Identifying individual profiles in the processing of morphological violations.
An ERP study on German regular and irregular plural forms

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SFB 1287 Limits of Variability in Language
Cognitive, Grammatical, and Social Aspects

Background

Morphological/Morphosyntactic violations

*buyed vs. bought → biphasic LAN-600 [1]

Result of individual variability? [2]

- individuals with negativity-dominant profile (N400)
- individuals with positivity-dominant profile (P600)

Two types of German plural forms

1. **Regular** (-s) = *Festival* 'festival' → *Festivals*
2. **Irregular** (-(e)n, -e, -er) = *Zwiebel* 'onion' → *Zwiebeln*

- *Festivals* vs. **Festivalen* → **Irregularizations**
- *Zwiebeln* vs. **Zwiebels* → **Regularizations**

Objectives

1. Replicate previous findings of LAN at group level *only for regularizations* [3]
2. Identify individual profiles elicited by plural violations
3. … And whether they are modulated by the type of violation (regularizations vs. irregularizations)

Methods

Materials and Participants

- EEG recording during silent reading
- Plural nouns embedded in sentences (word-by-word presentation)
- 480 trials in a 2x2 design: Plural Type x Correctness
- 40 participants

Data analysis

- Early time-window (300-500ms) + Late time-window (600-1000ms)
- Analysis of individual differences based on Tanner [2]

Results

(1) Group-Level

1. **LAN for regularizations** (effect of Correctness in left anterior ROI: $b = -0.45$, SE = 0.18, $t = -2.51$), **but not for irregularizations** ($b = -0.14$, SE = 0.18, t =-0.82).
2. **Late Positivity (P600) for both violation types** (Correctness: $b = 0.70$, SE = 0.10, $t = 7.014$; Correctness x Plural Type: $b = -0.31$, SE = 0.20, $t = -1.54$).

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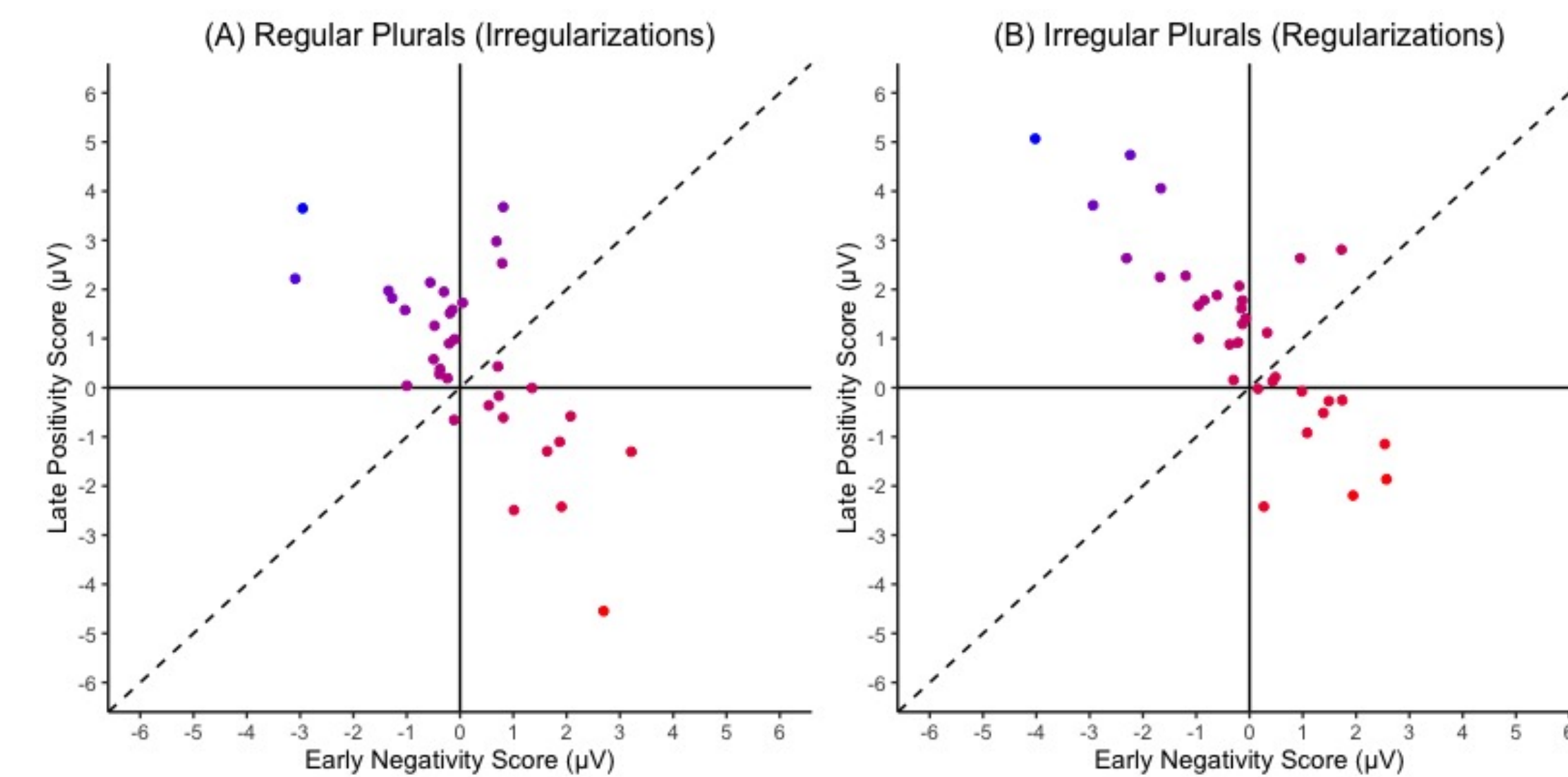### … Identifying the profiles

Figure 1: Scatterplots showing the relationship between the effect magnitudes of each individual in the early and late time window, for the two plural types. Individuals above/to the left of the dashed line showed primarily a positivity, while individuals below/to the right of the dashed line showed primarily a negativity.

Subjects divided into **positivity-dominant** and **negativity-dominant** based on Response Dominance Index (RDI):

$$RDI = \frac{Late\ Positivity\ Score - Early\ Negativity\ Score}{\sqrt{2}}$$

(2) Positivity-dominant individuals

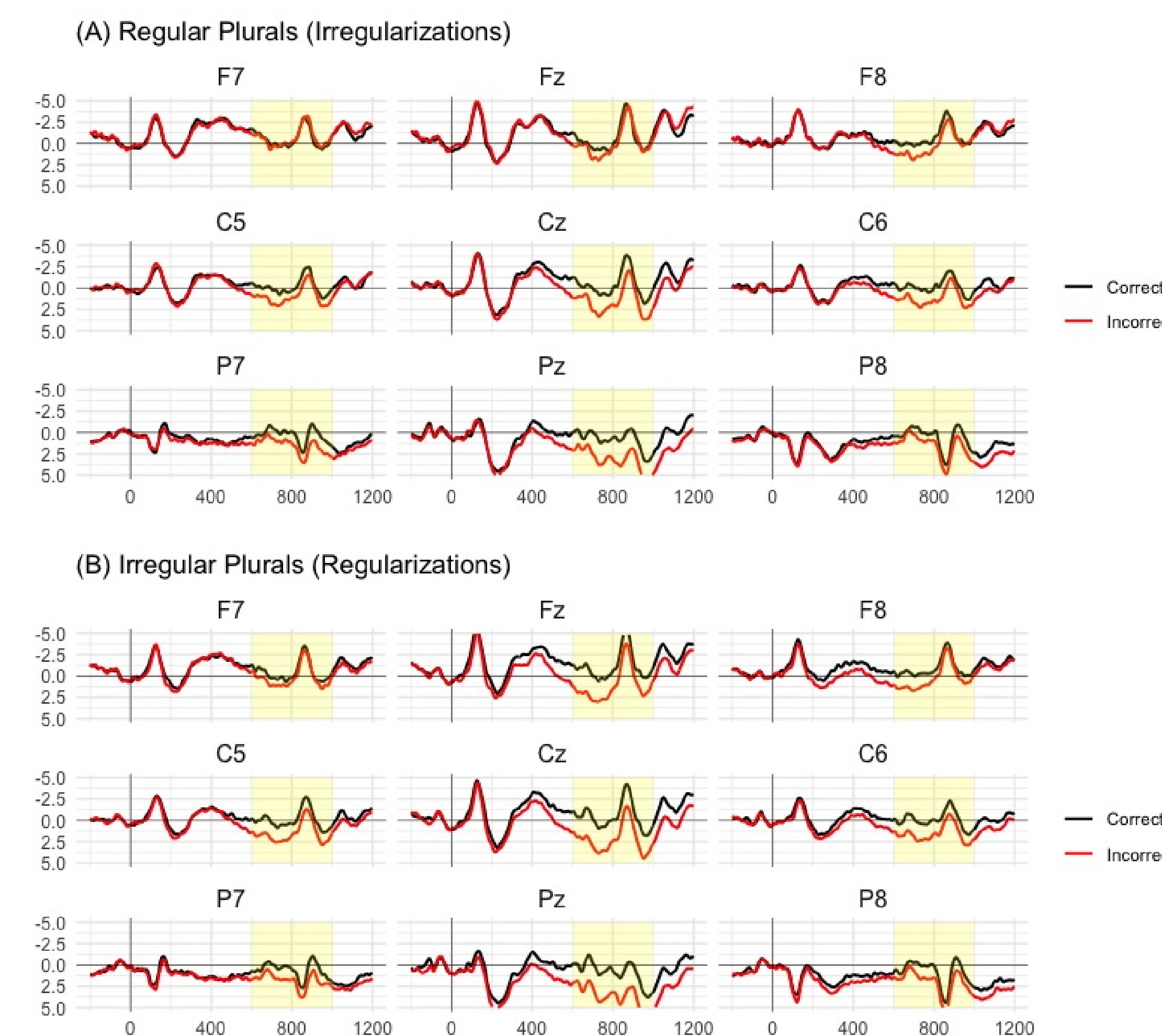Widespread late positivity for both types of violations

Figure 2: Grand mean waveforms from nine representative electrodes for the correct and incorrect plural forms for the participants showing a positivity-dominant profile in the regular (A; N = 21) and irregular plural type (B; N = 22)

(3) Negativity-dominant individuals

- Widespreach negativity for *irregularizations*
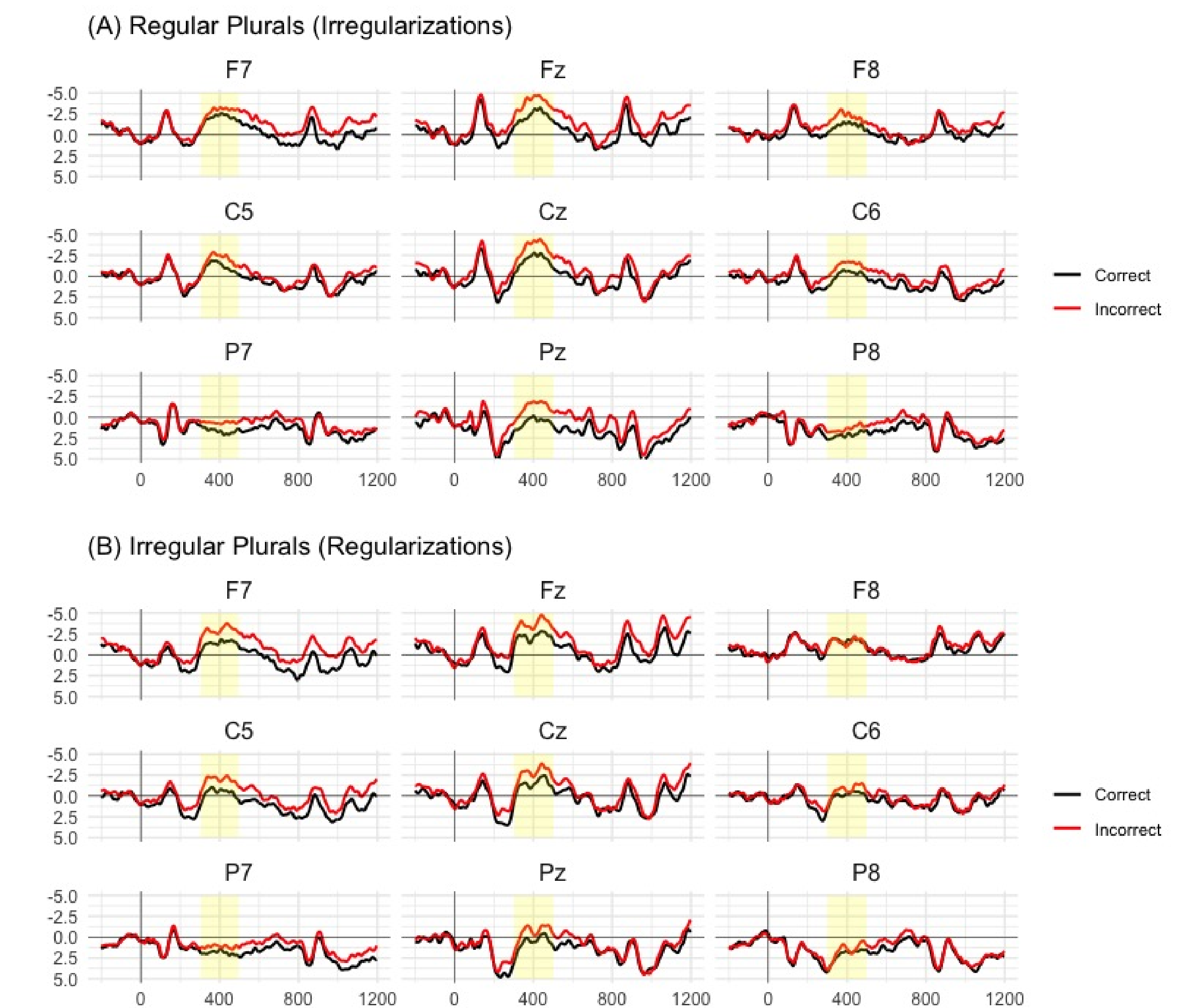- Lateralized negativity for *regularizations*

Figure 3: Grand mean waveforms from nine representative electrodes for the correct and incorrect plural forms for the participants showing a negativity-dominant profile in the regular (A; N = 13) and irregular plural type (B; N = 12)

Conclusions

- Group-level LAN = not (always) a result of individual differences
- Individual profiles **modulated by the type of violation**
- Individuals with positivity profiles = syntactic repair processes
- Individuals with negativity profiles = sensitive to the **internal structure of words** (LAN) or to **lexical-semantic information** (N400), depending on the nature of the stimuli; in line with Molinaro et al. [4].
- Implications for language learning research: do these profiles correlate with language learning aptitude [5]?

1. Morris J, Holcomb PJ (2005) Event-related potentials to violations of inflectional verb morphology in English. Cognitive Brain Research 25:963–981

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4. Molinaro N, Barber HA, Caffarra S, Carreiras M (2015) On the left anterior negativity (LAN): The case of morphosyntactic agreement: A Reply to Tanner et al. Cortex 66:156–159

5. Qi Z, Beach SD, Finn AS, Minas J, Goetz C, Chan B, Gabrieli JD (2017) Native-language N400 and P600 predict dissociable language-learning abilities in adults. Neuropsychologia 98:177–191