Perception of English Vowel Reduction by Trained Spanish Learners

Esther Gómez Lacabex[1], María Luisa García Lecumberri[1], Martin Cooke[2]

[1]University of the Basque Country, Spain
[2]University of Sheffield, United Kingdom
esther.glacabex@ehu.es, garcia.lecumberri@ehu.es

1. Introduction

It has been widely acknowledged that speech perception of non-native contrasts in second language acquisition (SLA) poses difficulties for L2 speakers (Best, 2001). Factors such as the influence of the L1 phonological system, markedness (Eckman, 1977) universal tendencies or individual characteristics may account for some of these difficulties. Nevertheless there are studies (Bongaerts et al., 1997; Markham, 1997; Escudero, 2006) that have shown that L2 speakers can learn to perceive new L2 vowels in a native-like manner and theories like the *Speech Learning Model* (SLM) by Flege defend the idea that the native language sound system mechanisms 'remain intact over the life span' (Flege, 1995:239) and that it is possible for adult learners to establish new non-native phonetic categories.

In line with the idea that it is possible to acquire a new sound category, our study aims at assessing the ability to perceive the English unrounded mid-central vowel schwa by Spanish learners of English. While schwa is a very frequent sound in English as the nucleus in unstressed syllables both in content words and function words, the Spanish vowel space has an empty central area with no central vowel categories. This fact in addition to others such as the influence of orthography, specially in contexts in which language is introduced in its written form (most formal instruction settings) may explain why this sound tends to be assimilated to L1 vowel sounds by Spanish speakers (and therefore identified and produced as a peripheral vowel).

Different views can be found in the literature on vowel reduction. It has been explained as a correlate of stress when described as the shortening in duration and obscuration of quality of nuclear vowels in unstressed syllables (Rietveld & Koopmans-van Beinum, 1987). It has also been defined as 'formant undershoot' or the failure of formant frequencies to reach target representations when duration is shortened (Lindblom, 1963). While this type of vowel reduction is very frequent in the languages of the world, the reduction degree reached differs between languages. As afore mentioned, vowel reduction in Spanish (Delattre, 1969) involves slight centring movements only and vowels never lose their quality (Quilis, 1996). In English, however, reduced vowels have become part of its phonological inventory, that is, they have become phonemes or sound categories, and thus, distinctive in contrasts of the type full vowel–weak vowel in unstressed syllable (*exorcise- exercise*).

Previous studies on the acquisition of vowel reduction in SLA have shown that stress and vowel reduction are treated as independent phenomena by Spanish speakers (Flege & Bohn, 1989) or that learners show some awareness of schwa but fail to produce contextual coarticulatory patterns (Kondo, 1995). We also find studies on the effect of treatment on the acquisition of vowel reduction. Gutierrez and Monroy's study (2003) tested a similar age group (15-17) with the same L1 (Spanish) as our study on the same type of vowel reduction ('phonological' as in *'priv<u>a</u>te'* or *'s<u>u</u>spect'*), and concluded that there was no improvement on the production of vowel reduction after the training. While the authors refer to the fact that the training period was too short in order to account for the lack of treatment effect, these results could be due to other factors such as type of training administered. A further study which

analysed the perception of the contrast full vowel-reduced vowel by Spanish learner of English without specific training revealed that perception of vowel reduction only occurred at chance performance levels (56% correct answers) (Gómez Lacabex & García Lecumberri, 2005).

This study also aimed at examining the relationship between perception and production training. Auditory and articulatory treatments were administered to two different training groups in order to explore potential different outcomes between them. Diverse findings may be found in the literature as far as this relationship is concerned. Studies like those of Lively et al. (1994) or McClasky et al. (1993) reported positive effects in laboratory discrimination training on perception abilities while positive effects of production training on production abilities have also been reported (Flege, 1988). Interestingly, a close relationship between production and perception is supported by those studies that have found that training in one of the skills exerts positive influence on the other. Leather (1990) analysed the effect of training on Chinese lexical tones on production and perception: while one group received computer-based training in perception, the other group was trained to use computer-managed visual feedback on their production. The groups were tested on both perceptual and production abilities and results suggested that both training types had positive effects since training in one modality 'tended to be sufficient to enable a learner to perform in the other' (Leather, 1990: 95).

In sound training research, generalization has often been used as a measure of learning robustness (Lively et al., 1994; Hardison, 2004) Our study also aimed at investigating whether the two types of training provided (perceptual and articulatory) were equally effective as far as robustness is concerned. Studies like those of Rochet (1995) or, McClasky et al. (1983) have concluded that generalization after a training period can occur. More precisely, Rochet found that his adult subjects (native speakers of Madarin Chinese) were able to transfer voice onset time (VOT) values across consonant place of articulation and vocalic contexts after a perceptual training with natural speech tokens. McClasky et. al reported similar findings, this time with synthetic stimuli, as their subjects (monolingual speakers of English) showed significant gains after discrimination laboratory training on voice onset time values in place of articulation which had not been used in the treatment sessions.

2. Method

2.1 Participants and procedure

This study selected a group of 50 subjects to take part in the experiment (two experimental groups and a control group). However, all groups suffered attrition, the control group being most severely affected (from 12 subjects in pre-test to 7 subjects in post-test). Eventually, data were obtained from 41 Spanish teenagers (24 female, 17 male, mean age: 15.8) learning English as a FL in a formal learning context. They attended English lessons for 3 hours a week at a private language school -where the training took place- in addition to English instruction at school. Subjects had been studying at the private language school for 4.1 years on average. This was an important factor as it involved exposure to native English accents, which they did not have in the state school. Subjects were divided into three groups: two experimental groups (A and B) undergoing two different types of vowel reduction training (perceptual or productive) and a control group (C), which was not given any specific training (see Table 1 for subject and gender distribution among groups). The training period was conducted over 3 months. Students received specific training on vowel reduction once a week (12 sessions on average) within their English course. Perceptual training was based on discriminatory exercises and production on the part of the students was not encouraged.

Production training, on the other hand, provided students with articulatory and visual cues and was based on production of the items on the part of the students and individual feedback provided by the trainer. Here, perceptual activities were avoided and sample/model productions were limited in the classroom.

Table 1. Distribution of subjects and gender for the three groups

	N	gender	
		male	female
ABC	41	17	24
A	17	10	7
B	17	5	12
C	7	2	5

2.2 Stimuli

A total number of 22 items were presented to the subjects in a two alternative forced choice identification task (AX) with orthographic input which was custom designed in MATLB. This corpus consisted of 11 minimal word pairs with the contrast 'full vowel' versus 'schwa'[1] in the unstressed syllable (i.e., *seafood-Seaford*). Prior to testing, students were familiarized with the stimuli so that they would know their meaning. These minimal word pair sets were also presented in the carrier sentence: *I'm going to say ... again*. Thus, vowel perception was presented at two different levels: word level and sentence level. Here we present results corresponding to the perception of the weak words (11), that is, those words with schwa as the nucleus of the unstressed syllable.

minimal word pairs	
weak (analysed in this study)	**strong**
turban	*turbine*
datum	*daytime*
Normanton	*Normantown*
commanders	*commandoes*
Seaford	*seafood*
salad	*sallowed*
pillars	*pillows*
hearers	*heroes*
Seaward	*seawood*
Upton	*upturn*
starlet	*starlight*

3. Data analysis and results

Students' perceptions were coded as percentages of correct answers. A repeated measures ANOVA of the results of the combined experimental groups (A&B) versus the control group (C) in the pre and post training conditions was carried out (Figure 1) and a further analysis

[1] Due to the difficulty of finding short vowel vs. schwa minimal pairs, the contrasts presented here were of the type long vowel-schwa. Being aware of this limitation an additional corpus -which is not analyzed in the present study- was created which contrasted short-full vowels vs. schwa as in *Superman-fireman* at syllable level.

compared the experimental group receiving perception training (A) with the experimental group receiving production training (B) (see Figure 2).

Inter-group analysis showed no significant differences between the experimental groups and the control group in the pre-test neither in words or sentences. Near significant differences were found between A&B and C in the post test for words ($F(1,39) = 2.91$, $p=.096$) and sentences ($F(1,39) = 3.81$, $p=.058$). They probably did not reach significance due to the large standard deviations in group C.

Intra-group analysis for experimental groups A&B taken together revealed significant differences between pre-test and post-test at word level perception ($F(1,39) = 15.78$, $p<.0001$) and at sentence level perception ($F(1,39) = 11.44$, $p<.005$). For control group C pre-test and post-test comparisons showed no significant differences at word nor at sentence level.

A further inter-task analysis revealed that there were no differences between perception at the word level and perception at the sentence level. This was found to be consistent across groups and treatment stages ($p>.05$).

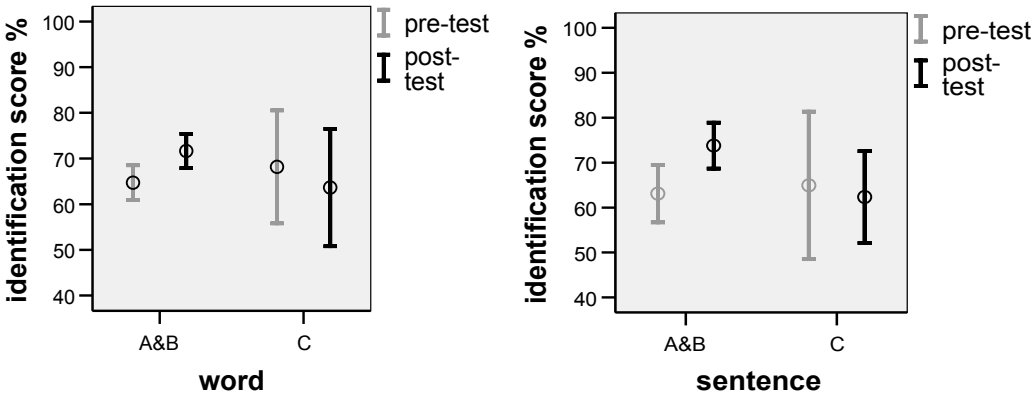

Figure 1. Perception of vowel reduction in words (left) and sentences (right) contrasting experimental groups together (A&B) and control group (C)

When comparing how the two experimental groups performed individually, inter-group analysis showed no differences between experimental group A and experimental group B in any of the perception tasks either in the pre-test (word level: $F(1,32) =.32$ $p=.576$ and sentence level: $F(1,32) =.72$ $p=.403$) or in the post-test (word level: $F(1,32) =.02$ $p=.888$, sentence level: $F(1,32) =.00$ $p=1.00$).

Intra-group analysis revealed significant/near significant differences between pre-test and post-test in both contexts and for both groups. At word level, both groups showed significant improvement (A: $F(1,39) = 6.72$, $p<.05$; B: $F(1,39) = 14.64$, $p<.005$); for perception of schwa at sentence level, it was observed that while improvement on the part of group B was significant, improvement in group A did not reach statistical significance (A: $F(1,39) = 3.21$, $p=.083$; B: $F(1,39) = 8.91$, $p=.005$). In order to explore group differences, correlation measures between students' perception scores and gender were computed; no significant correlations were found.

Further inter-task analysis revealed that there were no differences between perception at the word level and perception at the sentence level between experimental groups A and B either in pre-tests condition or in post-test condition ($p>.05$).

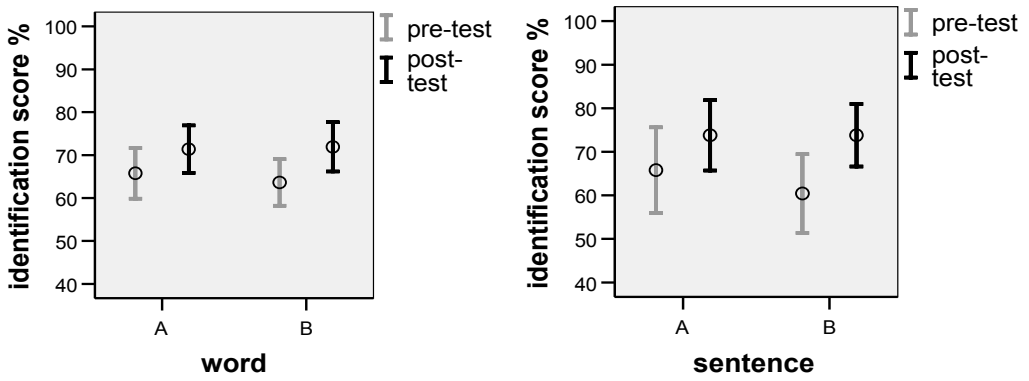

Figure 2. Perception of vowel reduction in words (left) and sentences (right) contrasting experimental groups separately

4. Discussion

In light of the data obtained, we can say that our students were able to improve their perception of schwa at the word level after the specific training administered; that is, the training proved effective since both experimental groups displayed an improvement as differences between testing stages reflect. Moreover, the control group did not show improvement indicating that the sole exposure and language experience gained in the period between pre and post tests was not responsible for the improvement displayed by the experimental groups. There were near significant differences between the experimental groups and the control group in the post-test for perception of schwa at word level. This lack of significance was probably due to group C's attrition and large standard deviation, so a larger control group would be necessary to explore this tendency further. Results agree with previous studies discussed above which have shown that non-native sounds can be learnt and support theoretical views which contemplate the possibility of developing perceptual abilities for non-native categories, in particular for sounds which may be perceived as 'new' due to their lack of similarity to L1 categories (Flege, 1995; Best, 2001) as is the case of schwa for Spanish speakers.

Generalization of perception of schwa to a non-instructed and new context (sentences) occurred in our experiment. Students were not trained in perceiving schwa within a sentence, a more complex and more natural context, nevertheless they showed significant improvement in their perceptual abilities in this context after the treatment (Figure 1 right). While the control group did not experience any improvement, near significant differences were found between A&B and the control group in the post test, supporting the treatment effect. In addition, this generalization happened in both experimental groups as Figure 4 shows. Our results agree with other studies which have shown the ability to generalize to non-instructed contexts (Rochet, 1995; McClasky et al., 1983). This result is only a first stage towards exploring learning robustness since other types of generalization (to non-instructed words and other speakers) are being studied.

Results revealed no significant differences between experimental groups A and B, that is, the two treatments administered in our study did not produce significantly different results. Given the fact that experimental group A received instruction based on perception, the type of task and the type of skills worked on during the treatment were similar to those used in the pre-test and post-test. Group B, on the other hand, received a different training approach based on articulatory cues and production feedback. This being so, group A would have been expected to perform better that group B as students were trained in the task demanded in the testing sessions. However, results indicate that both groups performed similarly in the

perception test. Our results suggest that production training exerts a positive influence on perceptual abilities being as efficient as perceptual training. At this point our study supports the facilitating view between perception and production training reported in Section 1 above in one direction: production training facilitating perception. Further analysis of the students' productions will reveal whether this view is fully supported.

5. Conclusions

Our study has shown that specific training on English vowel reduction in lexical words produced a positive effect on Spanish learners' perceptual skills. Results support recent theoretical views regarding the possibility of developing perceptual abilities when identifying non-native sounds and developing new phonetic categories.

Our results did not show differences in perception performance between auditory and articulatory training regimes. The group receiving auditory training could have been expected to show some degree of advantage since they were trained in the tests task but this was not so. We found that articulatory training contributed to the development of the students' perceptual abilities, supporting the facilitating relationship between perception and production. Further analysis of the students' productions of vowel reduction will answer the remaining question of whether perceptual training actively contributes to developing students' production abilities.

The present study also revealed that the improvement in perception carried over to a non-instructed more challenging context. This type of generalization is a first indication of robustness which will be further explored for schwa perception in novel or non-instructed words.

References

Best, C., McRoberts, G., & Goodell, E. (2001). Discrimination of non-native consonant contrasts varying in perceptual assimilation to the listener's native phonological system. *Journal of the Acoustical Society of America, 109*(2), 775-794.

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

Delattre, P. (1969). An acoustic and articulatory study of vowel reduction in four languages. *International Review of Applied Linguistics*, *6*(4), 295-323.

Escudero, P. (2006). The phonological and phonetic development of new vowel contrasts in Spanish learners of English. In B. O. Baptista, & M. A. Watkins (Eds.), *English with a Latin beat: Studies in Portuguese/Spanish English interphonology.* Amsterdam: John Benjamins.

Eckman, F. R. (1977). Markedness and the Contrastive Analysis Hypothesis. *Language Learning, 27*, 315-330.

Flege, J. E. (1988). Using visual information to train foreign-language vowel production. *Language Learning, 38*(3), 364-407.

Flege, J. E., & Bohn, O.-S. (1989). An instrumental study of vowel reduction and stress placement in Spanish accented English. *Studies in Second Language Acquisition, 11*, 35-62.

Flege, J. E. (1995). Second-language speech learning: Theory, findings and problems. In W. Strange (Ed.), *Speech perception and linguistic experience: Theoretical and methodological issues* (pp. 233-277). Timonium, MD: York Press.

Gómez Lacabex, E., & García Lecumberri, M. L. (2005). English vowel reduction by untrained spanish learners: Perception and production. PTLC 2005, http://www.phon.ucl.ac.uk/ptlc2005.html/.

Gutierrez, F., & Monroy, R. (2003). Proceedings of the 3rd International Contrastive Linguistics Conference, September 2003, 211-222.

Hardison, D. M. (2004). Generalization of computed assisted prosody training: Quantitative and qualitative findings. *Language Learning and Technology*, *8*(1), 34-52.

Kondo, Y. (1994). Targetless schwa: Is that how we get the impression of stress timing in English? *Proceedings of the Edinburgh Department Conference '94,* 63-76.

Leather, J. (1990). Perceptual and productive learning of Chinese lexical tone by Dutch and English speakers. In J. Leather, & A. James (Eds.), *New Sounds 90: Proceedings of the Amsterdam Symposium on the Acquisition of Second Language Speech* (pp.305-341). Amsterdam: University of Amsterdam.

Lindblom, B. (1963). A spectrographic study of vowel reduction. *Journal of the Acoustical Society of America, 35*, 1773-1781.

Liveli, S. E., Pisoni, D. B, Yamada, R. A, Tohkura, Y, & Yamada, T. (1994). Training Japanese listeners to identify English /r/ and /l/. III Long-term retention of new phonetic categories. *Journal of the Acoustical Society of America, 96*(4), 2076-2087.

McClasky, C. L., Pisoni, D., & Carrell, T. D. (1983). Transfer of training of a new linguistic contrast in voicing. *Perception and Psycholinguistics, 34*(4), 323-330.

Markham, D. (1997). Phonetic imitation, accent and the learner. Lund University Press.

Quilis, A., & Fernández, J. (1996). *Curso de fonética y fonología españolas para estudiantes angloamericanos* (15º Edición). Madrid: Consejo Superior de Investigaciones Científicas.

Rietveld, A., & Koopmans-van Beinum, C. M. (1987). Vowel reduction and stress. *Speech Communication, 6*, 217-229.

Rochet, B. L. (1995). Perception and production of second language speech by adults. In W. Strange (Ed.), *Speech perception and linguistic experience: Theoretical and methodological issues in cross-language speech research* (pp. 379-410*).* Timonium, MD: York Press.