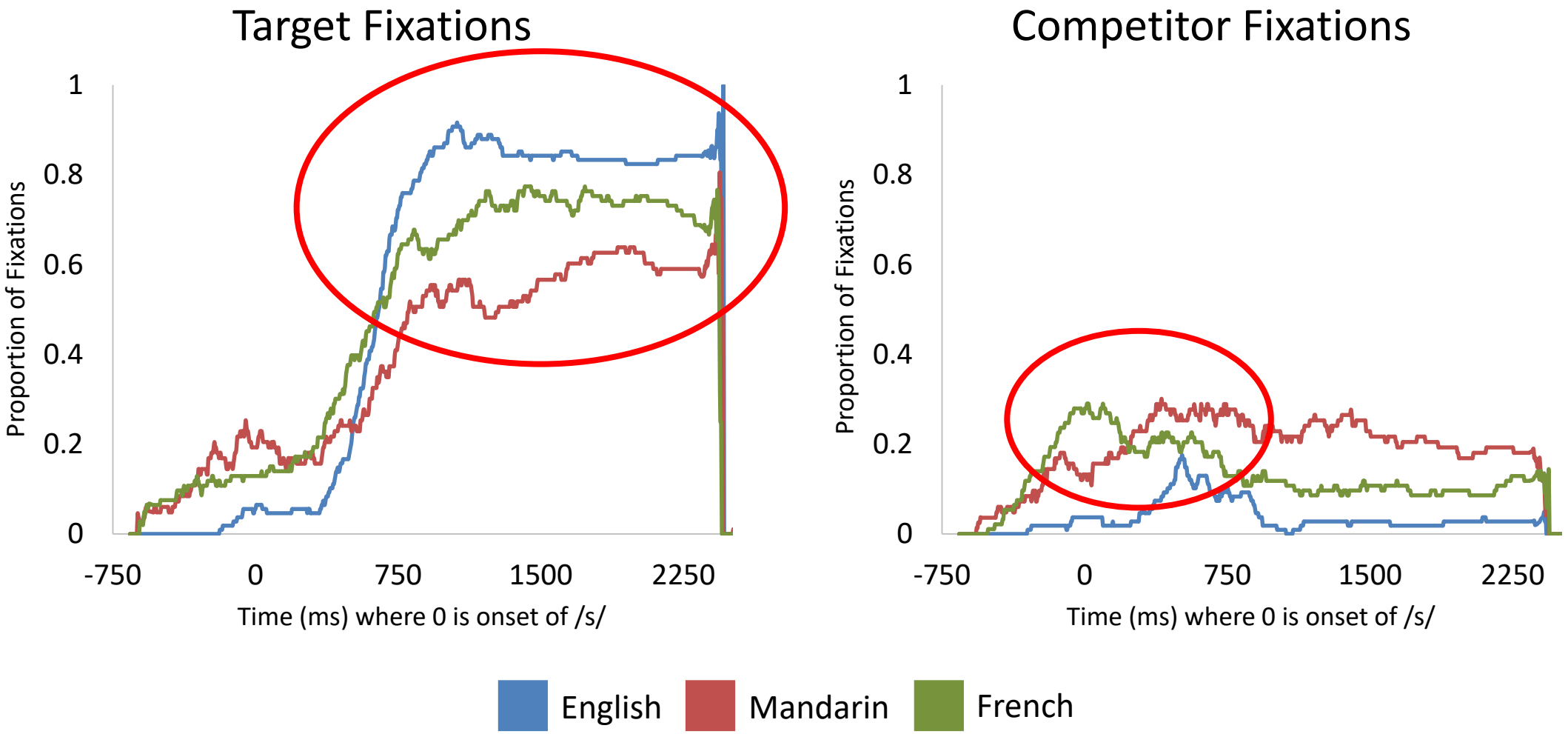
Production


English
Mandarin
French
/ɪ/ duration
Cross-boundary
Word-initial
0
50
100
Time (ms)
/s/ duration
Cross-boundary
Word-initial
0
100
200
Time (ms)
VOT duration
Cross-boundary
Word-initial
0
50
100
Time (ms)

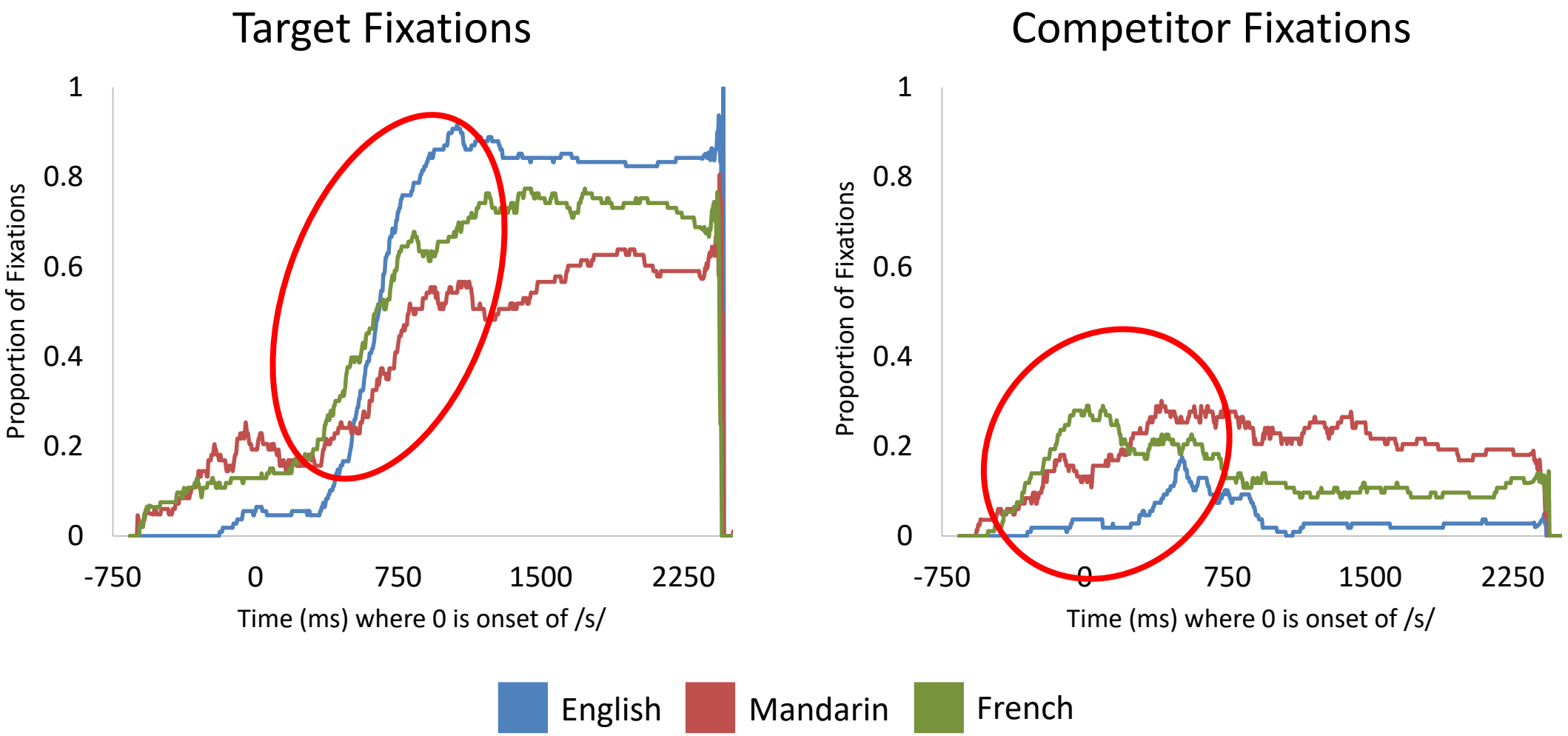
Accuracy


Accuracy by Cluster Type
Accuracy
1
0.8
0.6
0.4
0.2
0
*
Native English
Native Mandarin
Native French
Cross-boundary
Word-initial

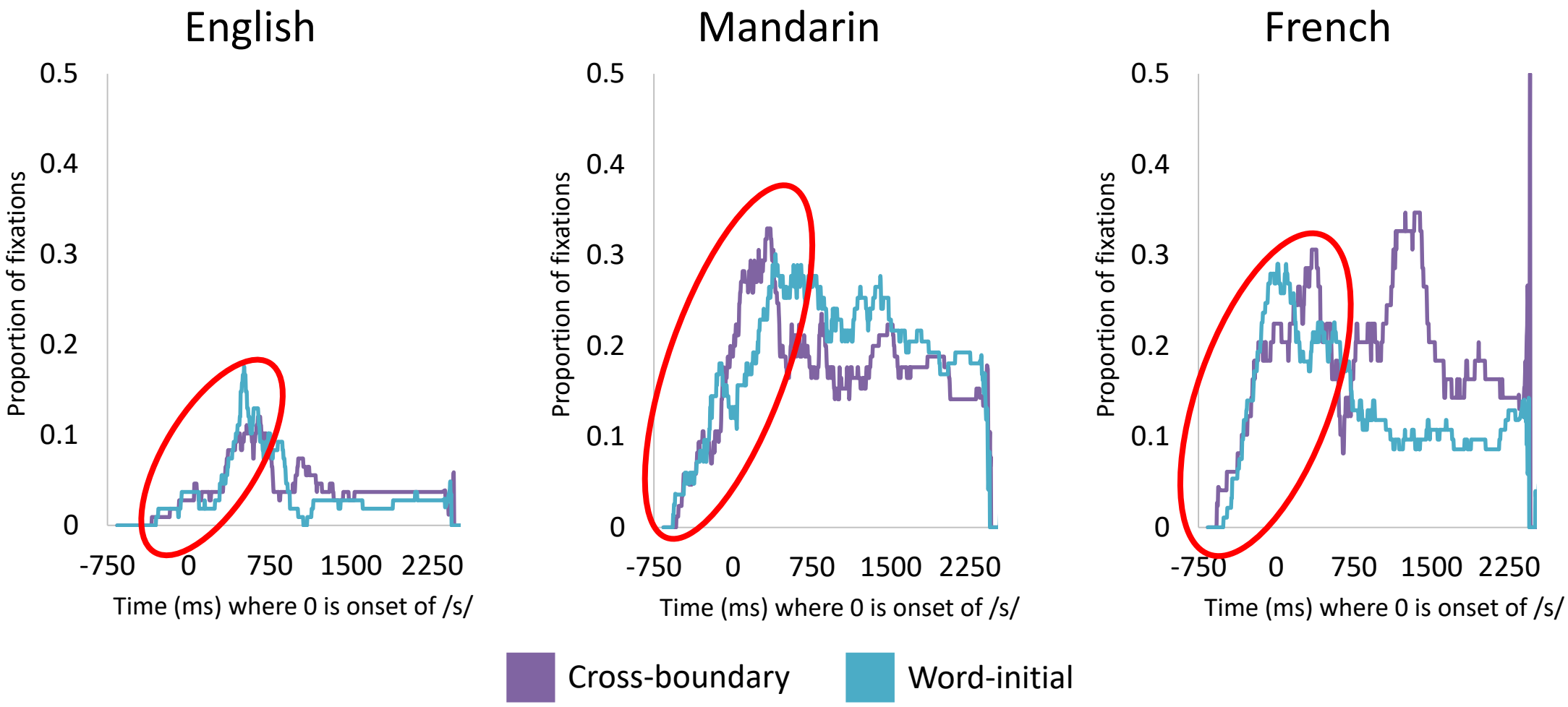
Perception - maximum proportion of fixations



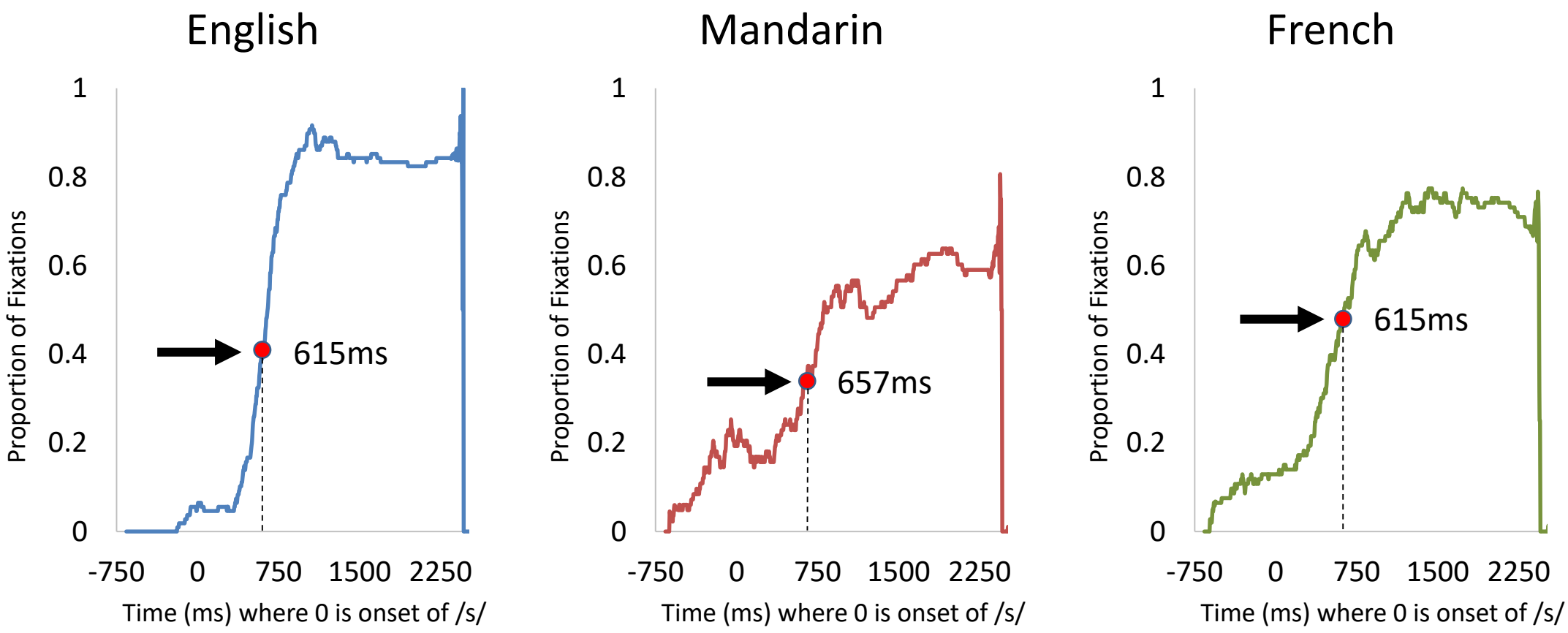
Perception - slope of fixations



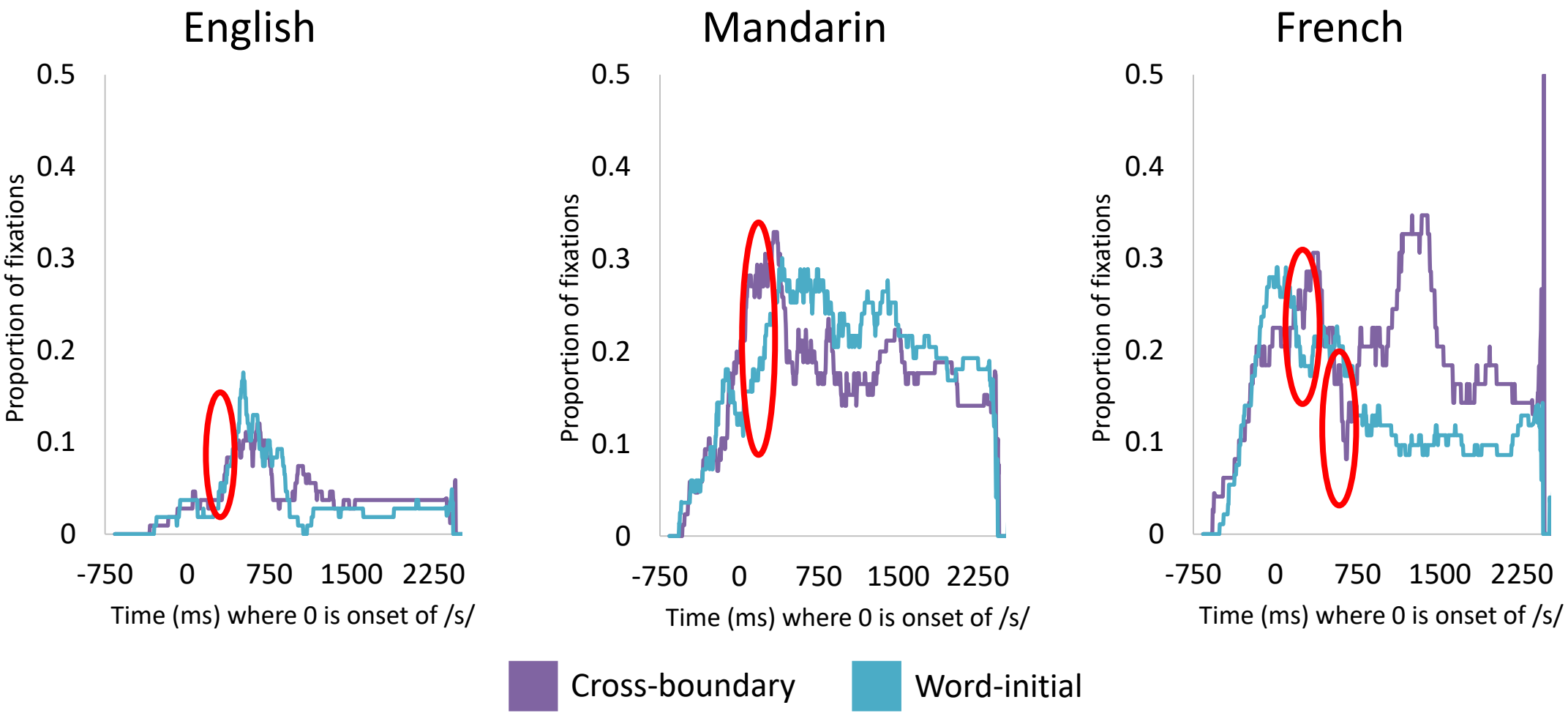
Perception - slope of fixations by language



Perception - crossover point of fixations



Perception - midpoint of competitor fixations



Conclusions

- The presence or absence of an aspiration contrast did not seem to strongly influence real-time processing
- Non-native English speakers more unsure over the course of a trial
- Overall having aspiration as a native contrast did not affect processing as much as predicted

- Future directions:
  - Run more native French speakers
  - A follow up study that would manipulate /s/ duration and VOT duration to determine which cues are being used during processing

Selected References

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