

Assessing the strength of the morpho-orthographic segmentation route for deaf readers using event-related potentials

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INTRODUCTION

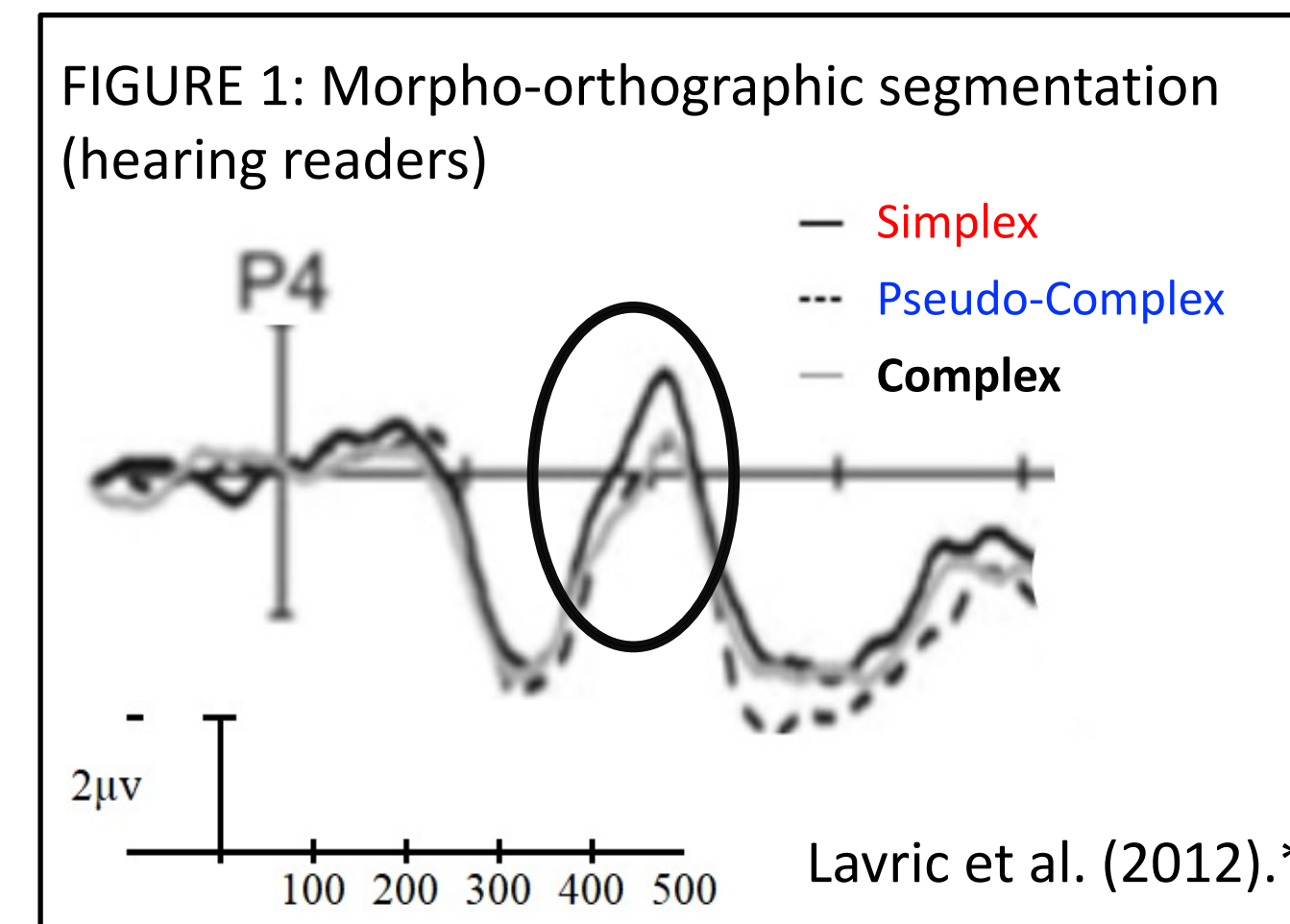
Morpho-orthographic segmentation

- System for parsing complex words based on morphological cues¹
climb + -er = climber

- In early stages (190-220ms), cues are "incorrectly" parsed according to *apparent* complexity reflected in orthography but not morphology or semantics^{2,3}

*beak + -er = beaker

Type	Orthographic complexity?	Morpho-semantic complexity?
Simplex "freeze"	✗	✗
Pseudo-Complex "beaker"	✓	✗
Complex "climber"	✓	✓



Deaf readers

- Morphological parsing based on orthographic cues may play a larger role for deaf readers⁴
- May be more attuned to orthographically defined segments

PRESENT STUDY: Research Questions

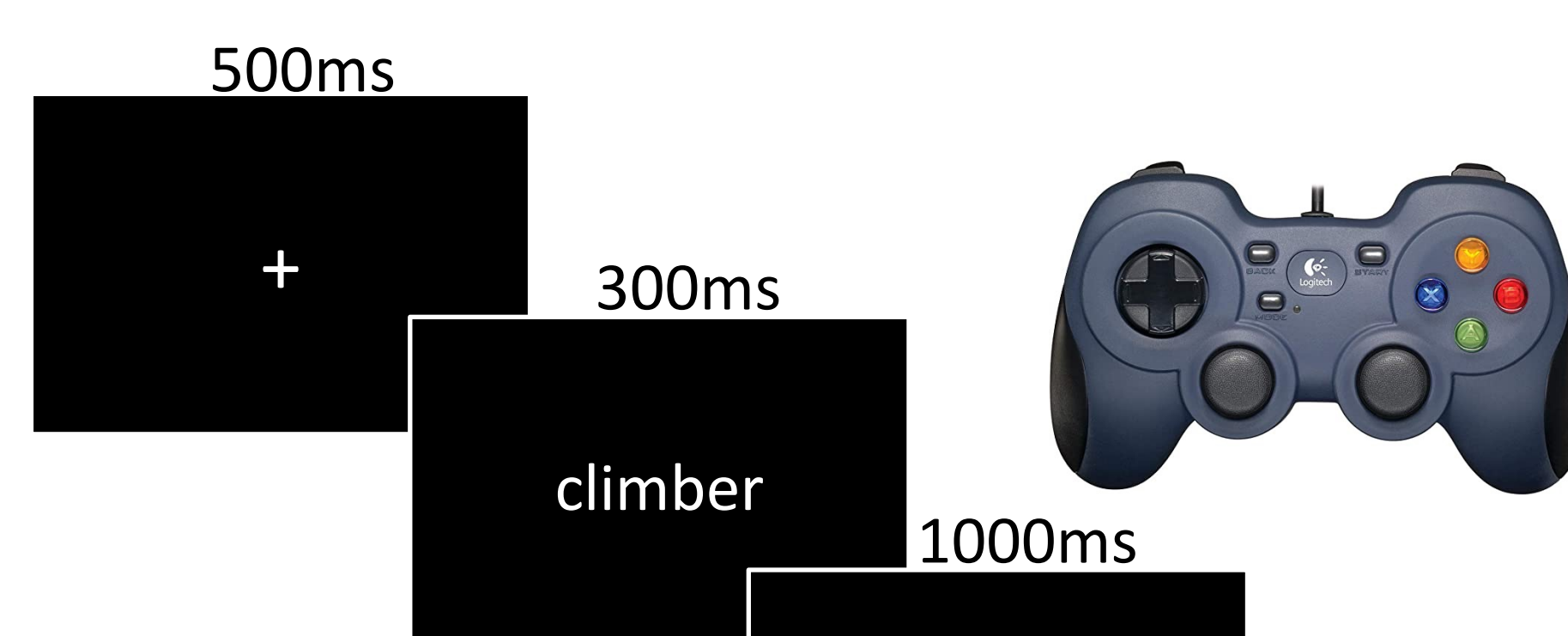
- Is the neural signature of the morpho-orthographic segmentation route stronger (i.e., earlier or more pronounced) for deaf than hearing readers?
- Does this signature correlate more strongly with reading skill for deaf than hearing readers?

CONDITION	STIMULI TYPE	EXAMPLE
REAL WORD	Simplex (n=50)	freeze
	Pseudo-Complex (n=50)	beaker
	Complex (n=50)	climber
NON-WORD	Suffix (n=30)	yumbling
	No Suffix (n=20)	prollen

METHODS

Participants (N=28):

- 11 Deaf native/early signers
 - 6 Female; Mean age = 32.4
- 17 Hearing non-signers
 - 10 Female; Mean age = 24.7

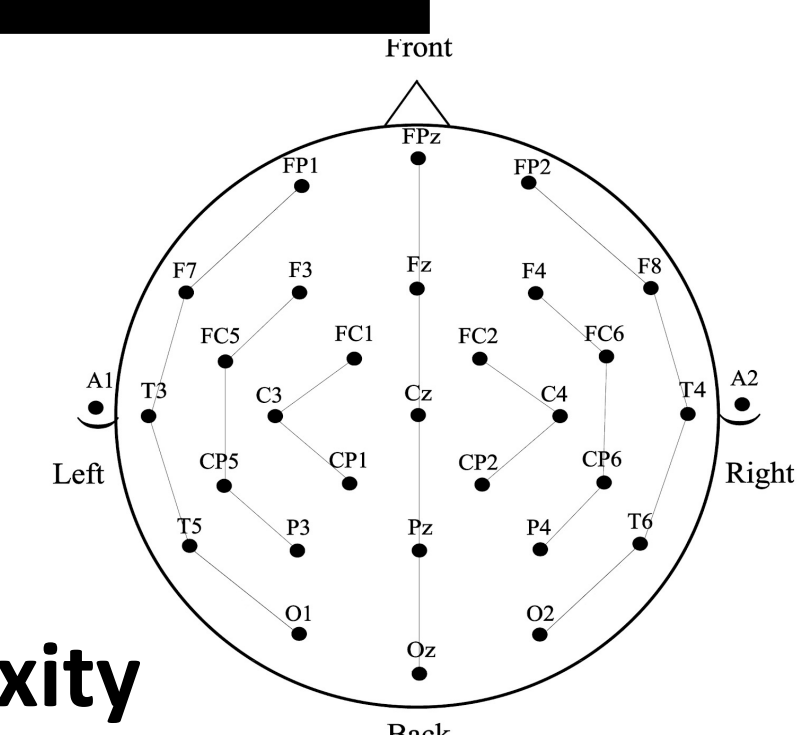


Task:

- Unprimed, go/no-go lexical decision**
 - Participants asked to press a button on a gamepad to "fake" words
- ERPs time-locked to stimulus onset**
 - 32 channel electrode cap

Stimuli:

- Real and non-words of varying morphological complexity and apparent complexity



RESULTS

- Simplex** words elicited more negative amplitudes than both **complex** and **pseudo-complex** words, which were not different from each other.
 - Pattern appears *earlier* for deaf readers (190-280ms) compared to hearing readers: 225-300ms (Figure 2)
 - More anterior distribution* for deaf readers compared to hearing readers (Figure 3)

FIGURE 2. ERPs to **simplex**, **pseudo-complex**, and **complex** words.

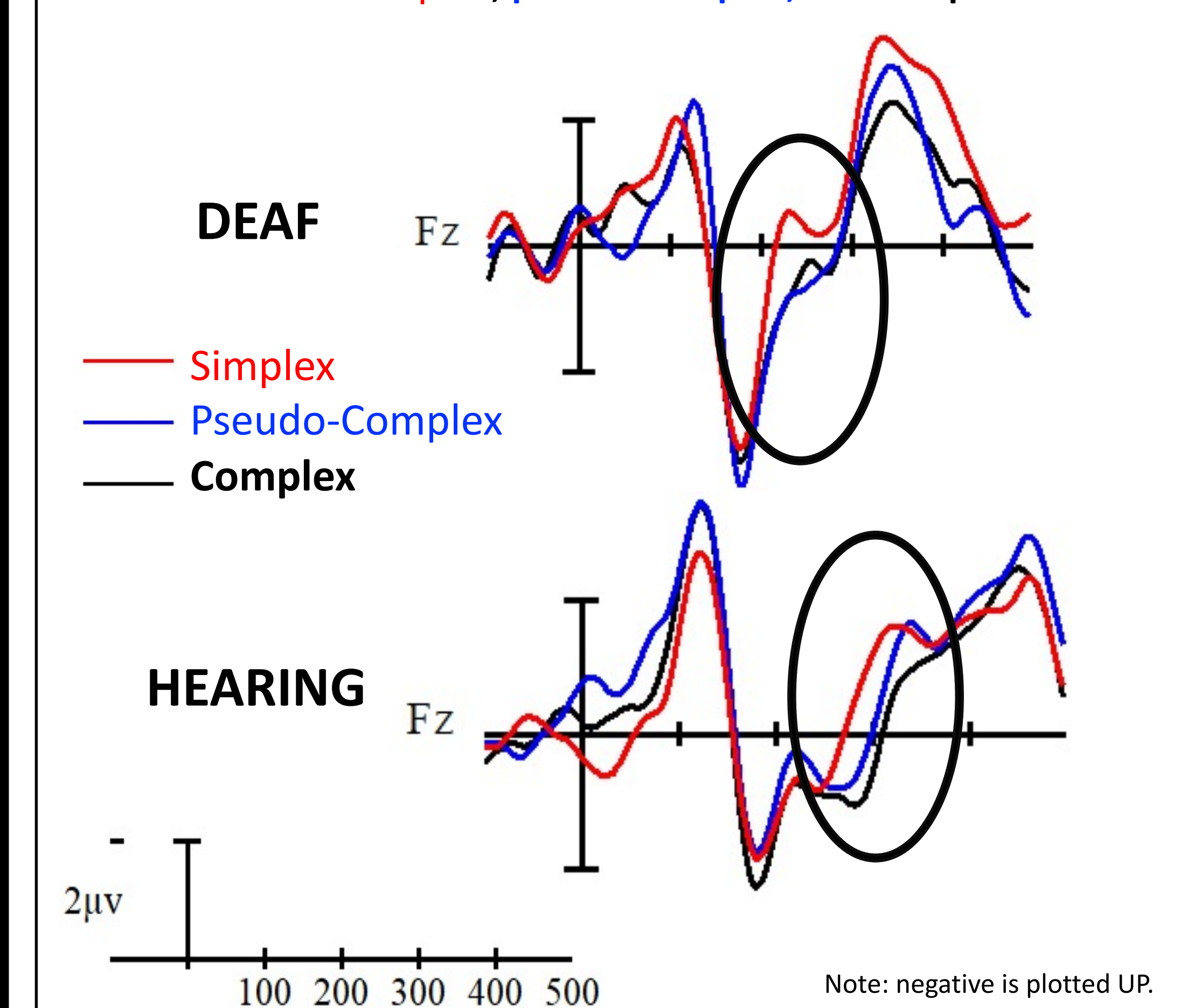
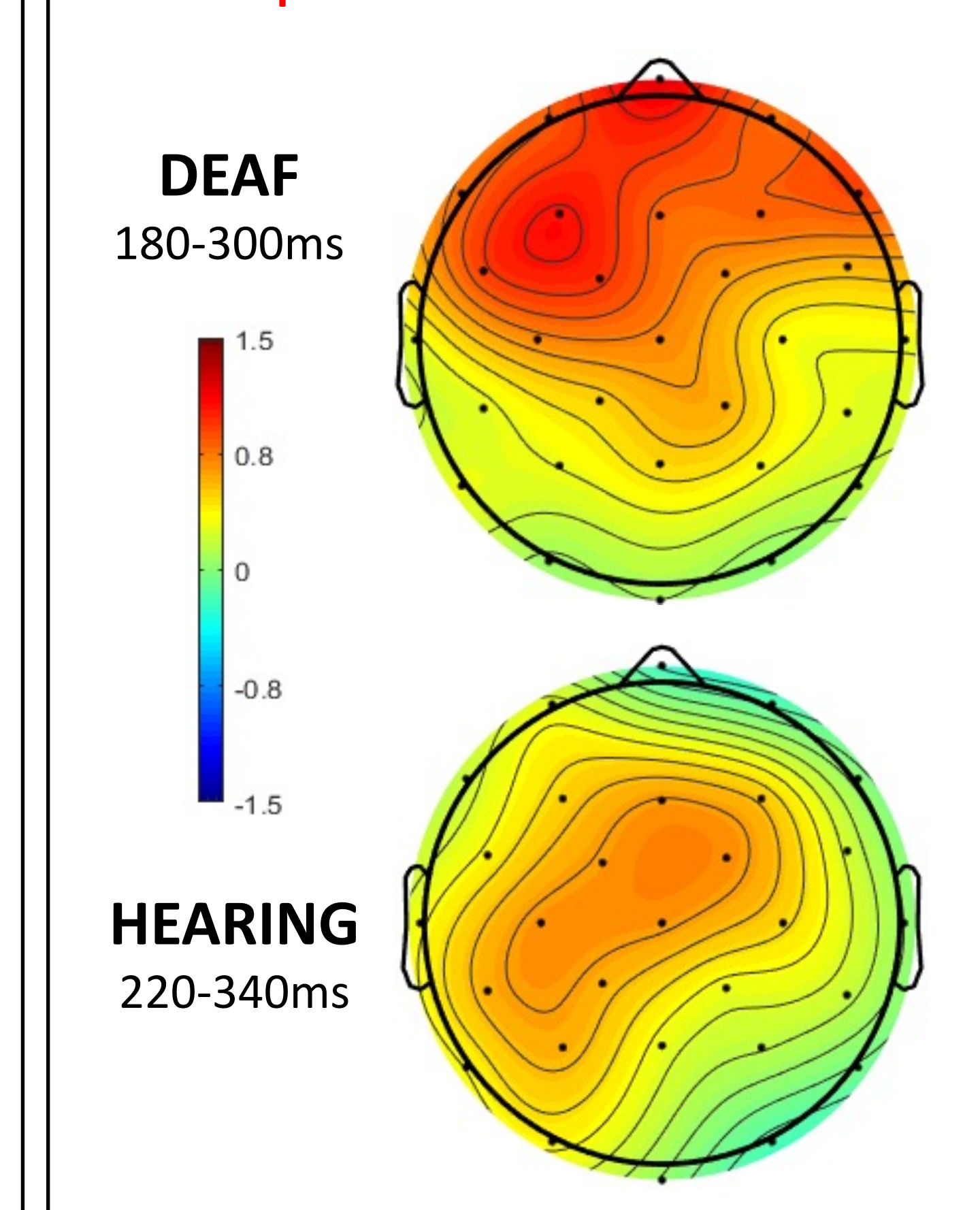
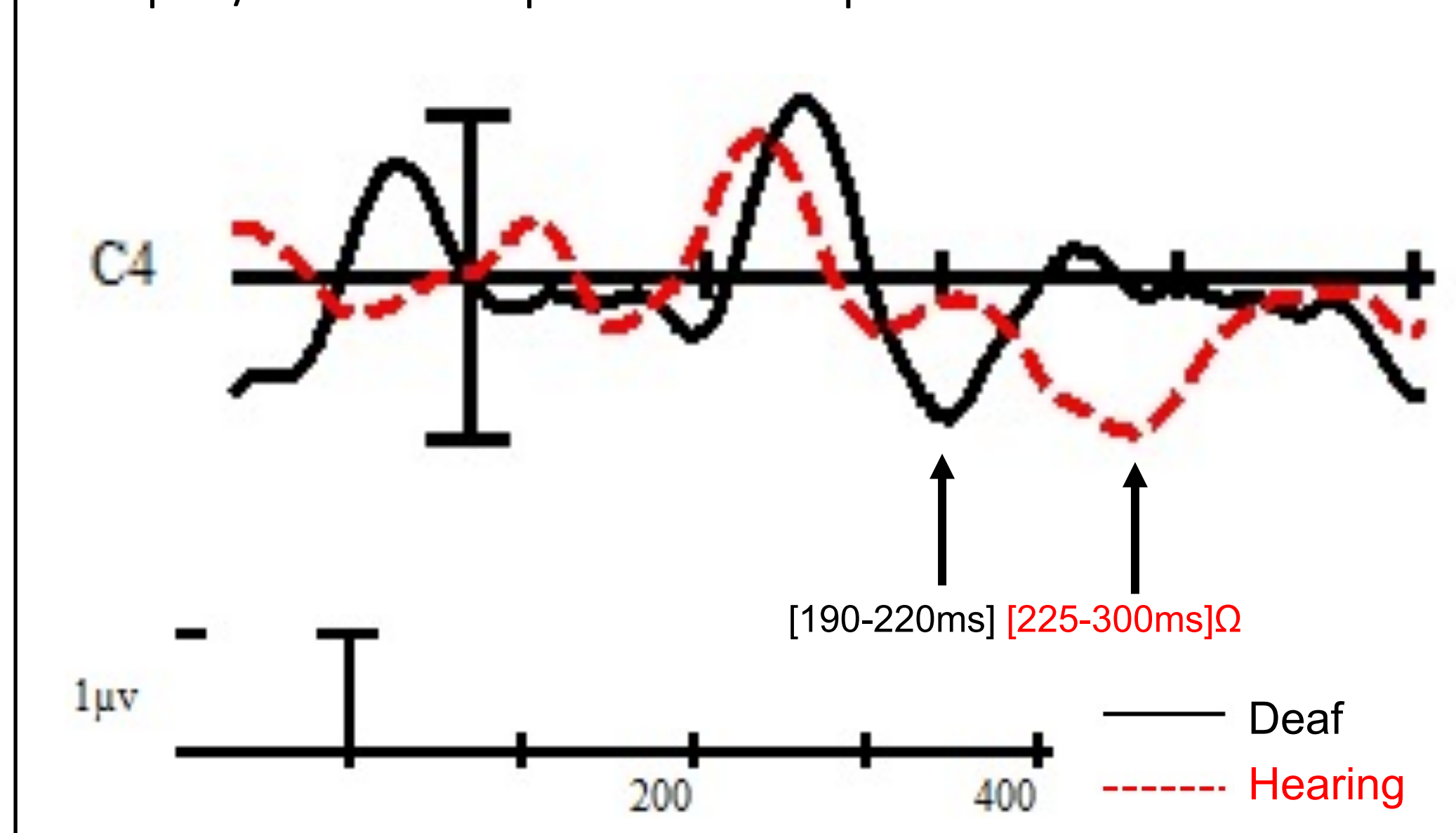


FIGURE 3. **Complex** and **Pseudo-Complex**** minus **Simplex** words



- Complex/pseudo-complex**** minus **simplex** for deaf compared to hearing readers
 - Difference appears *earlier* for deaf readers compared to hearing readers

FIGURE 4. Latencies of **Deaf** vs. **hearing** difference waves; Complex/Pseudo-Complex minus Simplex



Set created by collapsing **complex and **pseudo-complex** (n=100) for purposes of comparison with **simplex** words (n=50)

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*Note that waves in Figure 1 have been flipped to plot negative up.

DISCUSSION

- Complex** and **pseudo-complex** words pattern together, distinct from **simplex** words, at early stages for both groups.
 - Initial segmentation of words is based on orthographically-defined visual features
 - Replicates previous research with hearing readers
- Pattern is earlier, more anterior, and more left-lateralized for deaf readers than hearing readers.**
 - Deaf readers may be faster at recognizing morphologically-cued segments
 - Distinction between **complex/pseudo-complex** and **simplex** recruits areas of the brain consistent with orthographic processing for deaf readers⁵

CONCLUSIONS

- Initial morphological segmentation occurs without regard to semantics for both hearing and deaf participants.**
 - Early and automatic process
- Neural signature of morpho-orthographic segmentation occurs earlier and with a more anterior distribution for deaf than hearing readers.**
- Difference in amplitudes between Complex/Pseudo-Complex and Simplex is similar, but earlier for deaf than hearing readers.**

FUTURE DIRECTIONS

- Correlations between neural signature of morphological segmentation and measures of reading skill**
 - If morphological segmentation is a more important component of reading skill for deaf readers, these differences should correlate more strongly with reading and spelling skill than for hearing readers.

Additional resources