

Assessing Parallel Word Processing in Deaf and Hearing Readers with an ERP Flanker Paradigm

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Background

- We know readers can process upcoming words adjacent to the word being fixated on (**parafoveal preview**), but it is unclear the extent of lexical information that is available to the reader while words are in preview.
- Snell et al. (2019) used a **lexical flanker paradigm** with **EEG** to test how the **parafoveal-on-foveal effect** (the influence of parafoveally-presented words on processing a foveal target word) unfolds during online word recognition. [1]
 - They found that parafoveal words influenced sublexical and lexicosemantic processing of the target word, and ERP effects were larger when parafoveal flanker words differed from the target word.
- Deaf people's visual attention resources are more widely distributed into the periphery, which influences their reading behavior by expanding the span of letters they read with one fixation. [2] [3]

We ask: Do peripheral visual attentional adaptations in deaf people alter the time-course of the parafoveal-on-foveal effect?

Conclusions

- Performance in both groups decreases when parafoveally-presented words differ from the foveal word as compared to when they are identical.
- Both groups show a robust flanker effect. Consistent with our hypotheses, the presence of flankers caused a strong N250 and N400 effect, whereas flanker identity caused a strong N400 effect.
 - We also found a significant posterior N150 effect of flanker presence, which differs from Snell et al. (2019) but makes sense with its role in early visual processing, since adding flankers results in more visual complexity.
- There are no significant differences between deaf and hearing groups within the N150, N250, or N400 components.
- However, there may be small differences in how deaf vs. hearing people process parafoveal words when they differ from the target: deaf people seem to have an earlier N250, whereas hearing people show a later & bigger N250.
- We will replicate this experiment with flankers placed in the peripheral (not parafoveal) field of view, to test whether peripheral attentional adaptations may only cause lexical processing differences further in the periphery.

Methods

TASK

Lexical decision to a centrally-presented **target** word or pseudoword

45 words & 45 pseudowords per condition for a total of 270 trials over 15 minutes

STIMULI

three conditions:

no flankers	rock
same flankers	scan scan scan
different flankers	corn deer corn

two effects of interest:

different vs. none = effect of *flanker presence* on target processing

different vs. same = effect of *flanker identity* on target processing

ANALYSIS

- (2 groups x 3 conditions) **ANOVA** for behavioral data (accuracy and reaction time)
- (2 groups x 3 conditions) **ANOVA** for each ERP component of interest.
- A **time-course analysis** of the *flanker identity effect* on the Cz electrode
 - 50ms windows, from 200ms-600ms
 - 2x2 ANOVA for each window
- Significance values were adjusted with the Greenhouse-Geisser correction for sphericity.

PARTICIPANTS

DEAF 24 deaf native ASL/English bilinguals
age = 34.4 (9.0)
14 M / 10 F
PPVT (English vocab) = 194.3 (14.7)
PIAT (reading comprehension) = 83.4 (8.9)

HEARING 24 hearing non-signers
age = 30.8 (8.46)
9 M / 14 F / 1 genderqueer
PPVT (English vocab) = 206.6 (10.8)
PIAT (reading comprehension) = 84.4 (9.7)

DATA COLLECTION

- 32-channel electrode cap
- Time-locked to onset of target word
- Blinks were removed via independent component analysis (ICA) using EEGLAB on MATLAB

COMPONENTS OF INTEREST

replicated from Snell et al. (2019)

N/P150 = early visual feature processing

N250 = sublexical processing

N400 = lexicosemantic processing

Results

- Accuracy decreased and RT increased in the *different-flanker* condition as compared to the *same-flanker* condition (Figure 1).
- The presence of flankers caused a posterior, but not overall, N150 ($p < 0.01$ for flanker x anteriority interaction); and a strong N250 and N400 effect.
- The flankers being a different word from the target caused a strong N400 effect in both groups (p 's < 0.01).
- The hearing group trends toward a greater effect of flanker identity in the 250-300ms window ($p = 0.07$).

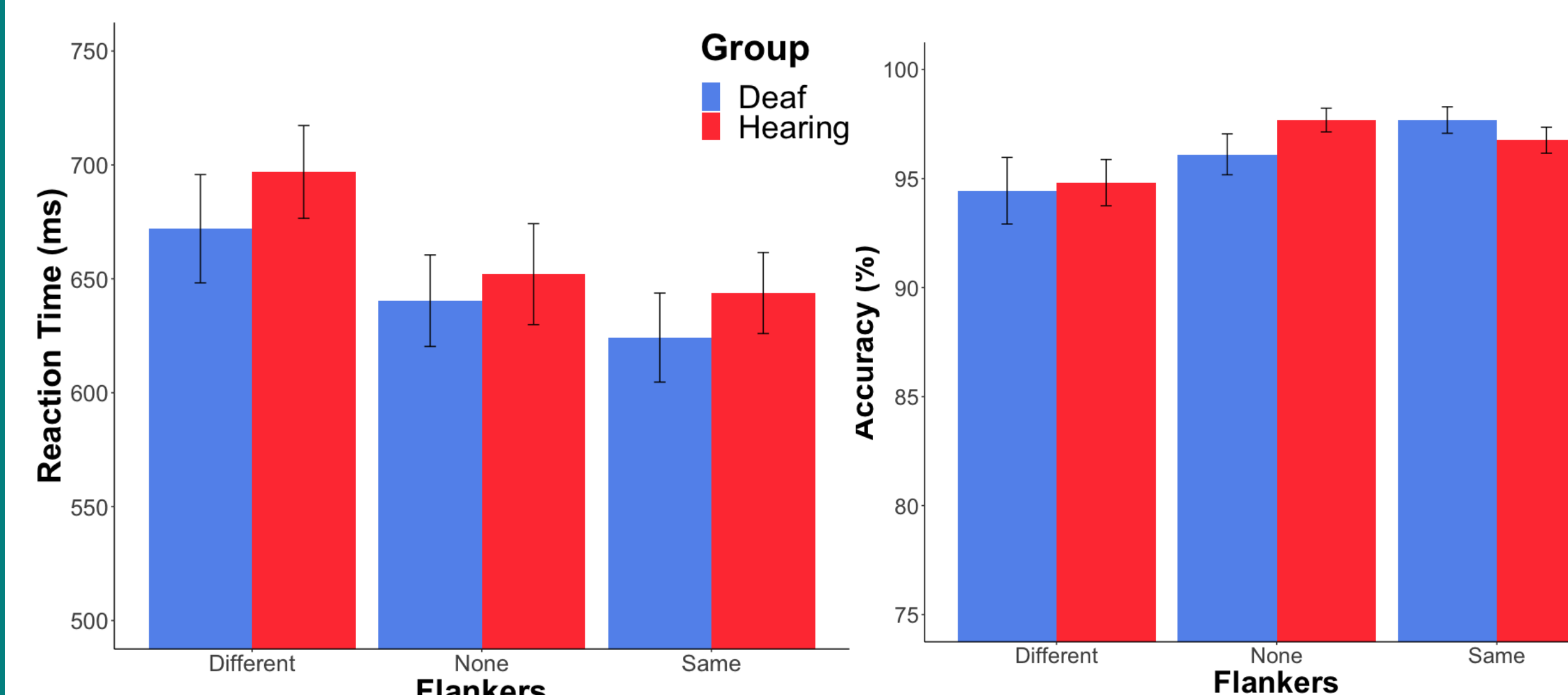


Figure 1. Mean (SE) accuracy (%) and reaction time (ms) for target words in the lexical decision task.

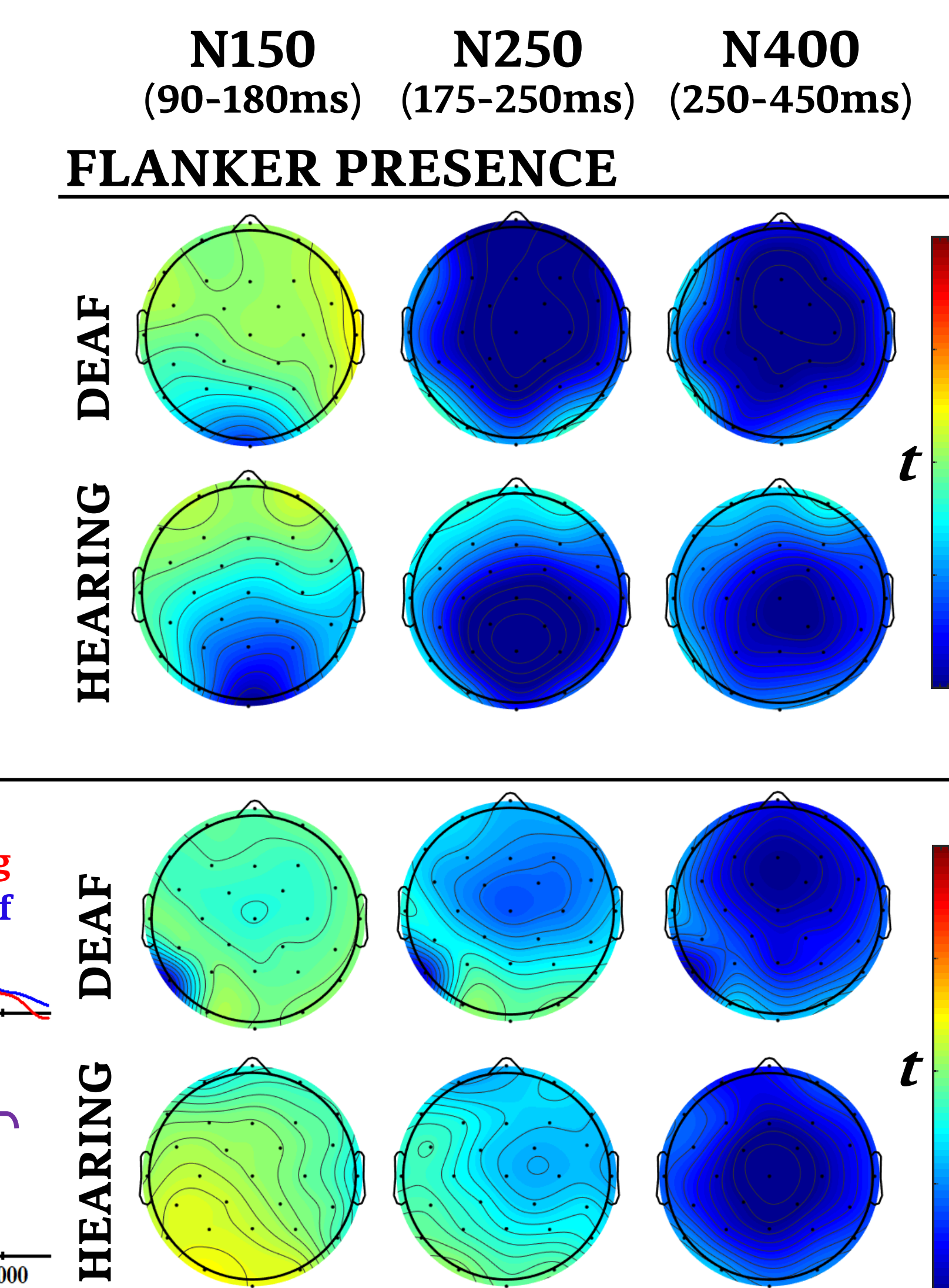


Figure 2. ERP effects of flanker presence and flanker identity. The time-course of the effects are shown via difference waves (only for flanker identity) on the left, and voltage maps averaged over the time-windows of the three components of interest are shown on the right. Voltage maps reflect t -values.

References