L1 Category Precision Hypothesis in L2 Production:
Korean Learners' English Front Vowels

Sujin Oh (sujinoh@uwm.edu) & Hanyong Park (park27@uwm.edu)
Department of Linguistics, University of Wisconsin-Milwaukee

RQ & Background

Research Question

Can L1 category precision predict L2 accuracy across phonetic categories?

L1 Category Precision Hypothesis

- The more precise/compact L1 categories speakers have, the more accurately they discern the L1-L2 differences, shaping a distinctive category, proposed in r-SLM [1].

(a) Compact categories
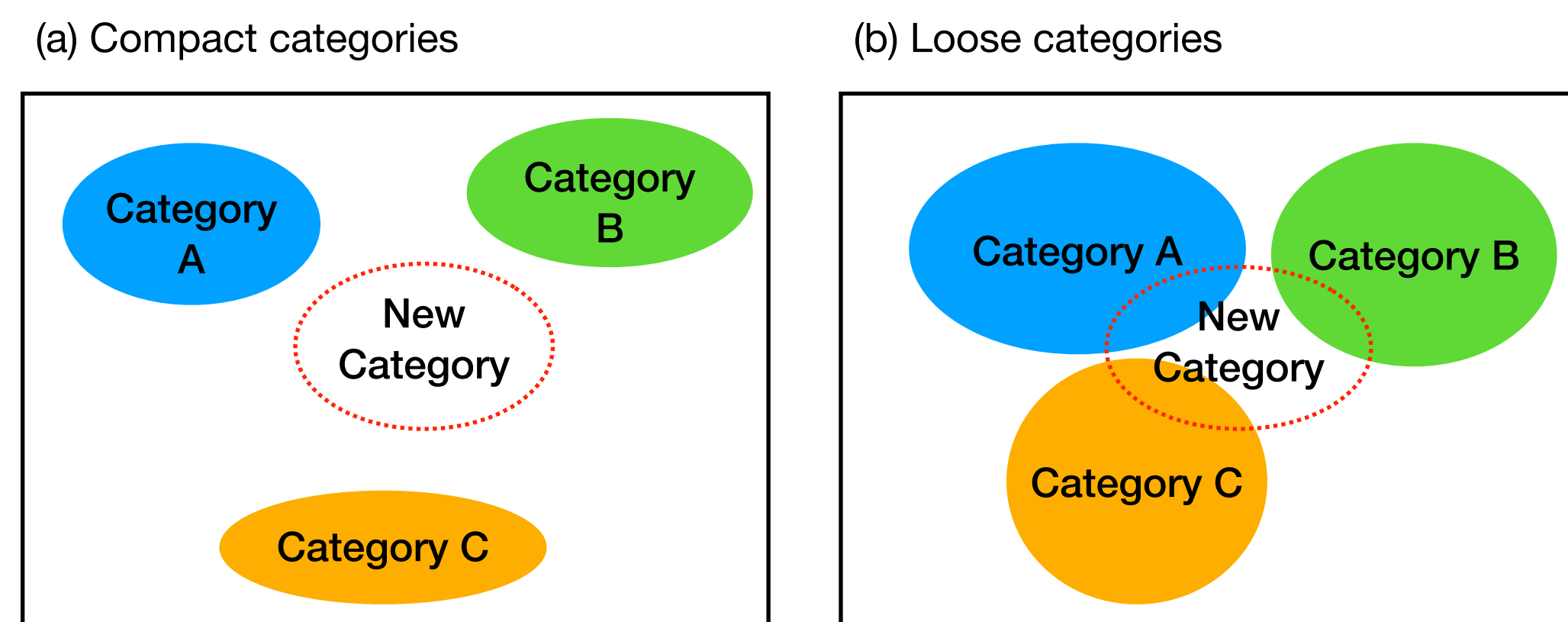
(b) Loose categories

- Individuals with more compact L1 categories tend to produce L2 sounds more accurately than those with loose L1 categories [2].
- **Limitations**: Only examined a couple of subsets of L1-L2 pairs in one language group per study

Methods

Materials

- 30 Native Korean speakers (21 F; AOA = 25.2; LOR = 26.3 mo) from Darcy et al. (2015) [3]
- 26 Native English Speakers (14 F; Midwest) from ALLSSTAR corpus [4] as reference data
- Reading & retelling *The North Wind and the Sun* passage in L1 and L2

Analysis

- F1, F2 in ENG front vowels /i, ɪ, ɛ, æ/ & KOR /i, e, æ/
- **L1 compactness scores (L1CS):** Areas of ellipsis of each vowel category in F1/F2 space [2]

$$CS = \sigma F1 \sigma F2 \pi$$

where $\sigma F1$ is 1 standard deviation of the mean of F1, and $\sigma F2$ is 1 standard deviation of the mean of F2.

- **L2 production accuracy (L2ACC):** Mahalanobis distance between the productions of NE and NK speakers in F1/F2 space [2]

$$d_M(\vec{x},Q)= (\vec{x}-\vec{\mu})^\top S^{-1}(\vec{x}-\vec{\mu})$$

where Q is a probability distribution, μ is the mean of samples, and S is the positive-definite covariance matrix.

- Multiple linear regression models with L1CS as a predictor & L2ACC as an outcome

Results

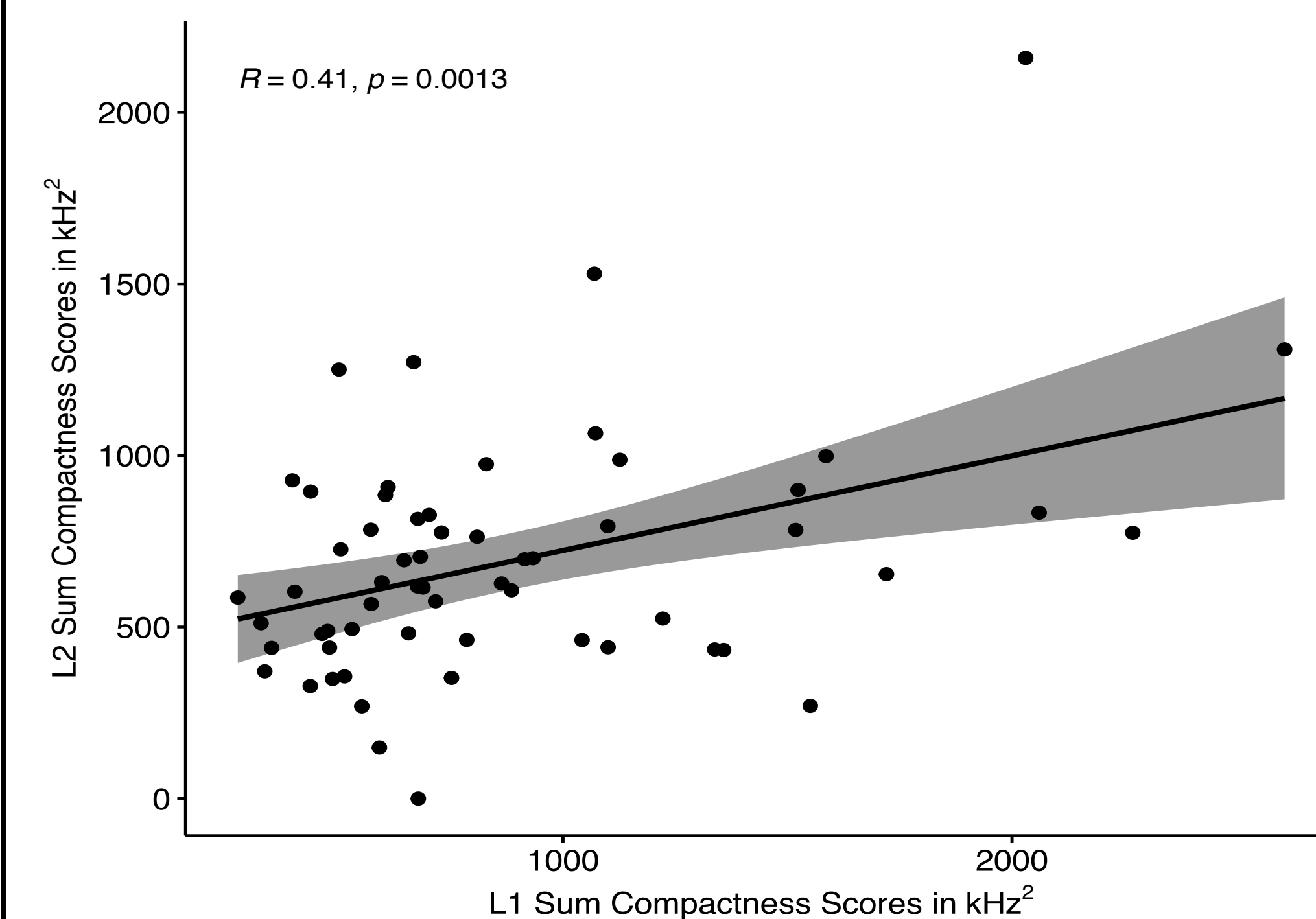- A correlation between L1CS and L2CS

$R = 0.41, p = 0.0013$

Figure 1. A correlation between L1 compactness scores and L2 compactness socres produced by the native Korean speakers

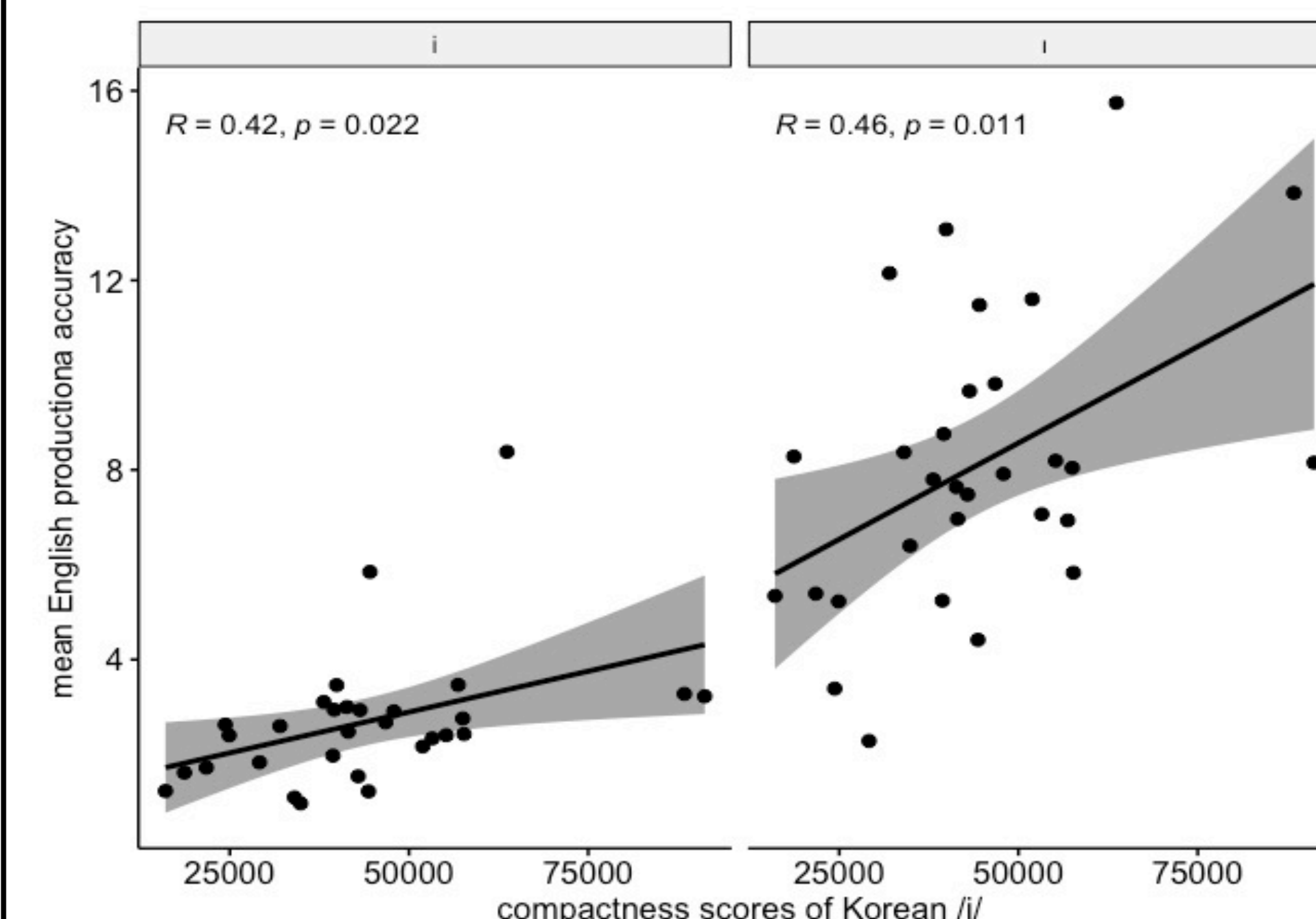- Correlations between L1CS and L2ACC for /i, ɪ/

$R = 0.42, p = 0.022$ $R = 0.46, p = 0.011$

Figure 2. Correlation lines between L1 compactness scores of Korean /i/ and mean L2 production accuracy of English /i/ (left panel) and /ɪ/ (right panel) produced by the native Korean speakers

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- No correlation between L1CS and L2ACC for /ɛ, æ/

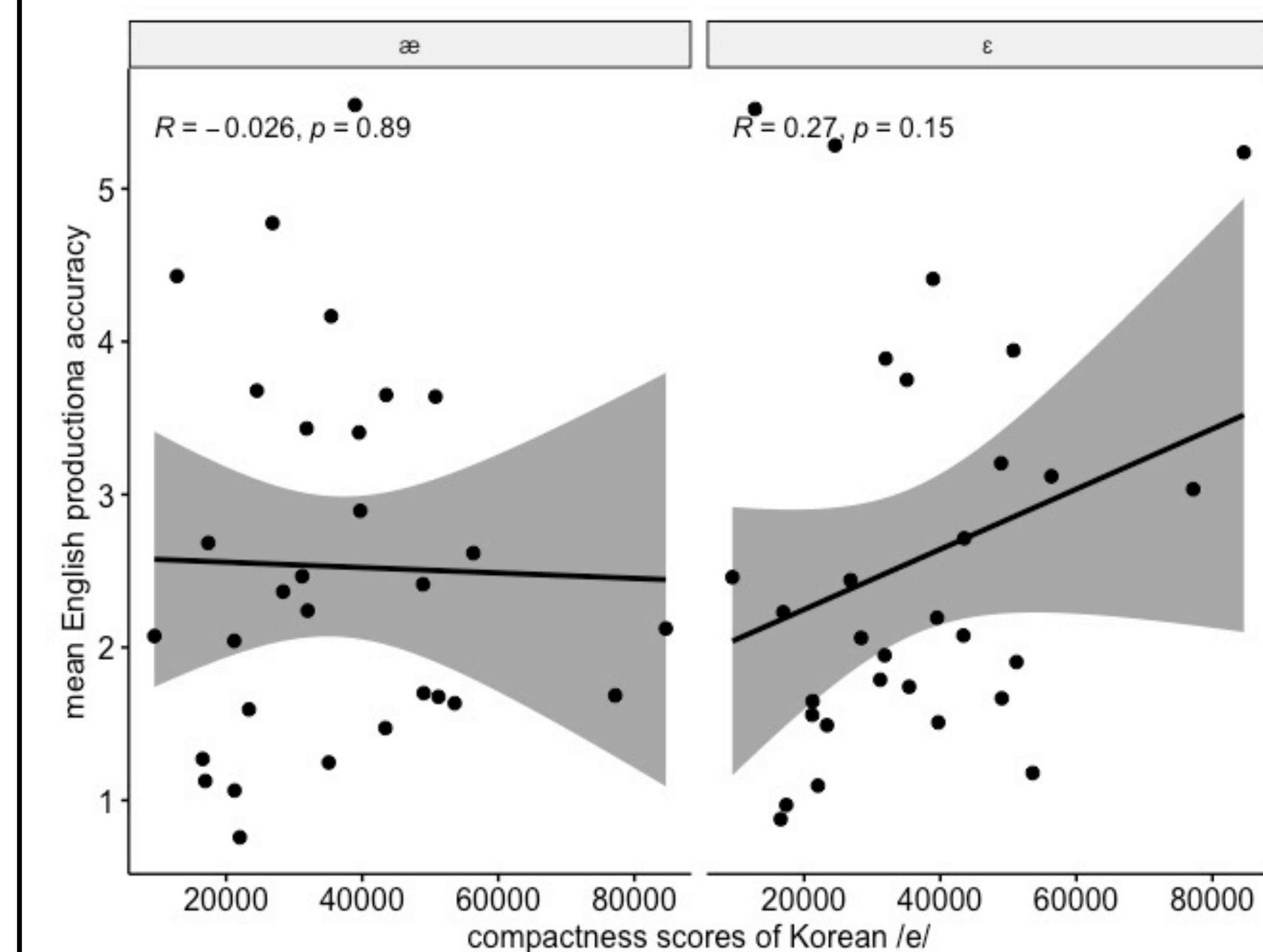$R = -0.026, p = 0.89$ $R = 0.27, p = 0.15$

Figure 3. Correlation lines between L1 compactness scores of Korean /e/ and mean L2 production accuracy of English /æ/ (left panel) and /ɛ/ (right panel) produced by the native Korean speakers

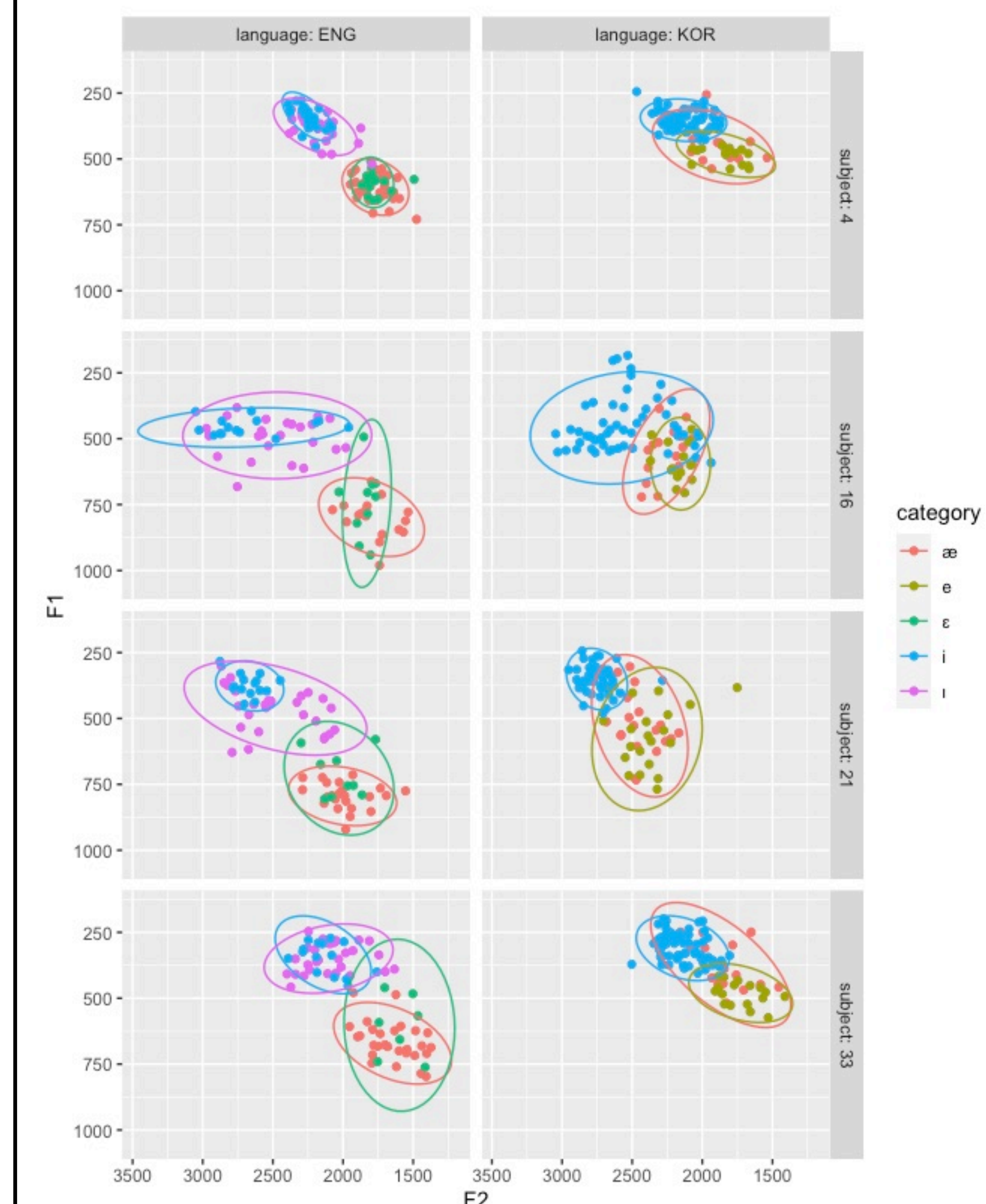- Individual differences between L1CS and L2CS

Figure 4. Front vowel spaces by language (L1 Korean, L2 English) in subjects 4, 16, 21 and 33.

Discussion

L1CS & L2CS

- The more compact the L1 categories are, the more compact the L2 categories are.
- The transfer of L1 individual trait to L2 production

L1CS & L2 Accuracy

- Speakers with more compact L1 categories show higher accuracy in L2 production than speakers with less compact L1 categories.
- **RQ?** Not all the categories show the same effect of category precision on L2 production.
    - Only high front vowels show the significant effect of L1 category precision (figure 2).
    - Possible reasons:
        - The merger between /e/ and /æ/ in Korean
        - The Northern Cities Vowel Shift in English
        - Individual differences in perceptual mapping between L1 and L2 categories
- Is being precise/compact always a good thing?; despite the compactness, the L2 accuracy might be lower due to the mislocation of the category.

L1CS & Cross-Language Similarity

- Cross-language similarity significantly predicts the L2 production accuracy of English /i, ɪ, ɛ/ ($p < .05$).
- Does cross-language similarity affect L2 learning stronger than L1 precision?

Selected References

[1] Flege, J. E., & Bohn, O.-S. (2021). The revised Speech Learning Model (SLM-r). In R. Wayland (Ed.), *Second language speech learning: Theoretical and empirical progress* (pp. 3-83). Cambridge: Cambridge University Press.
[2] Kartushina, N., & Frauenfelder, U. H. (2014). On the effects of L2 perception and of individual differences in L1 production on L2 pronunciation. *Frontiers in Psychology*, 5, 1246. DOI: 10.3389/fpsyg.2014.01246
[3] Darcy, I., Park, H., & Yang, C. L. (2015). Individual differences in L2 acquisition of English phonology: The relation between cognitive abilities and phonological processing. *Learning and Individual Differences*, *40*, 63-72.
[4] Bradlow, A. R. (n.d.) ALLSSTAR: Archive of L1 and L2 Scripted and Spontaneous Transcripts And Recordings. Retrieved from https://speechbox.linguistics.northwestern.edu/#!/?goto=allsstar

Acknowledgments