DIFFICULT CONTRASTS, NATIVE DIALECT AND EXERIENCE IN NON-NATIVE PERCEPTION*

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This study examines several factors in the reportedly different perception of the English vowels /æ, ʌ, ɑ/ by Spanish native listeners with different dialectal backgrounds. Previous studies with inexperienced Spanish learners of English (Guitart, 1985, 1996) found that each of the /æ, ʌ, ɑ/ vowels may be heard differently and, more importantly, that the learner's native variety influences L2 perception. Specifically, the English /ʌ/ tends to be perceived as /a/ by Peninsular listeners, but as /o/ by Caribbean listeners. Using a perceptual task, the present study aims to answer two questions: (i) How does non-native perception differ for listeners with distinct native varieties and what dialect-specific perceptual strategies are responsible for the differences? and (ii) How does the type of contrast and experience with non-native contrasts affect L2 perception? Two groups of Spanish native speakers from Spain and Cuba, each including two subgroups of learners and non-learners of English, were tested in an AX discrimination task on the Canadian English contrasts /ɑ-ʌ/, /æ-ʌ/ and /ɑ-æ/. The independent factors analyzed were the perceptual difficulty of the contrast, the experience with L2 and the native dialect. Given the reduced number of studies exploring the effects that the native variety has on non-native perception, this research aims to contribute information on such effects. The nature of the L2 contrasts analyzed here and the role of experience are also relevant to language acquisition and language teaching involving two widely spread linguistic varieties, English and Spanish.

1. Previous studies

1.1. Low and mid back vowels and inherently difficult contrasts

The domain of low and mid back vowels represents a source of perceptual confusion even for native listeners. In English, for instance, /ʌ/ is mistaken for /ɑ/, /ɔ/ or /ʊ/ and is identified correctly only in 82.7% of the cases (Syrdal and Gopal, 1986). Also, the neighbouring vowels /ɑ/ and /ɔ/ are incorrectly classified as /ʌ/ by native speakers. On the whole, more confusion is observed for back vowels (the lowest identification scores are 75% for /ɔ/), which suggests that the acoustic cues that signal back articulations are weaker and more likely to produce perceptual ambiguity. Lindblom (1986) attributes this effect to the reduced mobility of articulators and sensory control at the back of the mouth that correlates with less salient acoustic-perceptual phenomena as compared to the front.

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Contrasts involving low and mid back vowels may be difficult to perceive, particularly if the perceptual distance between them is small. Thus, the /ɑ-ʌ/ contrast, which involves two back vowels, is inherently more difficult to perceive than /ʌ-æ/ and /æ-ɑ/ contrasts involving back and non-back vowels. Native and non-native listeners alike obtain higher error rates and longer and more variable response times (Polka, 1995) when discriminating such 'difficult' contrasts. In a study that investigated cross-linguistic discrimination of the English vowel contrasts, Flege (1995) found that the English /ɑ-ʌ/ contrast was among those that generated the highest error rates among non-native listeners with various L1s, including Spanish. Moreover, the /ɑ-ʌ/ contrast was the most problematic even for L2 listeners (the L1 Dutch and German groups) whose overall performance on other contrasts was similar to that of the English natives. The L1 Spanish group in Flege's study also performed poorly on the /æ-ɑ/ contrast.

Not only are such contrasts problematic for native and non-native listeners, but also performance with some difficult L2 contrasts improves slowly with experience or training. For instance, after a perceptual training experiment on five English vowels, Japanese learners succeeded in learning the temporal cues of the /ɑ-ʌ/ contrast, but failed to attend to spectral cues (Lambacher et al, 2005). In the same vein, Levy and Strange (2008) showed that perception of non-native contrasts between French rounded vowels improved with experience but unevenly as, occasionally, inexperienced listeners performed better than experienced listeners on some contrasts. Specifically, for the /u-y/ contrast in alveolar context, the difference in error rates between inexperienced and experienced listeners was only 4%, and in bilabial context the inexperienced actually had lower error rates than experienced listeners (8% versus 25%). That supports the idea that, even without considering factors like transfer from L1 and inventory size, contrasts involving back vowels are inherently difficult.

1.2. Cross-linguistic differences in perception

Perception is language specific, that is, native listeners refine their perception to recognize automatically the contrasts in their language. Since phones in languages differ in many ways, perceptual strategies that listeners adopt also vary cross-linguistically. Fox et al. (1995) showed that English and L2 Spanish listeners perceive English vowels differently. Specifically, whereas English monolinguals use 3 dimensions to categorize vowels (height, backness and central/non central distinctions), Spanish listeners use only 2 dimensions (height and proximity to a prototype vowel). Moreover, vowel height tends to be strongly correlated with duration for American English monolinguals but not for Spanish native speakers. The vowel inventory size also plays an important role in perception (Flege, 1995, Wagner and Ernestus, 2008). The greater the vowel inventory of a language is, the greater the number of dimensions necessary to perceive contrasts is. If a particular area in the perceptual vowel space is crowded, then perception is more sensitive to fine-grained differences among phones in that vowel space, so perception is warped by the native inventory. This is true for native listeners' perception of L1 contrasts. However, the task of non-native listeners is different and more difficult particularly if their native language inventory is smaller than that of L2. For instance, in Spanish the low area in the perceptual space is committed only to the vowel /a/, whereas in English the corresponding area is occupied by three vowels /æ, ʌ, ɑ/. With fewer phonetic categories to attend to in L1, non-native listeners of L2 have to learn to reattune their perception to the specific contrasts in L2.

1.3. Cross-dialectal differences in perception

Perception of listeners from distinct varieties of a language may differ, too. Escudero and Boersma (2004) found dialectal differences between Scottish and Southern English in the perception of the /i-ɪ/ contrast. Whereas Scottish English listeners favoured the spectral cues, Southern English listeners perceived the contrast based on a combination of spectral and temporal cues. A similar finding is reported for the French vowels /o-ɔ/ and /ɑ-a/ in two dialects, Standard and Swiss French (Miller and Grosjean, 1997). In contrast with Standard French, which uses mainly spectral cues, in Swiss French duration is given a more important weight in vowel identification. Some distinctions in perception were also reported between American and Australian English (Cutler et al., 2006) for the /ɑ-ɔ/ and /æ-ɛ/ in the use of duration and tenseness cues. Thus, cross-dialectal differences are reflected in different perceptual strategies of weighting spectral and temporal cues.

1.4. Native dialect effects in non-native perception

A small number of studies showed that cross-dialectal differences in the perceptual strategies have repercussions on the processing of non-native phones. For instance, Holden and Nearey (1986) report such effect in three Russian varieties. Although these dialects have identical phonemic inventories, vowels display different distributions in the perceptual space, which seems to affect the listeners' perceptual behaviour in L2. Depending on the native variety, the non-native vowel /ʌ/ is perceived as [a], [o], or [e]. Morrison (2008) compared non-native perception in Mexican and Peninsular Spanish and found dialectal differences in the identification of the Canadian English front high and mid vowels. Guitart (1996, citing Valle, 1995) discusses an experiment in which the English /ʌ/ is identified as [a] in 83% of cases by Peninsular and as [o] in 71% of the cases by Caribbean learners. In his phonological interpretation, Guitart speculates that listeners with distinct dialectal backgrounds create different hierarchies of features based on the acoustic saliency of features like [+low] or [+round]. However, no clear justification for the listeners' preference for one or the other realization is given.

2. The current study

The studies reviewed in **1.** point out the fact that some contrasts are inherently more difficult than others. The arguments are (i) the nature of the cues they encode, (ii) the fact that native and non-native listeners alike have higher error rates and longer response times with the 'difficult' contrasts and (iii) that experience or training may not result in great improvement in performance. In identification tasks, Spanish listeners assimilate the English vowels /æ/ and /ɑ/ most often to [a] and /ʌ/ to [a] or [o]. In discrimination tasks Spanish listeners make more errors with the /ɑ-ʌ/ and /æ-ɑ/ contrasts. There are cross-linguistic and cross-dialectal differences in perception that can be attributed to different vocalic inventories and different perceptual strategies of cue weighting. A small number of articles supported the idea that the native dialect shapes non-native perception.

Based on these findings, the present study analyzes the influence that (1) the contrast inherent difficulty, (2) the experience with L2 and (3) the native variety have in non-native perception of Canadian English vowels /æ, ʌ, ɑ/. To test the first question regarding the difficulty of the English contrasts among low and mid back vowels, I hypothesized that these contrasts can be hierarchically ordered, with /ɑ-ʌ/ as the most difficult, followed by /ʌ-æ/ and /æ-ɑ/ (*hypothesis 1*). This hierarchical pattern, reflected in the discrimination error rates, can be observed for all groups of listeners tested: learners and non-learners from both dialects investigated here, Cuban (CS) and Peninsular (PS) Spanish.

Bearing on hypothesis 1, the second hypothesis addresses the role of experience with the L2 contrasts in discrimination performance. It is expected that experience with L2 contrasts will determine lower error rates for the learner groups especially with the 'easy' contrasts /ʌ-æ/ and /æ-ɑ/ whereas for /ɑ-ʌ/ contrast the error rates will drop less dramatically in the advanced group as compared to the monolingual group (*hypothesis 2*).

As I have argued that back vowels are perceptually confusable, I specifically investigated whether the /ɑ-ʌ/ contrast was more difficult for one dialectal group than for the other. I assume that in processing this contrast, listeners are likely to use categories situated in the low and back perceptual space of L1, that is, /a/ and /o/. Thus, *hypothesis 3* states that both groups of listeners use the perceptual strategy of shifting the boundary between their L1 vowels /a/ and /o/. The difference is that PS listeners shift their /a-o/ boundary towards /a/ whereas CS listeners towards /o/. If this is the case, different types of confusions with low and mid low vowels are expected for each group. Specifically, if Cuban listeners tend to perceive a back (rounded mid low) vowel for the L2 /ʌ/, they are more likely to err with back vowel contrasts /ɑ-ʌ/, as for them such contrasts represent a within-category contrast. Conversely, if Peninsular listeners tend to form fronted low unrounded percepts for the L2 /ʌ/, they will have a higher error rate with contrasts involving front vowels, /ʌ-æ/ and /æ-ɑ/.

3. Method

3.1. Procedure

A two-talker AX discrimination task was chosen for the experiment. In this paradigm, subjects had to attend to salient phonetic differences between pairs of stimuli and answer whether the words they heard were the same or different. This task operates at the phonetic level rather than at the categorization (phonological) level and thus the discrimination task is suitable both for L2 learners and non-learners. The phonetic interpretation was also tapped into by setting the interstimulus interval at 1 second (Werker and Logan, 1985). The test was performed in one session that lasted 30 minutes and was part of a larger experiment that elicited L1 and L2 production data, which is not reported here.

3.2. Stimuli and materials

Two female native speakers of Canadian English (Southern Ontario) pre-recorded the stimuli, which were then extracted from the context and paired to create the set of perceptual testing material. The recording equipment used included an M-Audio Microtrack 24/96 professional 2-channel mobile digital recorder and a lavaliere unidirectional microphone. The tokens were real English words with a C_1VC_2 structure, with C_1 a stop or the glottal fricative /h/ and C_2 a stop. There were 6 minimal triads (e.g. *hat* – *hut* – *hot*) and several minimal pairs (e.g. *buck* – *back*, *duck* – *doc*, *tap* – *top*). A block of 72 pairs was created by pasting together various tokens separated by a one-second ISI. The set included: an equal number of 'same' and 'different' pairs (36); an equal number of target vowel pairs /æ-ɑ/, /ʌ-ɑ/ and /ʌ-æ/ (24); within the 'different' pairs, tokens produced by one speaker combined with an equal number of tokens produced by the other speaker (18); within the 'same' pairs, an equal number of identical tokens, same name – same speaker and same name – different speaker (18). Nine distracter pairs were also added; the items in these pairs share the vowel but differ in voicing of the coda stop. The 81 pairs were randomized and uploaded twice to the perceptual testing software, thus yielding two blocks and a total of 162 audio files of token pairs. A short trial test was set up to familiarize participants with the software and testing material.

The perceptual testing software was developed in LabView 7.1 and runs under Windows on a portable computer. Two function keys of the computer (F1, F12) were assigned as decision buttons 'same' and 'different'. The answers and the corresponding response times were stored automatically.

3.3. Participants

Two groups totaling 39 participants were recruited for the study: 20 from León, Spain and 19 from Holguín, Cuba. Each of the two non-native groups, Peninsular and Cuban, consisted of two subgroups, one of advanced learners and one of monolinguals. The criteria used to assign participants to the experienced group were the formal training in English and the use of English in everyday activities. Participants in both advanced groups within the Peninsular and Cuban groups had obtained or were pursuing a university degree in English language and literature and used English more than 10 hours/week. The monolingual groups had little or no exposure to English.

The Peninsular Spanish advanced group included ten subjects (9 female, 1 male), mean age 36.8, sd 7.4. They had extensive formal training in English as they were students beyond the 3rd year (8) or had graduated (2) and used English on a daily basis. The monolingual group from Spain included ten subjects (7 female, 3 male), mean age 28.9, sd 8.9 with university education, who reported having minimal or no exposure to English.

The Cuban advanced group consisted of nine participants (7 female, 2 male) mean 29.2, sd 5.6, with university degrees in English language and literature (6) and other (3). They all worked in the Public Relations Office in a tourist resort and reported using English on a daily basis with foreign tourists. The monolingual group consisted of ten participants (7 female, 3 male) mean age 32.6, sd 5.6. They worked in the same tourist resort but they had little or no exposure to English, nor did their jobs require any interaction with foreign tourists.

4. Results

The number of incorrect answers was counted for each contrast and subgroup and converted into error rates. Participants' mean error rates and standard deviations are reported for each contrast and subgroup in Table 1. Overall, performance with the /ʌ-æ/ and /æ-ɑ/ contrasts is similar across dialects, however, the error rates with the /ʌ-ɑ/ contrast are higher for the Cuban group than for the Peninsular group. The /ʌ-ɑ/ contrast ranks the highest and /æ-ɑ/ the lowest in the hierarchy of difficulty predicted in 2. Worth noticing is the performance of the CS advanced subgroup which obtained higher error rates than the corresponding CS monolingual subgroup. This and the other findings are presented in detail in the next sections.

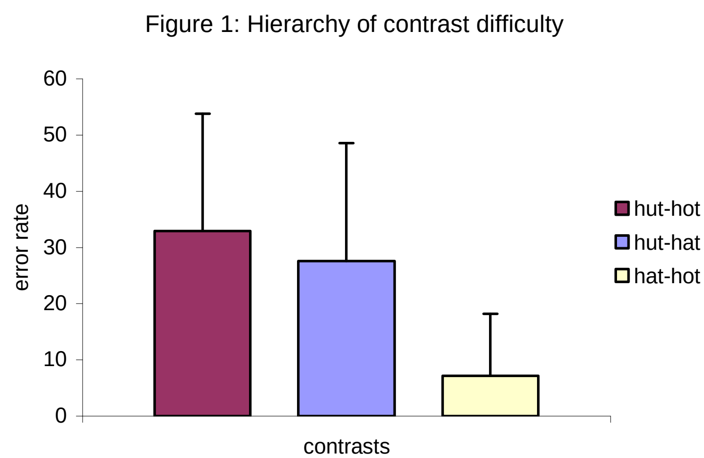
Table 1 – Mean error rates and standard deviations for each contrast and group

	n	/ʌ-ɑ/		/ʌ-æ/		/æ-ɑ/	
		error rate	sd	error rate	sd	error rate	sd
PS monolingual	10	44.5	18.8	42	19.1	11.2	10
PS advanced	10	13.7	10.5	13.3	11	2.9	4.8
Peninsular total	20	29.1	21.7	27.7	21.2	7	8.7
CS monolingual	10	35.8	19	42.9	16.4	12	16.9
CS advanced	9	37.9	21.7	10.1	9.5	1.8	3
Cuban total	19	36.8	19.8	27.4	21.4	7.2	13.2
Total	39	32.9	20.8	27.5	21	7.1	11

4.1 Contrast difficulty

Overall, the mean error rates collapsed for all 39 participants indicate that /ʌ-ɑ/ was the most difficult contrast (32.9% error rate) followed by /ʌ-æ/ (27.5%) and /æ-ɑ/ (7.15%) (Figure 1). A one-way repeated measures ANOVA on these three contrasts returned significant values (Wilks' Lambda = .239, $F(2, 37) = 58.913$). Pairwise comparisons show that error rates with the /æ-ɑ/ contrast are significantly different from each of the /ʌ-ɑ/ and /ʌ-æ/ contrasts.

Figure 1. Hierarchy of contrast difficulty based on overall error rates for each contrast



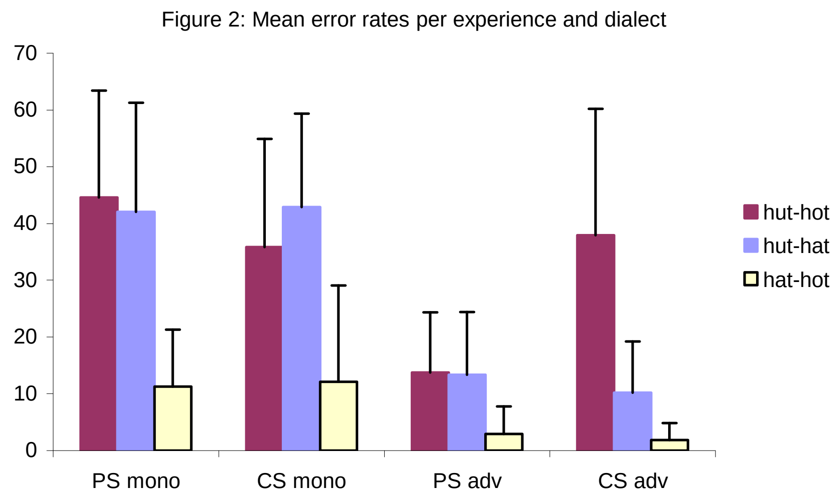
The perceptual distance between the vowels involved in the pairs analyzed here affected contrast discrimination. The perceptual distance in the /æ-ɑ/ contrast involving a front and a back vowel is large; therefore this contrast has the best discrimination scores. On the contrary, the distance between the back vowels in /ʌ-ɑ/ is small, so this contrast is difficult. In between is the /ʌ-æ/ contrast with moderate to high error rates. Given that mid (and high) back vowels tend to be centralized in alveolar contexts (Strange et al., 2007), the distance between [ʌ] and the low front /æ/ is reduced, rendering the contrast moderately difficult. The mid back (or centralized) vowel /ʌ/ received high scores in the confusion matrix even from native listeners (Syrdal and Gopal, 1986, Cutler et al., 2004). In the present study the vowel /ʌ/ appears in contrasts that rank high in the difficulty hierarchy, indicating that L2 listeners confuse it easily.

4.2. Experience

To test the effects of experience with the L2 contrasts, repeated-measures ANOVA with contrasts (between) and experience (within) was performed. As expected, the main effect of experience is significant ($F(3, 35) = 8.596$, $p < .001$,

η^2= .424), advanced learners discriminate the English contrasts better than non-learners (Figure 2).

Figure 2. Contrast difficulty as a function of experience and dialect



Post hoc tests revealed that there were significant differences in discrimination between advanced and non-learners within the PS group (p < .001) but not within the CS group. The same post hoc tests revealed significant differences between the advanced PS and CS groups, but not between the non-learner PS and CS groups. These are dialect-related differences and will be discussed in the next section.

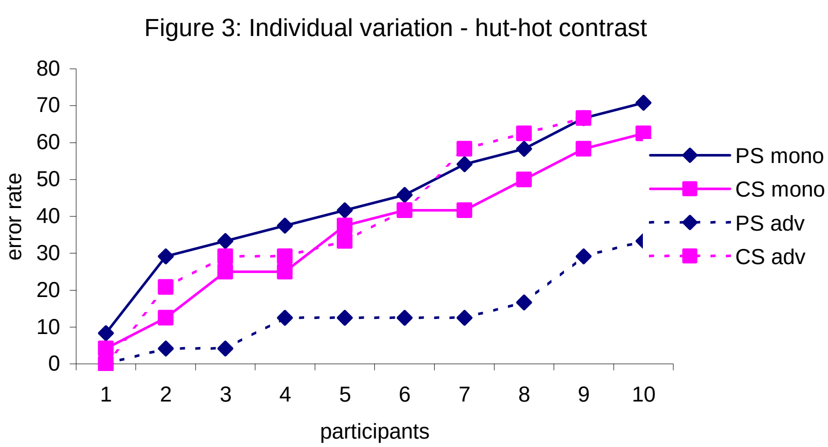
Given the high error rates for the /ʌ-ɑ/ across subgroups, a 2x2 ANOVA with dialect and experience was further performed for this difficult contrast only. There were significant differences between PS advanced and PS non-learners for the /ʌ-ɑ/ contrast ($F(1, 35) = 14.8$, $p < .001$) but no significant differences between the CS subgroups, for which the mean error rate is higher in the advanced group (37.9%) than in the non-learner group (35.8%). Apparently, L2 experience had a negative effect on discrimination in the CS group, as CS advanced learners failed to follow the pattern found for the other contrasts, for which the error rates decreased considerably in the learners' group.

4.3. Dialect

A repeated-measures ANOVA with contrasts (within) and dialect (between) showed that overall there are non-significant differences between dialectal groups. A separate analysis of variance performed only on the /ʌ-ɑ/ contrast returned a significant main effect of dialect (F (1, 35) = 8.647, p = .006); the advanced PS group performed better than the advanced CS group. If native dialect shaped indeed non-native perception, similar behaviour would be expected both for learners and non-learners. However, this was not the case in the non-learner groups, for which there was no significant main effect of dialect, as their mean error rates and variability were comparable (PS mono – 44.5%, sd 18.8, CS mono – 35.8%, sd 19, cf. Table 1). Therefore, the differences between dialectal groups can be pinpointed to different L2 learning experiences in the learner groups. Advanced Cubans had significantly more errors than advanced Peninsulars with the /ʌ-ɑ/ contrast, but performed comparably with the other two contrasts /ʌ-æ/ and /æ-ɑ/. It is known that perception is sharper at category boundaries and less accurate far from these boundaries (Strange, 1995). In other words, between-category contrasts are better discriminated than within-category contrasts. The fact that the advanced Cuban group obtained a higher error rate with the L2 /ɑ-ʌ/ suggests that it represents a within-category contrast, which is farther from the interlanguage boundary they may have for this contrast (L1 /a/-/o/ boundary). On the other hand, the good performance that the Peninsular learner group shows with this contrast indicates that their interlanguage boundary of the /ɑ-ʌ/ contrast is closer to the L1 /a/-/o/ boundary or it may even be the case that /ɑ-ʌ/ is a between-category contrast. Thus, different error rates with the /ɑ-ʌ/ contrast indicate that learners from distinct native dialects have different mappings of the L2 vowels. Additionally, greater variability in discrimination accuracy points to a fuzzier boundary for the contrast for the Cuban advanced group. Learners adopt the same perceptual strategy, that of shifting the L1 boundary between the L1 vowels /a/-/o/, however, the extent and the direction of this shift differs cross-dialectally.

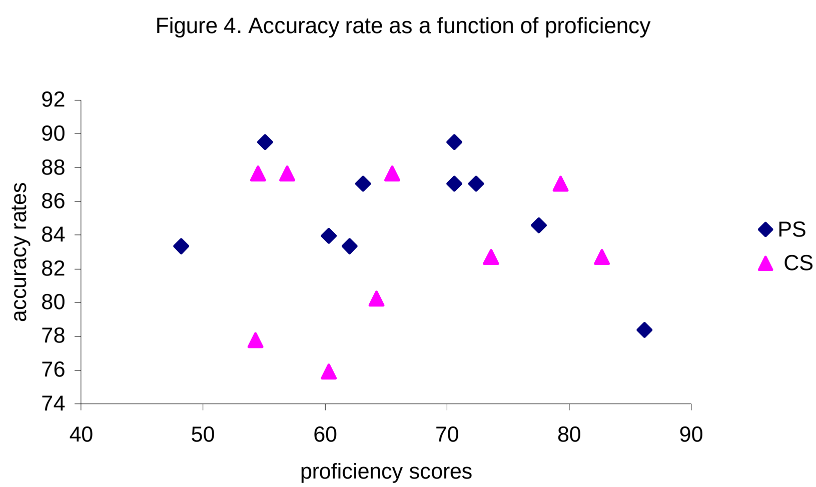
Another aspect worth noticing is the great amount of individual variability within the CS advanced group (Figure 3). In this group performance is comparable to those in the non-learner groups, as errors range between 0 and more than 60%.

Figure 3. Individual error rates for /ʌ-ɑ/ plotted separately by experience and dialect



According to the background questionnaire elicited at the time of testing, almost all advanced learners in both dialectal groups had or were pursuing a degree in English. Nevertheless, different levels of proficiency may have been the source of the great variability in performance. To test these effects, proficiency scores were compiled from a vocabulary test elicited as part of an L2 production experiment (not reported here) that accompanied the current perceptual task. Participants had to answer 58 vocabulary questions and, based on their answers, a score was assigned to each one. For both dialectal groups of advanced learners, Pearson correlation coefficients were computed to assess the relationship between proficiency scores in the vocabulary test and accuracy in discriminating the L2 contrasts (Figure 4). There was no correlation between the two variables neither in the PS group ($r = -.327$, $n = 10$, $p = .357$) nor in the CS group ($r = -.144$, $n = 9$, $p = .711$).

Figure 4. Correlations between the accuracy rate and proficiency score for PS and CS advanced learners.



5. Conclusions

This study proposed a hierarchy of contrast difficulty and predicted that contrasts involving two back vowels would be more difficult to discriminate than contrast involving a front and a back vowel. Results showed that discrimination was more accurate only for the ‘easy’ contrast /æ-ɑ/, but there were no significant differences in discrimination for the ‘difficult’ contrasts /ɑ-ʌ/ and /ʌ-æ/. The overall discrimination accuracy was above chance, and similar error patterns emerged for all groups, except for CS advanced. The hierarchy of difficulty obtained for L2 matches the pattern of difficulty reported for L1 (Lindblom, 1986, Syrdal and Gopal, 1986) and supports the finding that pairs involving front and back vowels are inherently easier to perceive as compared to contrasts involving two back vowels.

Experience with L2 contrasts had an effect on the listeners' performance as, overall, advanced learners discriminated contrasts better than the non-learners. The contrast difficulty was correlated with higher error rates in the monolingual groups as compared to the advanced groups. For the 'difficult' contrast /ʌ-ɑ/ the error rates dropped 69% in non-learners vs. advanced learners in the PS group; for the /ʌ-æ/ contrast, the drop was 68% and 76% in the PS group and, respectively in the CS group and 74% and 85% in the PS and respectively the CS group for the 'easy' contrast /æ-ɑ/, which almost half of all listeners discriminated correctly.

Overall, there is little evidence for a dialect effect, except for the /ʌ-ɑ/ contrast. An unexpected finding of this experiment was the poor performance on the /ʌ-ɑ/ contrast in the CS advanced group. Non-learners in the PS and CS groups perform similarly, thus suggesting that perception is the same for both dialects in the case of monolinguals but it diverges for learners as they adopt different paths when processing this non-native contrast. To explain this effect, other factors need to be taken into consideration, like the learning experience, the input, proficiency scores, amount of L2 use, knowledge of other languages. Based on the background questionnaire, participants in this study differed with respect to the other languages they knew and to the immersion in L2. Whereas the Peninsular group had more exposure to other languages and had spent various amounts of time in English-speaking environments, the Cuban group had less experience with other languages. The Cubans were, however, in an immersion situation due to their everyday contact with native and non-native English speakers, which is likely to have contributed to their highly variable performance.

This perceptual experiment led to three main findings: (i) that contrasts involving back vowels yield higher error rates and more variability in discrimination responses than contrasts involving front and back vowels, (ii) that L2 experience generally, but not always, determines a lower error rate with L2 contrasts and (iii) that the native dialect may influence the mapping of the non-native vowels, as the Peninsular advanced group discriminates the /ɑ-ʌ/ contrast better than the Cuban advanced group. However, there are no differences in the performance of the PS and CS *non-learner* groups, pointing out that the dialects effects on perception are minimal. Differences in the performance of the PS and CS advanced groups may be attributed to different interlanguage perceptual strategies as well as to factors like input, proficiency and knowledge of other languages.

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