RELATION BETWEEN MUSICAL APTITUDE AND L2 STRESS PERCEPTION IN FRENCH- AND KOREAN-SPEAKING LISTENERS

Maria Teresa Martinez Garcia[1], Sandra Schwab[2]

[1]University of Utah Asia Campus, [2]University of Bern
[1] maria.martinezgarcia@utah.edu, [2] sandra.schwab@unibe.ch

ABSTRACT

Several factors could explain individual differences in the perception of non-native stress contrasts. This study investigates the effect of the native language (Spanish, French, Korean) and the impact of music aptitude on French and Korean listeners' performance at stress-detection in Spanish. The results showed an effect of L1, with Korean and French listeners showing poorer discrimination than native speakers. Moreover, only French (but not Korean) listeners showed a positive correlation between music aptitude and stress discrimination. These findings suggest the existence of a link between music and L2 stress discrimination in French, but not in Korean listeners. Individual differences and the high music aptitude of Korean listeners are discussed as potential explanations for the different results reported for the two groups of non-native listeners.

Keywords: music aptitude; L2 prosody; stress 'deafness'; Korean, French

1. INTRODUCTION

1.1. Stress 'deafness' hypothesis

Depending on the properties of their native language, some speakers can easily detect second language (L2) stress, while others cannot, known as the stress deafness hypothesis (e.g., [1][2][3]). According to this hypothesis, the degree of stress deafness is related to the stress properties of the L1, specifically to the nature of their lexical stress (free or fixed). The hypothesis claims that listeners of fixed-stress languages have more difficulties in perceiving stress contrasts in the L2 than listeners of free-stress languages, as they cannot encode stress information in their mental lexicon (e.g., [1][2][3]). Among other factors, the ability to discriminate L2 stress contrasts also depend on the cognitively complexity of the perceptual task that listeners have to perform. For example, listeners tend to perform better in AX than in ABX discrimination tasks ([2]). The present study investigates L2 stress perception with two cognitively different tasks (i.e., identification and Odd-One-Out tasks) in listeners with fixed-stress (Korean and French) while listening to a foreign/L2 language with free stress (i.e., Spanish), and explores the role of musical aptitude in this perception.

1.2. Spanish, Korean and French stress properties

The languages included in this study –Spanish, Korean, and French– differ in their accentual properties. Spanish is a free-stress language where lexical stress has a distinctive function ([4]), distinguishing segmentally identical words such as in *número* (/'numero/, engl. (the) *number*) and *numero* (/nu'mero/, engl. I *number*). French is a fixed-stress language in which primary stress is realized at the phrasal level, precisely on the last syllable of the Accentual Phrase (AP) ([5]). Consequently, stress has a demarcative function (i.e., it marks the right end of the accentual phrase; [5]). Moreover, both the realization of primary stress and the intonation contours are anchored on the final syllable of the accentual phrase, which leads to a "fusion" between accentual and intonational structures (i.e., the so-called "syncretism" between accentuation and intonation; [6]). Similarly, Korean is a fixed-stress language (i.e., [7]), which uses phrase-level prominence, also at the end of Accentual Phrase, cued primarily by f0 in marking phrasal boundaries. The Accentual Phrase in standard (Seoul) Korean is demarcated by a phrase final High tone, while the initial boundary of the prosodic domain could be either a High or a Low tone, depending on the initial segment of the utterance (e.g., [8][9]). While certain dialects of Korean (e.g., Chonnam or North Kyungsang) may have a vowel length distinction in the first syllable of certain words (e.g., *sa:.kwa 'apology'* vs. *sa.kwa 'apple'*) ([10][11][12]), Seoul Korean (the dialect studied) has lost this feature.

1.3. L2 stress perception and music aptitude

In most studies dealing with musical expertise and pitch detection (e.g., [13][14][15][16]), pitch variations did not convey a linguistic/semantic meaning (i.e., no distinctive function). In this study, we examine whether musical skills enhance the perception of f0 variations that convey linguistic meanings. In languages such as Spanish, f0 variations are involved in the realization of lexical stress. Then, a change in f0, coupled with changes in duration and

amplitude, implies a change in the position of the stressed syllable (e.g., [4]) and, hence, a change in meaning.

To our knowledge, only a few studies have examined the influence of musical expertise on the perception of lexical stress in L2 French listeners (e.g., [17][18][19][20]). Using different experimental tasks (sequence repetition, discrimination of stress contrasts, or identification of stressed syllables), they all showed that musical expertise was significantly related to French listeners' performance at perceiving stress contrasts in an L2 with unpredictable stress (i.e., Dutch, English, or Spanish). On the other hand, while musical notation has been shown to help Korean learners understand stress placement in English ([21]), no other study has investigated the possible link between musical aptitude and L2 stress recognition among Korean speakers.

Our main aim is to examine to what extent French and Korean listeners differ in their L2 stress detection, in comparison with native listeners. We hypothesize that, given the similarities the two languages, both groups would show similar patterns, performing lower than native listeners. Like [22], we used a stress identification task (not cognitively very demanding). Participants heard Spanish words and had to indicate whether they perceived stress on the first, second or third syllable. The second task was an Odd-One-Out task which was more memory demanding. Listeners heard trials of three Spanish words and had to indicate the word with a different stress pattern. Secondly, we aim to determine how music aptitude and L2 stress detection are related in French and Korean listeners. Because of the similar nature of stress in French and Korean, we predicted a similar relationship between music aptitude and L2 stress detection for both groups of listeners.

2. METHOD

2.1. Participants

Three groups completed the study. The first group included 20 Swiss French listeners (hereafter 'FR') recruited at the University of Neuchâtel, Switzerland (*mean age*: 22.1 years, *sd*: 2.15, *age range*: 21-26 years). They had no knowledge of Spanish or other Romance language. The second group included 20 Korean listeners (hereafter 'KR') recruited at the University of Utah *Asia Campus*, Korea (*mean age*: 21.9 years, *sd*: 2.7, *age range*: 19-29 years). At the time of the experiment, they had been enrolled in a basic course of Spanish for 3 weeks (4 hours per week). The third group included 41 native Spanish/Catalan listeners (hereafter 'ES') recruited at the University of Pompeu Fabra, Spain (*mean age*: 21.56 years, *sd*: 4.46, *age range*: 19-44 years).

All the FR and KR performed the identification task, the Odd-One-Out task, and the music aptitude tests, whereas 24 ES performed the identification task and the other 17 ES performed the Odd-One-Out task. ES did not perform the music aptitude test.

2.2. Identification

Participants completed a stress identification task where they heard 120 trisyllabic Spanish words (e.g., *numero*) and had to indicate which syllable was stressed (i.e., see [22]). The experiment was run using Praat software scripts for all participants [23]. Different voices and both declarative and interrogative intonations were included.

2.3. Odd-One-Out

Participants performed an Odd-One-Out task in which they heard 216 trials of three segmentally identical Spanish words (e.g., *numero*). Among them, two words presented the same stress pattern (e.g., stress on the penultimate syllable) and one (i.e., the odd) presented a different stress pattern (e.g., stress on the final syllable). Participants' task was to indicate which of the three words was the deviant word (i.e., 'odd-one-out'; see [22] for details). The experiment was run using Praat software scripts for FR and KR participants [23] and using DMDX for ES participants [24]. Different voices and type of intonation (declarative and interrogative) were included in the stimuli.

2.4. Music aptitude test

We adapted the Advanced Measures of Music Audiation test (i.e., AMMA) developed by [25]. Participants performed a discrimination task in which they heard 16 sequences of two melodies. They had to indicate whether the two melodies were the same or different. As in the original test, the differences between the two melodies were either tonal or rhythmic. The experiment was run using Praat software scripts for all participants [23].

2.5. Data analysis

For the music aptitude test, the percent correct for each participant was calculated. For the identification and Odd-One-Our tasks, the accuracy (in percentage) was calculated for each participant.

Statistical analyses were conducted using R (lme4 R package; [26]). Two analyses were conducted. First, two mixed-effects logistic regression models were run on the correct/incorrect responses ([27]) to

test the effect of L1 in the identification and Odd-One-Out tasks. In each model, the fixed part was 'L1' (ES, FR, KR) which was recoded into [0, 1] dummy variables. The variable 'trial number', centered on the mean (for R operational reasons the variable 'trial number' was first rescaled between 0 and 1), was included as a control variable. The random part of the model included random intercepts for participants and items. In each model, the significance of the main effect was assessed with likelihood ratio tests that compared the model with the main effect to a model without it. The estimates (β) are expressed in logit and were computed taking 'incorrect response' as the reference level for the dependent variable. Post-hoc analyses with Tukey correction for multiple comparisons were performed to obtain 2 by 2 comparisons. The figures in the results section show percentage of correct responses, although the models were run on raw data (correct/incorrect responses).

Second, correlation analyses were performed, separately for FR and KR, between the participants' music aptitude and their average accuracy (%) at the identification and Odd-One-Out tasks respectively. We did not run regression analyses with L1, task, music aptitude, and their interaction as predictors because of the limited number of data points and hence, low statistical power.

3. RESULTS

3.1. Effect of L1

Figure 1 shows the results for the ES, FR, and KR groups in the identification (left) and Odd-One-Out task (right). For the identification task, the effect of L1 was significant ($\chi2(2) = 109.02$, $p < .001$). As expected, post-hoc analyses revealed that ES presented a better performance than FR and KR, ($\beta = -2.83$, SE = 0.20, $z = -14.23$, $p < .001$; $\beta = -2.86$, SE = 0.20, $z = -14.03$, $p < .001$). As predicted, we observe no significant difference between FR and KR ($\beta = 0.03$, SE = 0.20, $z = -0.17$, $p = .98$).

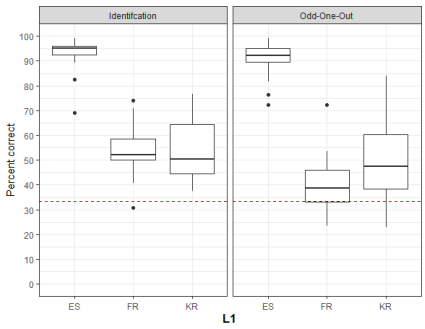

Figure 1: Percent correct by L1 (ES, FR, KR) in the identification (left) and the Odd-One-task (right).

Similar results were found for the Odd-One-Out task. The effect of L1 was significant ($\chi2(2) = 77.41$, $p < .001$). ES performed significantly better than FR and KR ($\beta = -3.30$, SE = 0.208 $z = -11.98$, $p < .001$; $\beta = -2.80$, SE = 0.28, $z = -9.94$, $p < .001$) whose performance did not significantly differ from each other ($\beta = 0.50$, SE = 0.26, $z = 1.92$, $p = .13$).

3.2. Relationship between music aptitude and stress detection accuracy

Figure 2 presents the relationship between music aptitude and accuracy for FR (top panels) and KR (bottom panels) in the identification task (left) and Odd-Out-Out tasks (right). For FR participants, results showed a marginally significant correlation for the Odd-One-Out task ($r = .44$, $p = .051$), but no signification correlation for the identification task ($r = .36$, $p = .12$). The better the French-speaking listeners' music aptitude, the better their Odd-One-Out performance. Although there seems to be an outlier in the Odd-One-Out task for the FR group (i.e., a participant who scored extremely low in the music test), the marginal correlation does not disappear when excluding this participant.

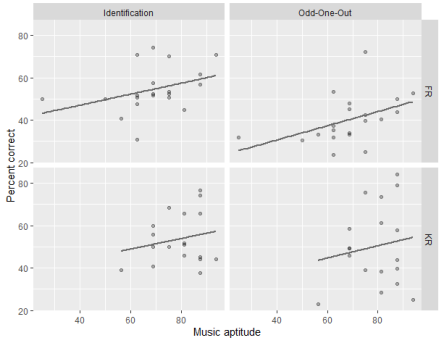

Figure 2: Percent correct by music aptitude for FR (top) and KR (bottom) in the identification (left) and Odd-Out-Out task (right).

For KR participants, the relationship between music aptitude and accuracy was not significant in neither the identification task ($r = .20$, $p = .42$) nor the Odd-One-Out task ($r = .15$, $p = .55$).

4. DISCUSSION

4.1. L2 stress perception in non-native listeners

The first goal was to examine the non-native stress detection performance of two groups of native listeners of a predictable stress language (i.e., French, Korean), who supposedly have difficulties in detecting stress contrasts in L2 Spanish. Their performance was compared with the performance of native listeners of Spanish. Results showed that, as expected, both French and Korean listeners showed

lower performance than native listeners in both tasks. According to our predictions, Korean listeners performed as poorly as French-speaking participants. The former, however, presented a higher degree of variability in their results. Two aspects should be considered to understand this variability difference. First, their knowledge of Spanish was different. French participants had no knowledge of Spanish (i.e., all were *ab initio* learners). However, Korean participants had been enrolled in a Spanish course for three weeks, which could generate interindividual perceptual differences. Second, the groups also differed in their Proficiency in English. While Korean's English (subjective) proficiency ranged from beginner to native-like, most French participants (i.e., 15/20) estimated their English proficiency as advanced. Spearman correlation analyses showed a significant relationship between the listeners' proficiency and their performance in the tasks for Korean participants ($rs(16) = .47$, $p = .05$; $rs(16) = .48$, $p = .04$), but not for French-speaking listeners ($rs(18) = .29$, $p = .22$; $rs(18) = .04$, $p = .86$). In sum, although Korean participants performed as poorly as French-speaking listeners, their stress detection performance in Spanish could have been related to their proficiency in English. Therefore, English (or other L2) proficiency constitutes a factor that needs to be either controlled or entered as a possible predictor of L2 stress detection performance, while studying the acquisition of L2 stress contrasts.

4.2. L2 stress perception and music aptitude

The second goal was to determine whether there was a relationship between the non-native listeners' music aptitude and their performance at detecting stress in a foreign language. Regarding the French group, we found that listeners with high musical aptitude tended to show better performance at discriminating stress contrasts in Spanish, but not at identifying the stressed syllable (i.e., the relationship was marginally significant in the Odd-One-Out, but not significant in the identification task). This finding, in line with previous research ([20]), suggests that similar perceptual mechanisms might be called in the discrimination of musical melodies (i.e., music test) and in the discrimination of non-native stress contrasts (i.e., in the Odd-One-Out task).

As for Korean listeners, no significant relationship between musical aptitude and L2 stress detection performance was found for either task, in disagreement with our expectations. One explanation is the fact that most of the Korean participants performed well in the music test (i.e., only one participant had a performance lower than 68%). Consequently, music aptitude, being high and relatively constant among Korean listeners, is not related to L2 stress detection. Korean students have mandatory music training during their education until the age of 18, which makes them be well trained in music. Their theoretical and practical music training could have had an input on how they perceived melodies in the music test performed in this study. Moreover, there is anecdotal evidence that the majority of Koreans have Karaoke as one of their hobbies and spend a couple of hours a week in Karaoke places (94% of 20-year-old Koreans spend at least 1.5 hours a week in a Karaoke, [28]).

Thus, possible explanations for the divergence between French and Korean results regarding musical aptitude could be either related to the lack of variability in the Korean data or task-dependent. On the one hand, all the Korean listeners performed well in the musical aptitude test, which could hinder any potential correlation between musical aptitude and stress perception. To confirm this hypothesis, it would be necessary to test Korean listeners without musical training or to find a more fine-tuned task, such as the PROMS tests proposed [29] to evaluate musical aptitude among individuals who are already trained in music.

On the other hand, a (marginal) correlation was found for French listeners in the Odd-Out-One task, not in the identification task. To rule out task-dependent results, other tests should be used to evaluate musical aptitude (e.g., PROMS tests, [29]). If the link between music aptitude and non-native stress perception is not task-dependent, a correlation should be found with different types of tasks.

.

5. CONCLUSION

Our findings support the hypothesis that the stress properties of the native language influence the perception of stress contrasts in a foreign language, shown by how the accentual similarities between French and Korean made them pattern similarly to each other. Two factors were found to explain the interindividual variability observed in non-native stress detection ability: musical aptitude and proficiency in a foreign language (i.e., English in this case). While these two factors correlated with the non-native stress perception performance, further studies should deeper explore their contribution in the perception of non-native contrasts by either examining other language combinations or using a wider range of experimental tasks.

6. REFERENCES

[1] Dupoux, E. Sebastian-Gallés, N. Navarette, E., Peperkamp, S. 2008. Persistent stress 'deafness': The

case of French learners of Spanish. *Cognition, 106*, 682-706.
[2] Dupoux, E., Pallier, C., Sebastian-Gallés, N., Mehler, J. 1997. A destressing 'deafness0 in French ? *Journal of Memory and Language, 36*, 406-421.
[3] Dupoux, E., Peperkamp, S., Sebastian-Gallés, N. 2001. A robust method to study stress 'deafness '. *Journal of the acoustical Society of America, 110*, 1606-1618.
[4] Quilis, A. 1981. *Fonética acústica de la lengua española*, Madrid, Gredos.
[5] Lacheret-Dujour, A., & Beaugendre, F. (1999). *La prosodie du français* (French prosody) (CNRS éditions, Paris), pp. 1-354.
[6] Rossi, M. (1979). Le français, langue sans accent (French, language without stress), *Studia Phonetica, 15*, 13-52.
[7] Lee, G. (2015). Production and Perception of Korean and English Prominence by Korean Speakers. Unpublished doctoral dissertation. Kansas University.
[8] Jun, S.-A., 1993. The Phonetics and Phonology of Korean Prosody. Ph.D. dissertation. Ohio State University.
[9] Jun, S.-A., 1998. The accentual phrase in the Korean prosodic hierarchy. *Phonology, 15*(2), 189–226.
[10] Heo, W., 1965. Kwuke Umwoonhak [Korean Phonology]. Cengumsa, Seoul.
[11] Kenstowicz, M., Park, C., 2006. Laryngeal features and tone in Kyungsang Korean: a phonetic study. *Stud. Phon. Phonol. Morphol. 12* (2), 247–264.
[12] Ko, E.-S., 2013. A metrical theory of Korean word prosody. *Ling. Rev. 30*(1), 79–115.
[13] Magne, C., Schön, D., Besson, M. 2006. Musician children detect pitch violations in both music and language better than nonmusician children: Behavioral and electrophysiological approaches. *Journal of Cognitive Neuroscience, 18*, 199–211.
[14] Marques, C., Moreno, S., Castro, S. L. Besson, M. 2007. Musicians detect pitch violation in a foreign language better than non-musicians: behavioural and electrophysiological evidence. *Journal of Cognitive Neuroscience, 19*, 1453-1463.
[15] Micheyl, C., Delhommeau, K., Perrot, X. et al. 2006. Influence of musical and psychoacoustical training on pitch discrimination. *Hearing Research, 219*, 36-47.
[16] Schön, D., Magne, C., Besson, M. 2004. The music of speech: Music training facilitates pitch processing in both music and language. *Psychophysiology, 41*, 341–349.
[17] Degrave, P. 2017.Can music help learners and teachers in word stress perception? *Travaux du Cercle Belge de Linguistique, 11*, 1-20.
[18] Kolinsky, R., Cuvelier, H., Goetry, V., Peretz, I., Morais, J. 2009. Music training facilitates lexical stress processing. *Music Perception, 26*(3), 235-246.
[19] Schwab, S., Calpini. N. 2018. Expertise musicale et perception de variations de f0 en L1 et en L2. *Revue Française de Linguistique appliquée, 23*, 15-30
[20] Schwab, S. & Dellwo, V. (2019). *Music and L2 prosody: the role of musical aptitude on the discrimination of stress contrasts.* In: Calhoun, S., Escudero, P., Tabain, M., Warren, P. (eds.) Proceedings of the 19th International Congress of Phonetic Sciences, Melbourne, Australia 2019 (pp. 1927-1931). Canberra, Australia: Australasian Speech Science and Technology Association Inc.
[21] Kim, K. 2019. The efficacy of lexical stress diacritics in the English comprehensibility and accentedness of Korean speakers. Ph.D. dissertation. University of Victoria.
[22] Schwab, S. & Dellwo, V. (2021) Explicit versus non-explicit prosodic training in the learning of Spanish L2 stress contrasts by French listeners. *Journal of Second Language Studies*.
[23] Boersma, P., Weenink, D. 2011. Praat: Doing phonetics by computer. [Computer Software]. Consulté sur: http://www.praat.org.
[24] Forster, J. C., DMDX updates page. Online: http://www.u.arizona.edu/~jforster/dmdx.htm
[25] Gordon, E. 1989. *Advanced measures of music audition.* Chicago, GIA Publications.
[26] Bates, D., Mächler, M., Bolker, B., & Walker, S. 2015. Fitting linear mixed-effects models using lme4. *Journal of Statistical Software, 67*(1), 1–48.
[27] Baayen, R. H., Davidson, D. J., & Bates, D. M. 2008. Mixed effects modeling with crossed random effects for subjects and items, *J. Memory Lang., 59*, 390-412.
[28] KB Bank (2019). 노래방 현황 및 시장여건 분석.Analysis of karaoke status and market conditions (KB Self-Employment Analysis Report) Retrived from: https://eiec.kdi.re.kr/policy/domesticView.do?ac=0000148861
[29] Law, L., & Zentner, M. (2012). *Assessing Musical Abilities Objectively: Construction and Validation of the Profile of Music Perception Skills.* PLoS ONE 7(12): e52508. doi:10.1371/journal.pone.0052508