

Cross-language perception of Russian plain & palatalized laterals and rhotics

Alexei Kochetov (a.l.kochetov@utoronto.ca) & James Smith (jg.smith@utoronto.ca), Dept. of Linguistics, University of Toronto, Toronto, ON, Canada

Background

- Previous research has shown that listeners' perception of non-native speech sounds is crucially influenced by the system of *native segmental contrasts* ([1, 2, 3]),
- while also being affected by subsegmental (allophonic, non-contrastive) articulatory or acoustic properties of non-native and native sounds ([4, 5, 6]).
- How all these factors interact and vary across languages, however, is still poorly understood – in part due to the paucity of studies examining non-native perception across multiple languages (but see [6]).

Goal

- The goal of this study is to examine the role of native contrast and subsegmental acoustic differences in the perception of a complex set of Russian lateral/rhotic plain/palatalized contrasts /l r li ri/ by listeners of languages that differ in presence or absence of relevant contrasts:
 - English (an l/r contrast; no C/Cⁱ contrast),
 - Mandarin (an l/r contrast; no C/Cⁱ contrast),
 - Japanese (a C/Cⁱ contrast; no l/r contrast),
 - Korean (no l/r or C/Cⁱ contrasts),
 - Cantonese (no l/r or C/Cⁱ contrasts) (see [7] for details).

Method

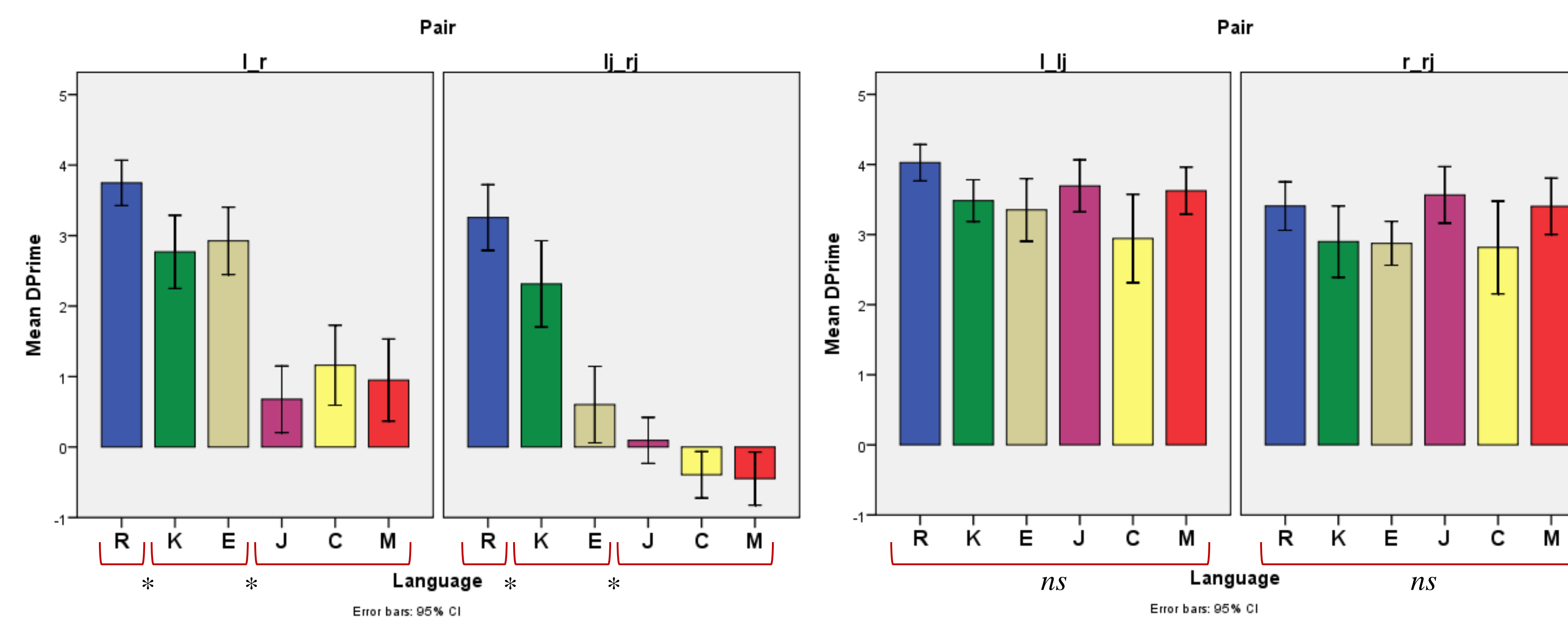
- **Participants:** 84 native speakers of Canadian English (n=13), Cantonese (n=13), Japanese (n=16), Korean (n=13), Taiwanese Mandarin (n=14), and Russian (n=15) as control (all residing in Canada).
- **Stimuli:** Minimal nonsense pairs with 4 consonants, produced by a female native speaker of Russian:
 - /talap/, /tarap/, /talⁱap/, and /tarⁱap/;
- **Task:** AX (same-different) discrimination task with pairs talap – tarap, tarap – tarⁱap, etc.
 - Total of 10,752 responses (128 trials x 84 listeners).
- **Analysis:** D-prime (D'), a measure of sensitivity [8], calculated for responses to lateral vs. rhotic and plain vs. palatalized pairs.

Predictions

- Assuming that presence or absence of native segmental phonemic contrasts is the primary factor in discrimination of non-native sounds (the '*Strong Phonemic Hypothesis*'):
 - **The lateral-rhotic contrasts /l-r/ and /li-ri/** should be discriminated better by listeners whose native language has a phonemic lateral/rhotic contrast:
 - English & Mandarin (& Russian) > Korean, Japanese, & Cantonese.
 - **The plain-palatalized contrasts /l-li/ and /r-ri/**, similarly:
 - Japanese (& Russian) > English, Korean, Mandarin & Cantonese (see *Goal*).

Results

Fig. 1. Discrimination of two lateral-rhotic contrasts: Mean D-prime by language group



R = Russian (control), K = Korean, E = English, J = Japanese, C = Cantonese, M = Mandarin

- **The lateral-rhotic contrasts** (Fig. 1):
 - Significant differences in discrimination across the language groups, with relatively good discrimination of the contrasts by Korean and English listeners (yet less accurate compared to Russian listeners), and much poorer discrimination by the other groups: (Russian >) English & Korean > Japanese, Cantonese, & Mandarin.
 - Consistently better discrimination of the plain /l-r/ contrast compared to the palatalized /li-ri/ contrast by all groups, including native speakers.
- **The plain-palatalized contrasts** (Fig. 2):
 - No significant differences in discrimination across the language groups, with all groups performing close to the ceiling, similar to Russian listeners.
 - Somewhat better discrimination of the lateral contrast /l-li/ (vs. /r-ri/).
- (The results are based on a repeated measures ANOVAs with factors Pair and Language, and post hoc Tukey HSD tests separately for the two types of contrasts.)

Fig. 2. Discrimination of two plain-palatalized contrasts: Mean D-prime by language group

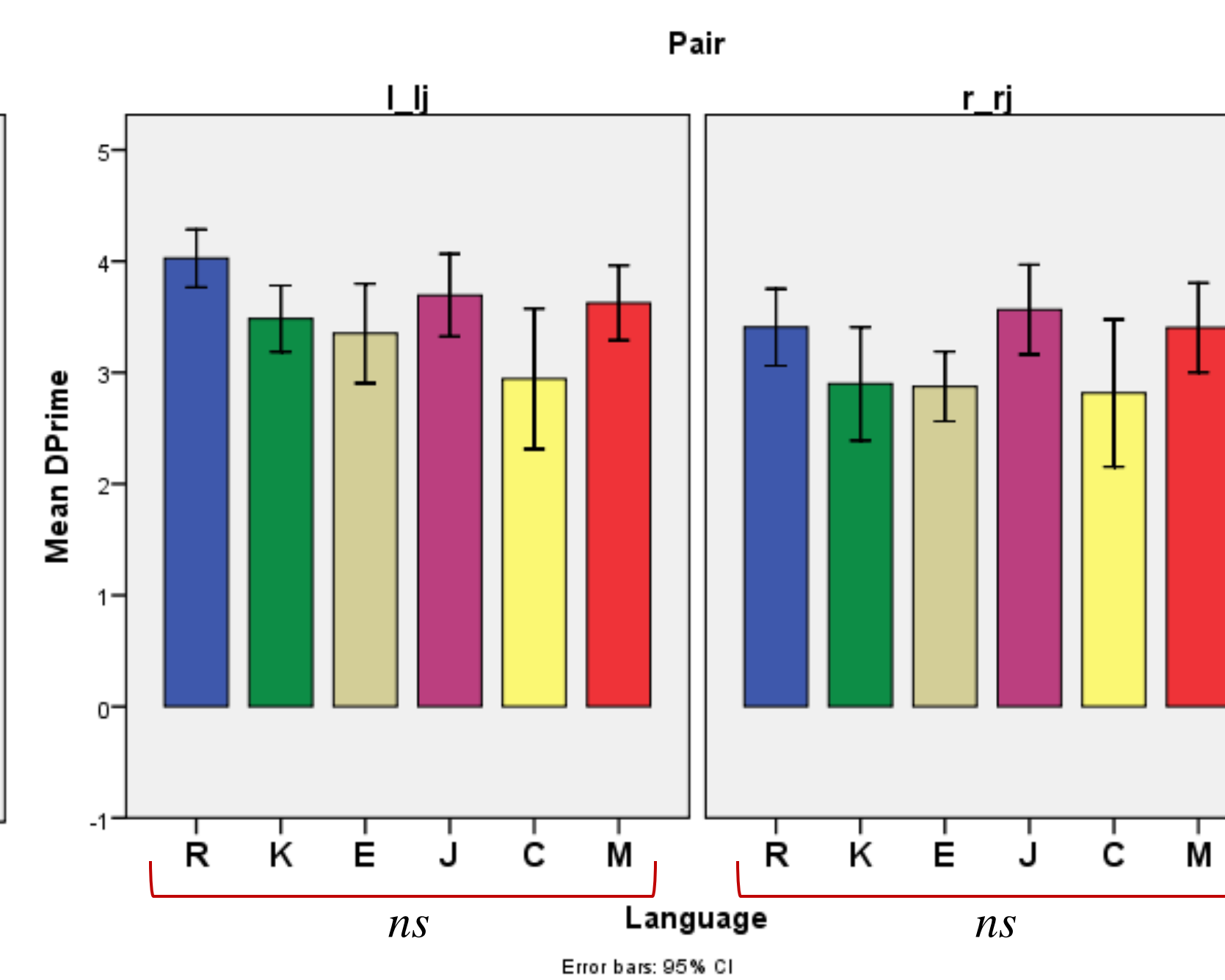
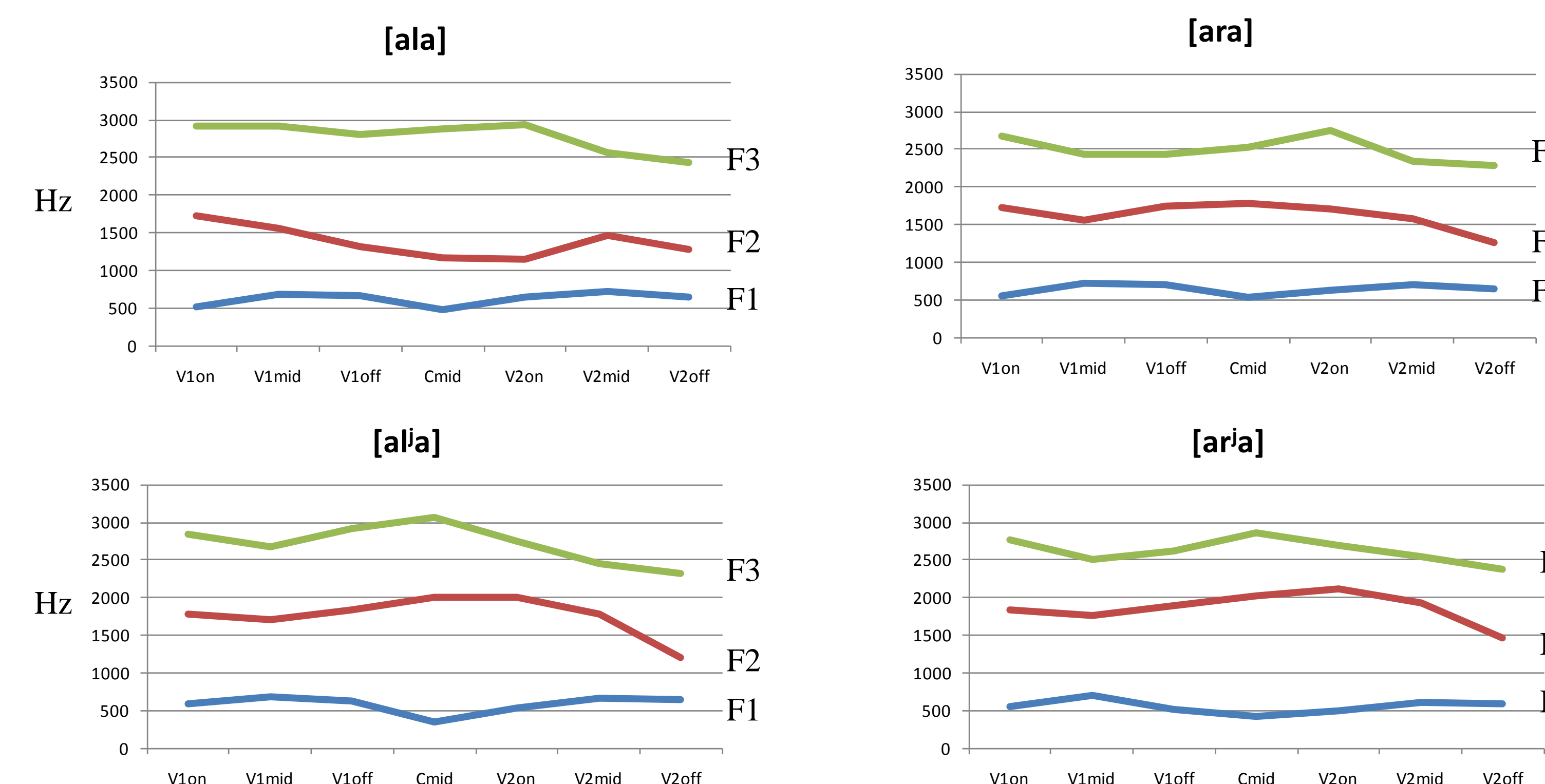


Fig. 3. Mean F1, F2, F3 values (in Hz) of the stimuli at 7 points throughout the VCV sequence



Discussion

- The results only partially confirm the predictions of the '*Strong Phonemic Hypothesis*':
- English listeners performed relatively well, while Japanese and Cantonese listeners performed relatively poorly with the Russian lateral/rhotic contrasts.
- Yet, Korean listeners did unexpectedly well, and Mandarin listeners did poorly with the same contrasts.
 - This perhaps can be attributed to the sensitivity of Korean listeners to relevant native allophonic (segment/sequence) differences and to the greater acoustic difference between Mandarin and Russian rhotics (see [7]).
- In addition, all language groups did unexpectedly well with the Russian plain-palatalized contrasts.
 - This can be explained by the relative acoustic salience of the contrasts (Fig. 3) and their similarity to consonant + glide or front vowel sequences in these languages.
- Overall acoustic differences (in F2 and F3) also explain the consistently better discrimination of the plain /l-r/ compared to the palatalized /li-ri/, and of the lateral /l-li/ compared to the rhotic /r-ri/ (Fig. 3).

Conclusion

- The results of the study suggest that presence or absence of similar native phonemic categories does not fully predict listeners' performance, underscoring the importance of sub-phonemic acoustic/gestural detail in non-native perception (cf. [4, 5, 6]).

Selected References

- [1] Flege, J.E. (1995). Second language speech learning: theory, findings and problems. In W. Strange (Ed.) *Speech perception and linguistic experience: Issues in cross-language speech research*, pp. 233-272. Timonium, MD: York.
- [2] Guion, S.G., Flege, J.E., Akahane-Yamada, R., & Pruitt, J.C. (2000). An investigation of current models of second language speech perception: The case of Japanese adults' perception of English consonants. *JASA*, 107(5), 2711-2724.
- [3] Iverson, P. & Kuhl, P.K. (1996). Influences of phonetic identification and category goodness on American listeners' perception of /r/ and /l/. *JASA*, 99(2), 1130-1135.
- [4] Best, C.T., & Strange, W. (1992). Effects of phonological and phonetic factors on cross-language perception of approximants. *JPhon*, 20, 305-330.
- [5] Best, C.T., McRoberts, G.W., & Goodell, E. (2001). Discrimination of non-native consonant contrasts varying in perceptual assimilation to the listener's native phonological system. *JASA*, 109(2), 775-794.
- [6] Harnsberger, J.D. (2000). A cross-language study of the identification of non-native nasal consonants varying in place of articulation. *JASA* 108, 764-783.
- [7] Smith, J. & Kochetov, A. (to appear). Categorization of non-native liquid contrasts by Cantonese, Japanese, Korean, and Mandarin listeners. *Toronto Working Papers in Linguistics*.
- [8] Macmillan, N.A., & Creelman, C.D. (2005). *Detection theory: A user's guide*. 2nd ed. Mahwah, NJ: Lawrence Erlbaum.

Acknowledgments

Thanks to Connie So for help with data collection. The research was supported by SSHRC grant 410-2006-1006 to the first author.