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The Perception of American English Vowels by Salento Italian Adult Listeners: Longitudinal Development in the Classroom Context

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Abstract

The present study investigates whether phonetic lessons enable improvement of adult L2 perception and whether 2) L2 perceptual learning in the classroom setting can be explained by the Second Language Linguistic Perception (L2LP) model (Escudero, 2005). Salento Italian (SI) listeners' initial state of perception of American English (AE) vowels was examined. SI listeners performed cross-language assimilation and discrimination tasks on AE vowels before attending a phonetic course (pre-test), at the end of the phonetic course and three months later (post-tests). Their perceptual assimilation of AE phonemes did not change across the test sessions, while their discrimination of the same AE vowels improved for two of the nine contrasts in both post-test sessions, approximating native discrimination, but worsened for two other contrasts. It is argued that both results can be explained in terms of the L2LP model.

Adult second language (L2) perception seems to be influenced by the similarities and differences between the native language (L1) and the L2 phoneme inventories. Recent theories—the Speech Learning Model (SLM; Flege, 1995), the Perceptual Assimilation Model (PAM; Best, 1995) and the Second Language Speech Perception (L2LP; Escudero, 2005)—argued that the way of foreign sounds are perceptually related to native phonemes determines how they are eventually acquired. The SLM addresses ultimate attainment of L2 production, whereas the PAM examines naïve listeners, i.e., functional monolinguals not actively learning or using an L2, but has recently been extended to explain L2 development (PAM-L2; Best & Tyler, 2007), and the L2LP model aims at capturing the entire developmental process of L2 speech perception (Mayr & Escudero, 2010).

Both the L2LP and the PAM-L2 assume that the way listeners assimilate L2 contrasts to native categories predict how the contrasts will be discriminated. If a contrast is assimilated to a single native category (*single category assimilation* in PAM terms and *new scenario* in L2LP terms), listeners will have difficulty to discriminate and learn it, while if it is assimilated to two different native categories (*two category assimilation* in PAM terms and *similar scenario* in L2LP terms), discrimination will be easier. These two perceptual models, however, differ in that the former states that L2 assimilation is determined by the acoustic properties of the native languages while the latter by the articulatory gestures.

Further, the PAM-L2 predicts development in perceptual assimilation patterns and non-native discrimination, while the L2LP predicts development in L2 perception tasks but not for cross-language/non-native tasks, i.e., where listeners perform tasks in their native language mode. For L2 development, the L2LP model predicts that learners who hear an L2 contrast as one single L1 category have to create a new L2 category or split the single native category, while learners who hear a non-native contrast as different L1 categories need to reuse them or shift their perceptual boundaries to match that of the L2. The tasks of creating L2 categories or splitting native categories are more difficult than those of reusing or shifting native categories.

The L2LP and PAM-L2 models make predictions for L2 development in a naturalistic context (SLA). As observed by Piske (2007), both differences and similarities exist between immigrant L2 learners in a foreign country and students in a foreign language classroom (FLA). Generally, FLA represents a more impoverished context than SLA (Best & Tyler, 2007) because L2 learning in SLA acquisition commonly takes place through conversational experience with communicative goals, whereas in FLA, it occurs through formal instruction of grammar and vocabulary (Best & Tyler, 2007).

In the present study, we focus on how phonetic instruction influences L2 perceptual development in an FLA context. Most studies on explicit phonetic instruction have focused on improvement in L2 production (Suter, 1976; Yule & Macdonald, 1995, Elliott, 1995; Derwing, 2008; Bongaerts, van Summeren, Planken, & Schils, 1997; Couper, 2003; Mildner & Tomic, 2007). Studies that showed improvement in L2 perception have mostly used training sessions (Logan, Lively, Pisoni, 1991; Bradlow, Pisoni, Akahane-Yamada, & Tohkura, 1997; Nishi & Kewley-Port, 2007). Very few studies have focused on the effect of formal phonetic instruction on L2 perception (Mora & Fullana, 2007; Fullana & Mora, 2007). We investigate whether phonetic instruction in the form of pronunciation lessons lead to L2 perceptual development.

We examined how Salento Italian (SI) listeners, whose native language (spoken in southern Apulia) has five vowels /i, e, a, o, u/, learned the 10 American English (AE) monophthongs, i.e., /iː, ɪ, ɛ, æ, ʌ, ɑː, ɝː, ɔː, ʊ, uː/ in a classroom setting. We chose these learners because many previous studies have shown that listeners with a five-vowel inventory, e.g., Spanish or Salento Italian, have large difficulty perceiving English vowel contrasts, since many of them are not present in their native language (Escudero & Chládková, 2010; Sisinni, Escudero & Grimaldi, 2013).

Figure 1 shows the average F1 and F2 formants of the five SI vowels and the 36 AE stimuli that were used in the two perceptual tasks of the present study. The SI vowels were produced by the 8 female native speakers who performed the perception tasks, while the AE vowels were produced by three female native speakers[1].

[1] Vowels were produced in real words with the same shape and formants were measured in the 25ms central window. The AE stimuli values compare well with those reported in previous literature, except for /æ/, which has higher F1 and lower F2 values than in Hillenbrand et al. (1995), and /uː/, with higher F2 than in Peterson and Barney (1952) and Hillenbrand et al. (1995).

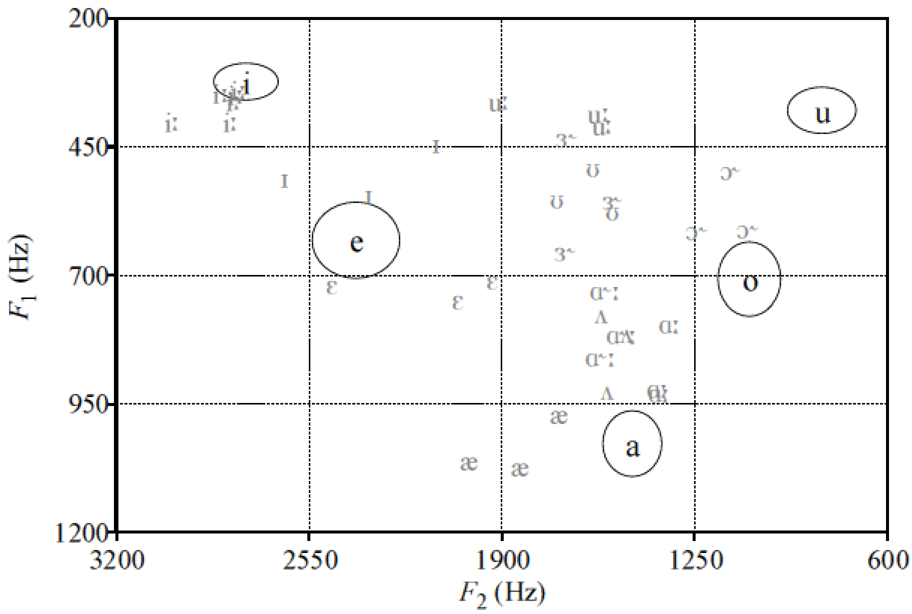

Figure 1. Average F1 and F2 values of SI (black) and AE vowels produced by female speakers. The ellipses represent one standard deviation from the mean.

On the basis of F1-F2-F3 acoustic comparisons, AE /iː, ɛ, æ-ɑː-ɑ˞ː, ɔ˞ː, uː/ will be identified as the acoustically closest SI counterparts, /i, e, a, o, u/. The AE vowels /ɪ, ʌ, ɝː, ʊ/ will be classified as /i-e/, /a/, /e/ and /u-o/, respectively. Based on the acoustic comparison shown before, the following AE contrasts are likely to be difficult to discriminate for SI listeners: /iː-ɪ/, /ɛ-ɝː/, /æ-ɑː/, /æ-ʌ/, /ɑː-ʌ/, and /uː-ʊ/. Conversely, contrasts such as /ɛ-æ/, /ɑ˞ː-ɔ˞ː/, and /iː-uː/ will be very easy. We used /iː-uː/ as a control contrast since it is likely to be the easiest to discriminate.

We first tested how SI listeners assimilate and discriminate AE vowels and examined the effect of phonetic lessons on this performance. It was predicted that if phonetic lessons influence SI listeners' non-native vowel perception, the way they assimilate and discriminate AE vowels will change across the three test sessions, namely, before, immediately after and two months after the phonetic lessons. Additionally, we examined whether SI listeners' perceptual assimilation patterns predicted their discrimination of AE vowel contrasts. We discuss the results of the perceptual tasks in terms of the L2LP model.

METHOD

Participants

Eight SI and 10 AE female listeners participated in the study. The SI participants were young (mean age = 19.1 years) monolinguals from Salento, the southern part of the Apulia region. They were raised by monolingual Italian parents, started studying English as a foreign language at school at the mean age of 11 years and had never been to a foreign country for a period superior to a month. At time of testing, they were first year students at the University of Salento. The 10 AE listeners constituted the control group. They were young (mean age = 21.3) participants coming from USA. They performed the discrimination task to help determine the SI listeners' level of difficulty with AE vowel contrasts and to validate the stimuli.

Longitudinal Design

Participants attended an L2 phonetic course which consisted of 7 weekly lessons of 3 hours each. The lessons were designed using a multimodal methodology (Elliot, 1995), which has been shown to be effective because it includes variable types of tasks and input for a wider targeting of learners' particular learning styles and needs (Elliot, 1995). Prior to the phonetic course, SI listeners performed identification perceptual assimilation and a discrimination tasks (a pre-test session, in November 2007). Listeners were tested using the same tasks in two other sessions: one immediately after the last lesson of the phonetic course (post-test on January 2008) and another two months later (2nd post-test on April 2008). The third test session was included to measure the longitudinal effect of the phonetic instruction as well as its long-lasting effect (Derwing, 2008).

Stimuli

The AE stimuli for both tasks were real words produced by three native female speakers of AE (mean age = 47 years), who were born and raised in the US. They were English lecturers at the University of Salento at the time of recordings and had lived in Italy for a mean of 22.6 years. Words containing 10 AE vowels monophthongs, i.e., /iː, ɪ, ɛ, æ, ʌ, ɑː- ɑ˞ː, ɜ˞ː, ɔ˞ː, ʊ, uː/, were recorded. The shape of the words was /pVt/, where V was one of the AE vowels /iː, ɪ, ɛ, æ, ʌ, ɑː- ɑ˞ː, ɜ˞ː, ɔ˞ː/. Given that the contrasts /iː-uː/ and

/uː-ʊ/ were part of the discrimination task, /iː, ʊ, uː/ needed to be recorded in the further consonant context /sVt/. Each word was embedded in the carrier phrase "I say___now" repeated six times. For each vowel, the first author chose the best item which was edited and normalized in peak amplitude by means of Praat 4.6.29 (Boersma & Weenik, 2010), for a total of 36 tokens (12 vowels + /i/ in an extra context x 3 AE speakers).

Figure 1 shows the F1 and F2 formants of the 36 AE stimuli used in the two perceptual tasks. Segmentation and formant analysis of SI and AE productions were conducted with Praat. The vowel start (voicing onset) and end (beginning of the subsequent consonant) were manually labeled and the F1 and F2 values were measured over a 25-ms Gaussian window placed around the vowel mid-point. All tokens were visually inspected to manually correct for software mistakes when extracting formant values.

Tasks

In each test session, listeners performed the same two perceptual tasks reported in Sisinni et al. (2013), namely a perceptual assimilation and a discrimination tasks. In the former, the 36 AE vowels were randomly presented one at time and listeners had to identify the incoming stimulus with one of the five SI vowels on a computer screen. A total of 864 judgments (8 SI X 36 stimuli X 3 repetitions) were collected in each test session. Subsequently, they performed separate discrimination tasks for the nine AE contrasts /iː-ɪ/, /ɛ-ɝː/, /ɛ-æ/, /æ-ɑː/, /æ-ʌ/, /ɑː-ʌ/, /ɑ˞ː-ɔ˞ː/, /uː-ʊ/ and /iː-uː/, which were predicted to lead to different degrees of difficulty based on the perceptual assimilation results. For each contrast, 8 *change* (e.g., /iː-iː-uː/) and 8 *catch trials* (e.g., /iː-iː-iː/) were randomly presented, each trial containing three stimuli produced by a different AE native speaker so that listeners had to ignore the phonetic differences between tokens and concentrate on vowels category differences. Listeners were asked to decide which of the three stimuli was different from the others, i.e., the *odd item*, by clicking on its corresponding number within the trial ("1", "2", or "3"). They could also click on "none" if they did not hear any odd stimulus, which would be the correct response for catch trials. The interval between the three stimuli in a trial was 300 ms. Despite this short interval, the inclusion of catch trials and the production of the three stimuli by different speakers would ensure a categorical perception of the vowel tokens through the activation of a phonetic mode (Strange & Shafer, 2008). Importantly, the differences in discrimination accuracy between AE and SI listeners (see Table 2) confirm the language-specific and categorical nature of the task.

The two tasks were administered in the listeners' native language by a SI native speaker. Listeners were tested individually in a soundproof room listening to the stimuli at a comfortable volume level through headphones. For both tasks, they were told to guess if unsure and could replay a stimulus or a trial as much as needed. They were given a short practice of 10 trials which were not analyzed.

Phonetic Instruction

SI learners received a phonetic course that consisted of weekly lessons given by a bilingual speaker of AE and SI, who provided explicit instructions about the articulation of AE vowel phonemes, taught the International Phonetic Alphabet (IPA) for SI and AE vowels, and showed how phonetic symbols compared to spelling in both languages. During the lessons, students had to identify each AE vowel produced by the instructor with the correct phonetic symbol and produce it. Each student produced all AE phonemes individually and was immediately corrected if necessary, in order to avoid the fossilization of erroneous forms. The AE stimuli consisted of real words, drills, tongue twisters and real sentences. The phonetic lessons were divided in two parts. In the first part, lessons included only a subset of AE vowels, those assimilated to the same native phoneme/s in the pre-test (see Results), while lessons in the second part included all the 10 AE vowels.

RESULTS

Perceptual Assimilation Results

The categorization results of the pre-test are reported in Table 1. In line with the acoustic comparisons, AE vowels /iː, ɛ, ɑ̤ː -ɑ˞ː, ɔ˞ː, uː/ were consistently classified (i.e., > 70%) with SI counterparts /i, e, a, o, u/. Contrary to the predictions, AE /ɜ˞ː/ was assimilated only to SI /e/; AE /ɪ/ was perceived only as SI /i/ and not as /e/, in spite of their acoustic proximity; AE /æ/ was assimilated both to SI /e-a/, and AE /ʌ, ʊ/ mainly, respectively, to SI /a, u/. However, categorization of AE /ɪ/ as SI /i/ and AE /æ/ as /a-e/ can be explained by taking formant movements into account, i.e., by measuring parts of the vowel other than the steady-state (Escudero & Vasiliev, 2011). Finally, categorization of AE /ʌ/ as SI /a/ seems to suggest that listeners may use one cue, e.g., F2, more than the other when classifying foreign vowels (Escudero & Chládková, 2010). A series of repeated measure Analysis of Variance (ANOVA) was conducted for each AE phoneme on the percentage of assimilation for each AE vowel with test session as within-subject variable (one single assimilation > 70% or the first two assimilations) to see if the way SI listeners categorized the AE vowels changed across the test sessions.

In spite of the pronunciation lessons, subjects did not modify the way of categorization of AE vowels since no significant differences were found [F-values = 0.22 to 3.24 p > 0.05]. This result is in line with the L2LP prediction that cross-language categorization should not change with L2 experience (Escudero, 2005; Mayr & Escudero, 2010).

Table 1. Perceptual Assimilation (in Percentages) of AE Vowels to SI Vowels in the Pre-Test

	AE Vowels										
SI	/iː/	/ɪ/	/ɛ/	/æ/	/ɑː/	/ɑ˞ː/	/ʌ/	/ɜ˞ː/	/ɔ˞ː/	/ʊ/	/uː/
/i/	100	97									
/e/		3	99	46			4	75			
/a/				54	94	93	71	8			
/o/					6	7	15	8	100	26	
/u/							10	8		71	100

Discrimination Results

A-prime (A') scores were computed on the proportion of "hits", i.e., correct selection of the odd item in change trials, and "false alarms", i.e., incorrect selection of an odd item in catch trials (Sundara et al., 2006): a score of 1.0 indicates correct responses in all 16 trials, while 0.5 score indicates chance level. Table 2 shows that the 10 AE listeners discriminated all 9 vowel contrasts with an very high accuracy (> .95 except for one contrast only > .80) and this confirms that the stimuli used are good examples of AE vowels.

Table 2. A' Scores for SI Listeners in the Pre-Test (Pre), Post-Test (Post1) and 2nd Post-Test (Post2), and for 10 Native American English (AE) Listeners

	ɑː-ʌ	iː-ɪ	ɛ-æ	æ-ɑː	uː-ʊ	ɛ-ɜ˞ː	æ-ʌ	ɑ˞ː-ɔ˞ː	iː-uː
Pre	0.31 (0.22)	0.62 (0.22)	0.60 (0.28)	0.64 (0.27)	0.79 (0.14)	0.76 (0.19)	0.81 (0.15)	0.90 (0.06)	0.95 (0.05)
Post1	0.36 (0.18)	0.32 (0.22)	0.65 (0.31)	0.82 (0.27)	0.74 (0.18)	0.85 (0.16)	0.76 (0.23)	0.96 (0.05)	0.86 (0.06)
Post2	0.48 (0.23)	0.37 (0.26)	0.85 (0.12)	0.95 (0.02)	0.79 (0.15)	0.94 (0.06)	0.93 (0.03)	0.98 (0.02)	0.90 (0.03)
AE	0.80 (0.18)	0.99 (0.03)	0.99 (0.02)	0.95 (0.05)	0.99 (0.02)	0.99 (0.04)	0.99 (0.01)	0.99 (0.01)	0.99 (0.02)

Note. Standard deviations appear in parentheses

A repeated measures ANOVA with contrast as the within-subject variable and group as between–subjects factor yielded main effects of contrast [$F(8,128) = 17.289$ $p < .001$] and group [$F(1,16)= 60.124$ $p < .001$], as well as an interaction group * contrast [$F(8,128) = 6.015$ $p < .001$]. No significant difference between contrasts was found after Bonferroni correction for the AE native listeners. Conversely, SI listeners had the lowest accuracy for /ɑː-ʌ/ and /ɛ-æ/, followed by /iː-ɪ/, /ɛ-ɜ˞ː/, then /æ-ɑː/, /uː-ʊ/, with /ɑ˞ː-ɔ˞ː/, /æ-ʌ/ and /iː-uː/ showing the highest accuracy. These results have been largely predicted by the acoustic comparison except for /ɛ-æ/ and /æ-ʌ/ which were poorly and well discriminated, respectively. We further examined the interaction with nine independent samples t-tests, single-tailed and corrected for multiple comparisons ($\alpha = 0.05/9 = 0.0056$). These tests showed that AE listeners had significantly higher scores than SI listeners for all the contrast except for /iː-uː/.

For SI listeners, a repeated measures ANOVA with session and contrast as within-subject variables revealed a main effect of contrast [$F(8,40) = 22.498$ $p < .001$] and an interaction session * contrast [$F(16,80) = 2.724$ $p = .002$], but no main effect of session. To explore the interaction, we conducted repeated measures ANOVA for each contrast with test session as the within-subject variable. After Bonferroni correction, /ɑ˞ː-ɔ˞ː/ showed an improvement from pre-test to 2nd post-test ($p = 0.049$), while /iː-ɪ/ and /iː-uː/ showed lower performance from pre-test to post-test ($p = 0.018$) and from pre-test to both post-tests (ps = 0.015 and 0.004), respectively.

To test whether or not SI listeners approximated native AE listeners in either of the two post-tests, we conducted two separate ANOVA as the one conducted above for the pre-test accuracy scores. In both analyses, we found similar main effects of group [post-test: $F(1,16) = 49.168$ $p < .001$; 2nd post-test: $F(1,14) = 88.014$ $p < .001$] and contrast [post-test: $F(8,128) = 19.108$ $p = .000$; 2nd post-test: $F(8,112) = 31.660$ $p < .001$] as well as an interaction group * contrast [post-test: $F(8,128) = 10.521$ $p < .001$; 2nd post-test: $F(8,112) = 19.301$ $p < .001$]. After Bonferroni correction, AE listeners had significantly higher scores than SI in all contrasts but for /ɑ˞ː-ɔ˞ː/ and /æ-ɑː/ in both post test sessions. This suggests that although no improvement across sessions was found, SI listeners seemed to approximate native performance in the two post-test sessions for these two contrasts.

DISCUSSION AND CONCLUSIONS

Perceptual assimilation and discrimination results were mostly predicted by the acoustic comparisons between SI and AE vowels. Discrimination was predicted by perceptual assimilation patterns in almost all cases since /ɑː-ʌ/, /iː-ɪ/, /ɛ-ɜ˞ː/ were more difficult than /ɑ˞ː-ɔ˞ː/ and /iː-uː/, and /æ-ɑː/ and /uː-ʊ/ were more difficult than /iː-uː/.

As for the effect of the phonetic lessons, the perceptual assimilation patterns did not change longitudinally. This is in line with previous studies showing that native language perception, as measured in a perceptual assimilation task, is not affected by L2 learning since learners perform perception task in their native language, as was the case in the present study (Escudero 2005, Escudero & Boersma 2002, Mayr & Escudero, 2011). Conversely, discrimination accuracy improved longitudinally for one contrast, i.e., /ɑ˞ː-ɔ˞ː/, but worsened for two, i.e., /iː-ɪ/ and /iː-uː/. However, when comparing SI to native AE discrimination accuracy, while they differ in most contrasts but /iː-uː/ in the pre-test, no significant group difference was found for two contrasts /ɑ˞ː-ɔ˞ː/ and /æ-ɑː/ in the two post-test sessions. The fact that improvement for /æ-ɑː/ did not emerge in the within group analysis might be due to the small number of SI learners and their large individual variation.

In terms of L2LP predictions, the positive effect for the *similar scenario* contrasts /ɑ˞ː-ɔ˞ː/ and /æ-ɑː/ seems to extend the validity of an important prediction to the classroom context. Specifically, in FLA, it is also easier to reuse existing categories through adjusting their boundaries rather than creating a new category or splitting a native one to accommodate new contrasts, as was proposed in Escudero (2005) and evidenced in many studies (e.g., Escudero & Boersma, 2002; Escudero & Vasilev, 2011).

The positive effect observed for /ɑ˞ː-ɔ˞ː/ and /æ-ɑː/ both in the post- and 2nd post-test might also indicate that the phonetic lessons had a long-lasting effect (Derwing, 2008). However, improvement for only two contrasts suggests that the phonetic course may have not been effective. Other studies based on perception training, using synthetic stimuli and focused tasks, have shown more positive effects (e.g., Logan et al., 1991; Nishi & Kewley-Port, 2007), even in a very short time, i.e., 2 minutes (Escudero, Benders & Wanrooji, 2011). The present study thus shows that formal phonetic lessons based on the use of the IPA and drilling may not be as effective as perceptual training sessions.

REFERENCES

Best, C. T., & Tyler, M. D. (2007). Nonnative and second-language speech perception: Commonalities and complementarities. In O. S. Bohn & M. J. Munro (Eds.), *Second Language speech learning: the role of language experience in speech perception and production* (pp. 13–34). Amsterdam, John Benjamins.

Best, C. T. (1995). A direct realist view of cross-language speech perception. In W. Strange (Ed.), *Speech Perception and linguistic experience: Issues in cross-language research* (pp. 171-204). Timonium, MD: York Press.

Boersma, P., & Weenink, D. (2007). PRAAT: Doing phonetics by computer (Version 4.6.29), [Computer program], retrieved October 2007. Online: http://www.praat-org/ (University of Amsterdam, Amsterdam) 1992-2010.

Bongaerts, T., van Summeren, C., Planken, B., & Schils, E. (1997). Age and ultimate attainment in the pronunciation of foreign language. *Studies in Second Language Acquisition*, *19*, 447-465.

Bradlow, A.R., Pisoni, D.B., Akahane-Yamada, R., & Tohkura, Y., 1997. Training Japanese listeners to identify English /r/ and /l/: IV. Some effects of perceptual learning on speech production. *Journal of the Acoustical Society of America*, *101* (4), 2299–2310.

Couper, G. (2003). The value of an explicit pronunciation syllabus in ESOL teaching. *Prospect*, *18*(3), 53-70.

Derwing, T. M, (2008), Curriculum issues in teaching pronunciation to second language learners, in J. G. Hansen Edwards, M. Zampini (Eds.), *Phonology and Second Language Acquisition*, 347-369, Amsterdam/Philadelphia, John Benjamins.

Elliot, R. A., (1995), Foreign language phonology: field independence, and the success of formal instruction in Spanish pronunciation, *The Modern Language Journal*, *79*, 530-542.

Escudero, P., (2005). *Linguistic perception and second-language acquisition: explaining the attainment of optimal phonological categorization*. PhD dissertation, Utrecht University: LOT Dissertation Series 113.

Escudero, P., & Boersma, P. (2004). Bridging the gap between L2 speech perception research and phonological theory. *Studied in Second Language Acquisition*, *26*, 551–585.

Escudero, P., & Chládková, K. (2010). Spanish listeners'perception of American and Southern British English vowels. *Journal of the Acoustical Society of America, 128*(5), EL254-EL260.

Escudero, P., & Vasiliev, P. (2011). Cross-language acoustic similarity predicts perceptual assimilation of Canadian English and Canadian French vowels. *Journal of the Acoustical Society of America*, *130*(5), EL277-EL283.

Escudero, P., Benders, T., & Wanrooij, K. (2011). Enhanced bimodal distributions facilitates the learning of second language vowels. *Journal of the Acoustical Society of America*, *130*(4), EL206-EL212.

Escudero, P., Simon, E., & Mitterer, H. (2012). The perception of English front vowels by North Holland and Flemish listeners: Acoustic similarity predicts and explains crosslinguistic and L2 perception. *Journal of Phonetics, 40,* 280-288.

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 research* (pp. 233-273). Timonium, MD, York Press.

Fullana, N., & Mora, *Production and Perception of Voicing Contrasts in English Word-Final Obstruents: Assessing the Effects of Experience and Starting Age*. Paper presented at New Sounds 2007, Proceedings of the Fifth International Symposium on the Acquisition of Second Language Speech.

Hillenbrand, J., Getty, L. A., Clark, M. J., & Wheeler, K. (1995). Acoustic charateristic of American English vowels. *Journal of the Acoustical Society of America*, *97*, 3099-3111.

Iverson, P., & Evans, B. G. (2007). Learning English vowels with different first-language vowel systems: Perception of formant targets, formant movements, and duration. *Journal of the Acoustical Society of America*, *122*(5), 2842-2854.

Logan, J. S., Lively, S. E., & Pisoni, D. B. (1991). Training Japanese listeners to identify /r/ and /l/: a first report. *Journal of the Acoustical Society of America, 89,* 874–886.

Mayr, R., & Escudero, P. (2010), Explaining individual variation in L2 perception: Rounded vowels in English learners of German. *Bilingualism: Language and Cognition*, *13*(3), 279-297.

Mildner, V., & Tomic, D. (2007), *Effects of phonetic speech training on the pronunciation of vowels in a foreign language*. Paper presented at the International Congress of Phonetic Science, Saarbrücken, 6-10 August 2007, 1665-1668.

Mora, J. C., & Fullana, N., (2007), *Production and perception of English /i̤ːɪ/ and /ṳːʊ/ in a formal setting: Investigating the effects of experience and starting age*. Paper presented at the International Congress of Phonetic Science, Saarbrücken, 6-10 August 2007, 1613-1616.

Nishi, K. & Kewley-Port, D., (2007), Training Japanese Listeners to Perceive American English Vowels: Influence of Training Sets, *Journal of Speech-Language and Hearing Research*, *50*, 1496-1509.

Peterson, G. E., & Barney, H. L. (1952). Control methods used in a study of the vowels. *Journal of the Acoustical Society of America*, *24*, 175-184.

Piske, T. (2007a). Implications of James E. Flege's research for the foreign language classroom. In: Bohn, O.-S. & Munro, M. J. (Ed.). *Language Experience in Second Language Speech Learning. In Honor of James Emil Flege* (pp. 301-314). Amsterdam: John Benjamins.

Ellen, S., & D'Hulster, T., (2012), The effect of experience on the acquisition of a non-native vowel contrast, *Language Science*, *34*(3), 269-283.

Sisinni, B., Escudero, P., & Grimaldi, M. (2013). *Salento Italian listeners' perception of American English vowels*. Paper presented at the Annual Conference of the International Speech Communication Association, Interspeech, Lyon, France, 26-30 August 2013.

Strange, W. & Shafer, V.L. (2008). Speech perception in second language learners: the re-education of selective perception. In M. Zampini & J. Hansen (Eds), Phonology and Second Language Acquisition 153-191, Cambridge, Cambridge University Press.

Sundara, M., Polka, L., & Genesee, F. (2006). Language-experience facilitates discrimination of /d-ð/ in monolingual and bilingual acquisition of English. *Cognition*, *100*, 369-388.

Suter, R.W., 1976. Predictors of pronunciation accuracy in second language learning. Language Learning 26, 233–253.

Yule, G., & Macdonald, D. (1995). The different effects of pronunciation teaching. *IRAL 34* (4), 345–350.