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# Perception and Production of SSBE Vowels by Foreign Language Learners: Towards a Foreign Language Model

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## Abstract

Millions of Foreign Language (FL) learners spend many years learning English in the classroom. Most FL learners learn English in their countries with local teachers, with little or no native L2 input. The Perceptual Assimilation Model (PAM) (Best, 1995, 1999) and Speech Learning Model (SLM) (Flege, 1995) are the most widely used L2 models in L2 speech analysis. However, neither model, to the author's knowledge, accounts readily for the speech of FL learners. In the present study, insights of these models are employed to examine the perception and production of Standard Southern British English vowels (SSBE) by 20 Syrian Arabic (SA) FL learners. A Perceptual Assimilation Task (PAT) was used to test the similarity between the participants' L2 and L1 vowels, and an identification task was used to test the correct identification of the SSBE vowels compared to Native English (NE) listeners. For a production task, the SSBE vowels were produced and analysed in the /hVd/ context by SA and NE participants. The results suggest that FL learners differ from naturalistic L2 learners and naive L2 listeners in their level of FL speech perception, their ultimate aim, and the classroom instructions given to FL learners. Thus, a Foreign Language Model (FLM) is needed because neither PAM nor SLM account entirely for the properties of FL speech.

Key words: Perception, Production, L2 English, Syrian Arabic

Even though 80% of English speakers are non-natives, for decades, L2 speech perception and production studies focused on two groups of learners: naturalistic L2 learners and naive listeners. The SLM developed by Flege (1995) focuses mainly on the first group of naturalistic advanced L2 learners who learned their L2 within an L2 country, i.e. immigrants. Flege argues that using L2 speech of beginners might reveal differences from native speakers that are due to learning in progress, not inability to learn. Accordingly, the postulates and hypotheses of the SLM emphasize the effects of Age of Arrival (AOA) to the L2 country and Age of Learning (AOL) suggesting "earlier is better (1995, 233)", i.e. the ability to detect the phonetic differences between L1 and L2 sounds decreases as the AOA and AOL increase.

The SLM claims that during the early stages of L2 learning, L2 sounds are heard as instances of existing L1 categories regardless of the L1-L2 differences. After gaining some experience with L2 speech, adult learners may gradually detect the phonetic differences between some L2 and L1 sounds. At this stage, a new phonetic category representation might be established for the L2 sound. However, establishing phonetic categories for L2 sounds might be blocked due to an equivalence classification with L1 sounds; that is L2 learners may fail to detect the phonetic differences between some L2 and L1 sounds, as they perceive L2 sounds as allophones of their L1, which leads to lack of pronunciation accuracy and foreign accent in L2 speech. An advantage of the SLM is that it explicitly links L2 perception and production. Flege et al. (1995) claim that L2 categories will be ultimately produced with phonetic implementations that correspond to their feature or feature weight representations. However, those features might not be native-like since their representations differ from those of monolinguals (Bohn & Flege, 1992; Flege, 1987; Flege, et al., 1995).

On the other hand, the PAM developed by Best (1995), was formulated to model cross-language speech perception. The main focus of this model is naive listeners or early L2 learners with little or no L2 experience. It involves examining cross-language perceptual assimilation in a laboratory environment rather than in a natural L2 learning environment (Guion et al., 2000). The PAM is predominantly a perceptual model which provides general predictions about the assimilation patterns of L2 learners.

However, it does not provide any clear predictions about the production patterns of L2 learners.

Best claims that the perception of sounds in a foreign language is determined by their gestural similarities to, or discrepancies from, L1 sounds (Best, 1999). The main claim of this model is that perceptual limitations of L2 learners determine the kind of difficulty the learners may encounter when learning L2 sounds. For example, if two languages share a similar phoneme or phonemic contrast, it is likely that these languages differ in the articulatory and phonetic detail of those phonemes (Best, 1999). The similarity between non-native and native segments is judged in the PAM based on their articulatory and gestural properties (Best, 1995, 193).

More recently, Best and Tyler (2007) proposed an L2 version of PAM (PAM-L2), which predicts the perceptual patterns of L2 learners rather than monolinguals with little L2 experience. The main interest of PAM-L2 is natural speech communication rather than the laboratory artificial situations of the original PAM (2007, 18). PAM-L2 focuses on two groups: late L2 learners and monolinguals, which differ in their L2 perception. The first group is argued to use the phonological perception which they gained from learning the L2 in a natural setting i.e. L2 learners are predicted to be able to perceive the L2 phonological categories. This means that late L2 learners are able to overcome within-category phonetic variations which are phonologically irrelevant. The second group, on the other hand, is argued to use phonetic perception due to the lack of the L2 phonological exposure. This means that naive listeners perceive the L2 phonetic categories because they do not recognise the phonetic detail of the phonological categories of the L2 (2007, p. 14). Therefore, naïve listeners are predicted not to differentiate between the phonetic and phonological levels of the L2 (2007, p. 23).

Similarly to late L2 learners, the SLM, arguably, assumes phonological rather than phonetic perception of the L2 as the advanced L2 learners are exposed to native L2 input, which enables them to learn to differentiate the phonetic and phonological levels of perception, i.e. to realise what is phonologically relevant. With this in mind, the FL learners of the present study, who learned their L2 to satisfy particular educational requirements, differ from both naive and advanced L2 learners. The FL learners can be argued to have a different level of L2 perception due to the lack of native L2 input, thus they are similar to naive listeners in using their phonetic level of perception. Additionally, FL learners gain phonological and structural knowledge via direct teaching in the classroom. Thus, the FL learners can be argued to exhibit both levels of speech perception. However, the extent to which their perception can be native-like is subject to the phonological instructions they get in class.

In sum, the present study aimed to examine the perception and production patterns of Syrian Arabic (SA) FL learners of English. The SA FL learners did not have native L2 input, but did have L2 instructions in the classroom by non-native teachers. Thus, the SA participants do not match the descriptions of PAM nor SLM learners. Accordingly, our research questions are: i) to what extent do current L2 models PAM/SLM account for the perceptual and production patterns of SA FL learners?; and ii) in light of the results of the present study, what can we infer about the perception-production link for the FL learners compared to advanced L2 learners? Based on the differences between the FL and PAM/SLM target learners, we predict that neither model can entirely account for the perceptual and production patterns of the FL learners of this study. We expect to find a greater effect of L1 transfer than naturalistic L2 learners, as well as a great effect of classroom instructions.

## THE PERCEPTUAL ASSIMILATION TASK (PAT)

### Methods

The English stimuli were produced by a 41 year old British English male speaker. Similarly, a list of SA target responses was recorded by a 36 year old SA male speaker. The recordings were made in York in .wav format at 44.1 KHz 16 bit, using a Marantz PMD660 and head-mounted Shure SM10 microphone. Ten male and ten female SA participants took part in the PAT. The participants were from Damascus and they all had English formal education during school for at least 8 years. The participants were medium/advanced FL learners of English; they had no exposure to English in an English speaking country. On average, they were 27 years old, and they had English formal education for 11.8 years. The participants were asked to rate their language skills on a 7-point scale and on average their scores were: speaking (4.8), understanding (5.4), reading (5.4), and writing (5.3).

The English stimuli consisted of a set of monosyllabic CVC words. For each of the English vowels (FLEECE, KIT, DRESS, TRAP, STRUT, BATH, LOT, THOUGHT, FOOT, GOOSE, NURSE, FACE, GOAT, PRICE, MOUTH, CHOICE, NEAR, and SQUARE), 4 or 5 representative real English words were used. The English speaker read three randomised blocks of the target words in the phrase 'say ___ again'. Then, the best production of each vowel was chosen and presented to the participants, in total the stimuli consisted of 120 items. The SA alternative responses consisted of a list of real monosyllabic CVC and disyllabic CVCC**V**C words for short vowels since they do not occur in monosyllabic words. SA responses represent the participants' L1 vowel categories (/iː/, /eː/, /aː/, /oː/, /uː/, /i/, [e], /a/, [o], /u/ and [ə]) (Cowell, 1964). Additionally, SA vowel-glide sequences /aj/ and /aw/, which are diphthong-like, were added to the list because some English diphthongs were predicted to map to them. Also, the pharyngealised allophone [aˤː] was added to the list of SA alternatives because of its phonetic similarity to the English BATH vowel. Altogether 14 SA alternative responses were presented throughout the whole task.

The listening experiment was run using Praat MFC experiment. The participants were presented with the English words in the phrase 'say ___ again'. The participants listened to the target English word and then selected the SA/L1 vowel category to which each English vowel was most similar. Then, they rated its category goodness of fit as a good example of the SA/L1 vowel category on a 7-point scale (1-different, 7-identical). There were 14 L1 alternative audio responses, which listeners could listen to as many times as they wished by clicking on the relevant button. Based on the results of a pilot study, the patterns of six English vowel contrasts were found interesting (TRAP, BATH), (FACE, SQUARE), (KIT, DRESS), (LOT, STRUT), (GOAT, THOUGHT) and (NEAR, FLEECE) (Almbark, 2011). Due to space limitation, only the results of the perception and production of English (FACE, SQUARE) and (GOAT, THOUGHT) are presented here, for full results see (Almbark, 2012).

## Results

A confusion matrix was created to show the categorisations of English vowels into their equivalents in SA. Table 1 presents the percentages of categorisations of English (FACE, SQUARE) and (GOAT, THOUGHT). As shown, English FACE and SQUARE were mapped with high percentages into a single SA vowel /eː/ with high but not identical goodness of fit. In contrast, English GOAT and THOUGHT vowels were mapped into a single SA vowel /oː/, with GOAT being more deviant in the number of categorisations and goodness of fit.

A two-sided Fisher's exact test was used to examine the difference between the members of each English contrast in the distribution of the responses into their predicted SA vowel vs. other SA responses grouped together. The results showed there is no significant difference between (FACE, SQUARE) in their categorisation into SA /eː/ vs. other SA responses: p= .877. This result suggests that English (FACE, SQUARE) match the PAM description of the Single Category (SC) assimilation type, in which both L2 sounds assimilate to one phoneme in the native language and both are equally deviant from the native sound, and this yields poor discrimination (Best, 1995).

On the other hand, the results of the Fisher's exact test showed that English THOUGHT was categorised as SA /oː/ significantly more than English GOAT: p=.0001. This finding suggests that English THOUGHT is closer to the SA vowel. Table 1 shows that English GOAT is categorised as equally close to three SA back vowels but not identical to any of them. This suggests that GOAT shares some articulatory-phonetic properties with all these vowels. The description of English (GOAT, THOUGHT) matches the PAM Category Goodness (CG) assimilation type, in which each member of the L2 contrast assimilates to the same native category with one of the members being more deviant from the native sound than the other, for which PAM predicts good descrimination, but not as good as the members of a Two Category (TC) assimilation type.

**Table 1:** Percentages of the categorisation of the English vowel contrasts into SA vowels, showing goodness of fit ratings (in brackets: 1 different- 7 identical), and the total number of responses for each English vowels (in bold). Shaded cells show the predict categorisation.

| English vowel | /iː/ | /i/ | /eː/ | [e] | /aː/ | [aːˤ] | /a/ | /oː/ | [o] | /uː/ | /u/ | [ə] | /aj/ | /aw/ | NUM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FACE | | 6 (4) | 63 (5) | 6 (4) | | 1 (2) | 2 (2) | | | | 2 (2) | 4 (5) | 16 (5) | | **90** |
| SQUARE | 2 (2) | 6 (5) | 65 (5) | | 2 (2) | 7 (4) | 2 (1) | | | 2 (2) | | 4 (5) | 9 (6) | 1 (2) | **90** |
| GOAT | | 2 (4) | | | | 1 (1) | 1 (4) | 34 (4) | 7 (4) | 23 (5) | 19 (5) | 4 (2) | | 9 (3) | **72** |
| THOUGHT | | | | | | | | 68 (6) | 1 (2) | 13 (5) | 7 (6) | | | 11 (4) | **72** |

## THE IDENTIFICATION TASK

### Methods

The recording procedures of the English stimuli were the same as in the PAT. The same 20 SA participants took part in the identification task. Five Native English (NE) female and four male speakers participated as a control group. The NE participants were 32.8 years old on average. The stimulus material consisted of a list of real monosyllabic CVC words. All target words were recorded and presented in the phrase used in the PAT, 'say ____ again'.

The identification task was designed to examine only the identification and discrimination of the six English vowel contrasts. Similar to the previous section, only the results for English (FACE, SQUARE) and (GOAT, THOUGHT) will be presented. The identification task was presented to the participants using Praat MFC experiment in two parts. The first part aimed to examine the identification of the target English vowels and the responses consisted of 5 or 4 CVC minimal words which differed in their vowel, amongst which the participants were asked to choose the word they hear. The identification task was immediately followed by paired presentation of the minimal words representing the target English vowel contrasts paired with each other and with the other distracters from the first part of the task and the participants were asked to choose the word they hear. The aim of the paired presentation was to obtain discrimination results of the vowel contrasts under investigation. Altogether, 162 items were presented to the participants.

### Results

The correct vs. incorrect identification of the target vowels was calculated across all SA participants. Table 2 below presents the percentages of the correct and incorrect identification for these English vowels. The shaded cells presents the discrimination results of the target vowels. A similar table was created for NE participants, whose identifications were 100% correct for the same vowels. Fishers' exact tests were used to compare SA and NE results, and to compare the identification and the discrimination of the members of these contrasts.

**Table 2.** Percentages of correct (shaded cells) and incorrect identification of the English vowel contrasts by SA participants.

| | TRAP | BATH | LOT | STRUT | FACE | SQUARE | KIT | DRESS | GOAT | THOUGHT | FLEECE | NEAR | **NUM** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FACE | | | | | 95 | | 2 | | | | 3 | | **240** |
| SQUARE | | | | | | 98 | | 2 | | | | | **200** |
| GOAT | | | 13 | | | | | | 73 | 14 | | | **440** |
| THOUGHT | | | | | | | | | 23 | 77 | | | **200** |

Table 2 shows that SA participants had excellent identification of (FACE, SQUARE) vowels, which is close to NE participants': p=.837. Contrary to the PAM prediction, the SC contrast English FACE and SQUARE had a similarly high correct identification: p = 0.082, as well as excellent discrimination: p < .0001. In contrast, English (GOAT, THOUGHT) vowels had very good identification, but not as good as NE (100%). However, the results of the Fisher's exact test showed that L2 productions were not significantly different from those of the NE: p=.745. Additionally, there was no significant difference between GOAT and THOUGHT: p=.379. ] shows that 14% of English GOAT was misidentified as THOUGHT, and 23% of English THOUGHT was misidentified as GOAT. Nevertheless, there was a significant difference in the identification of these vowels: p=.0001, which meets the PAM prediction for the CG contast, i.e. correctly identified and with very good discrimination.

Flege (1995) argues that L1 and L2 sounds are perceived as allophones, which suggests that they are phonologically similar but phonetically different. Additionally, the SLM argues that in order to have accurate L2 production, learners are required to have accurate L2 perception (arguably Flege means native-like). Based on the results of the PAT and the identification task, the members of (FACE, SQUARE) and (GOAT, THOUGHT) contrasts are predicted to be produced with distinct acoustic parameters, but not necessarily native-like, as none of these vowels were given an identical goodness of fit rating to their L1 equivalents in the PAT.

## THE PRODUCTION TASK

### Methods

The same 10 male and 5 of the 10 SA female participants were recorded for this study. Also, the same 9 NE participants were recorded as a control group. The recording procedures were the same for all participants. The SA participants were recorded at Asia Institute for Languages in Damascus, whereas the NE participants were recorded at the University of York. The English stimuli consisted of a full list of /hVd/ (except for word final <r>) words representing all English vowels (heed, hid, head, had, hudd, hard, hod, hawed, hood, who'd, heard, hayed, hoed, hide, howdy, hoyed, hear, and hair), however, the vowels representing the six English contrasts under investigation were analysed. The target words were produced in the phrase 'say ____ again'. The participants produced five repetitions of the stimuli and the best three productions were chosen and analysed. Similarly, the SA participants produced five blocks of SA/L1 vowels which consisted of /hVd/ words produced in the phrase /ktoːb ____ marteːn/ “Write ____ twice”, representing the following vowels (/iː/, /eː/, /aː/, /oː/, /uː/, /ɪ/, /e/, /a/, /o/, /u/, /ə/, /aj/, /aw/, and /aːˤ/) (Cowell, 1964). To ensure that the speakers produce the target vowels correctly, a real monosyllabic /CVC/ word, that had the same target vowel as the one in the /hVd/ context, was presented simultaneously. The speakers were asked to produce the target /hVd/ word with the same vowel as in the real word.

The analysis included vowel duration, which was normalised over the word duration, and F1 and F2 frequencies, which were also normalised using Lobanov procedure. The results of these analyses were put into a series of Linear Mixed Model (LMM) tests, with normalised vowel duration, normalised F1 and F2 as dependent variables, and ‘language’ with three levels: NE, SA (L1), and SA (L2), as a fixed factor, but ‘participant’ as a random factor.

## Results

The results of the LMM showed that language had a significant effect on normalised vowel duration differences for FACE: $F(2,108) = 36.14$, $p < .000$*, for SQUARE: $F(2,107) = 91.18$, $p < .000$*, for GOAT: $F(2,108) = 25.5$, $p < .000$*, and for THOUGHT: $F(2,107) = 47.3$, $p < .000$*. Bonferroni post hoc tests showed that L2 productions of (FACE, SQUARE) were significantly shorter than NE productions ($p < .000$), but longer than L1 productions ($p < .000$). A LMM showed that L2 productions of FACE were significantly shorter than L2 SQUARE: $F(1,86) = 30.3$, $p < .000$*. Similarly, L2 productions of (GOAT, THOUGHT) were significantly shorter than NE productions ($p < .000$), however, L2 productions were similar to L1 /oː/ duration ($p=1$), which can be seen in Figure 1. A LMM showed that L2 productions of (GOAT, THOUGHT) do not differ from each other: $F(1,85) = .21$, $p = .642$.

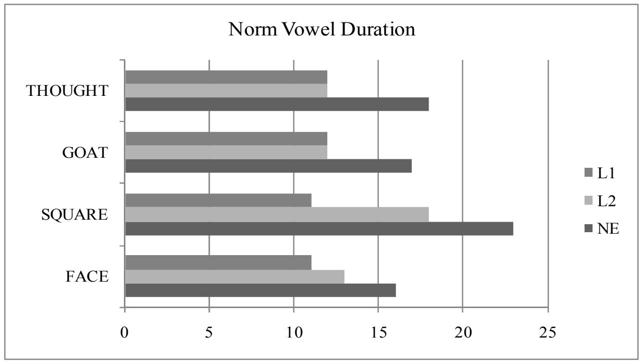


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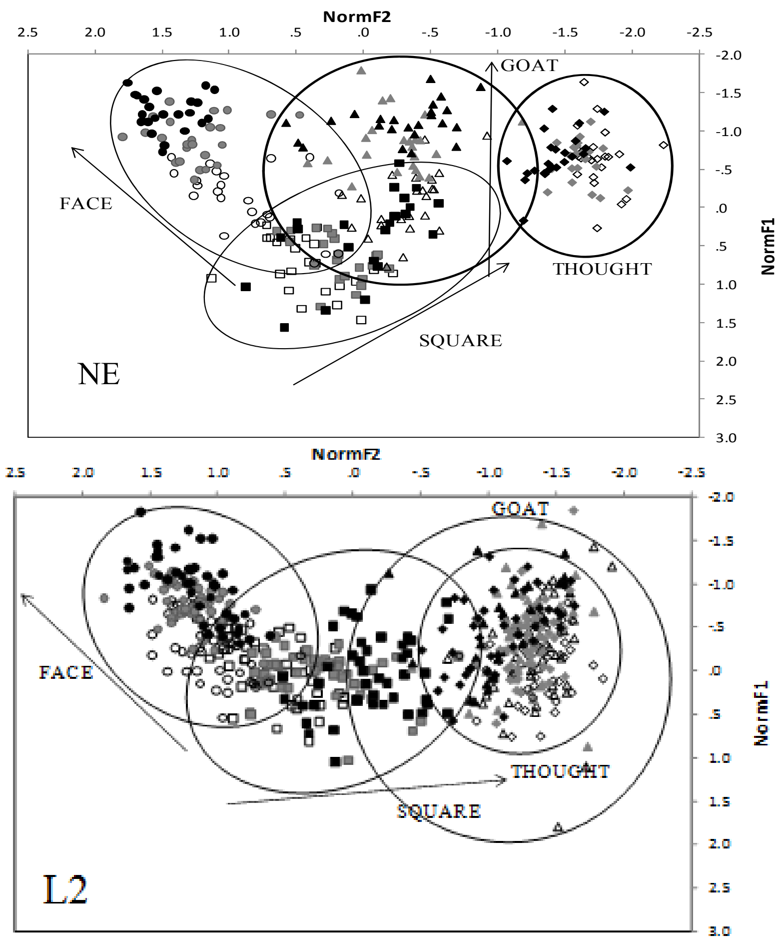
**Figure 1.** Normalised vowel duration of L2 productions of English (FACE, SQUARE) and (GOAT, THOUGHT) by SA participants compared to their L1 productions of SA /e:/ and /o:/, respectively, and to NE productions



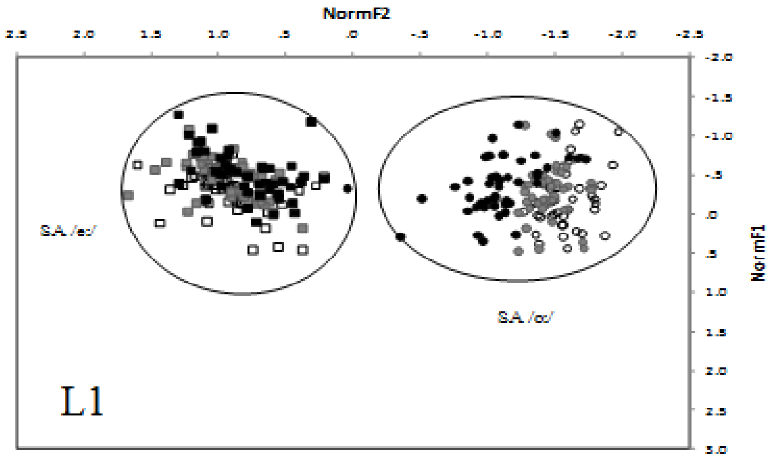



**Figure 2.** Normalised F1/F2 of L2 productions of English (FACE, SQUARE) and (GOAT, THOUGHT) by SA participants compared to their L1 productions of SA /e:/ and /o:/, respectively, and to NE productions. The measurements were taken at 25% (clear), 50% (grey), and 75% (black) of the vowel.

The results of the LMM showed that language had a significant effect on normalised F1 and F2 differences for (FACE, SQUARE) and (GOAT, THOUGHT) throughout the vowel (25%, 50%, and 75%): $p < .000$. Post hoc tests showed that F1 and F2 of L2 FACE productions differed significantly from NE productions at the on-glide 25% and off-glide 75%: $p < .000$. This shows that L2 FACE was produced with a less clear trajectory which differed from the trajectory produced by NE. Similarly, F1 of L2 SQUARE were significantly different from NE productions: $p < .000$, whereas F2 values were not different from NE productions: 25% ($p = .306$), 50% ($p = 1$), and 75% ($p = .239$). These findings suggest that the SA participants produced SQUARE with a trajectory similar to NE but on a higher position. Figure 2 above shows that L2 productions of (FACE, SQUARE) differ from their L1 equivalent vowel /e:/, which is a monophthong. Furthermore, F1/F2 of L2 productions of (FACE, SQUARE) were compared using a LMM test. The results showed that L2 FACE and SQUARE were produced with distinct F1 and F2 throughout the vowel: $p < .000$, which supports what is predicted for this contrast, i.e. produced with distinct acoustics but not native-like.

Similarly, the Bonferroni post hoc tests showed that L2 GOAT productions were significantly different from NE productions in F1 and F2 values throughout the vowel: ($p < .000$), but not different from their L1 equivalent productions of /o:/. Compared to their L1, L2 productions were significantly fronter (F2) than their L1 productions at the beginning (p <

.000) and midpoint ($p=.003$) of the vowel, but similar at the 75% of the vowel ($p = 1$). On the other hand, L2 THOUGHT productions differed from NE significantly in F1 at the beginning and midpoint of the vowel ($p < .000$), ($p=.024$), but not at the end ($p=.222$). Additionally, L2 productions differed from NE productions in F2 throughout the vowel ($p < .000$). Compared to their L1, L2 productions of THOUGHT differed in F1 and F2 throughout the vowel: ($p < .000$). Another LMM showed that L2 GOAT and THOUGHT productions did not differ from each other in F1 and F2 values throughout the vowel, which contradicts what is predicted for this contrast, i.e. L2 (GOAT, THOUGHT) were produced with overlapping F1 and F2 values, which can be seen in.

## DISCUSSION

The results of this study showed that English FACE and SQUARE were mapped into a single SA category with high goodness of fit. Contrary to what is predicted by PAM (Best, 1995), this SC contrast had excellent identification and discrimination, and they were produced with Distinct acoustic Parameters (DP). On the other hand, English GOAT and THOUGHT were mapped into a single SA category with THOUGHT being closer to the L1 vowel. This CG contrast had good identification and discrimination, which coincides with the PAM prediction. However, GOAT and THOUGHT were produced with Overlapping acoustic Parameters (OP), suggesting that the lack of accuracy in perception led to inaccurate production, which is predicted by the SLM (Flege, 1995).

The findings of this study can be explained by referring to FL learning as opposed to the naturalistic L2 learning of the SLM or naive L2 listening of the PAM. With little native L2 exposure, the FL learners of this study can be argued to have had classroom instruction (phonemic) which highlights the distinction between the (FACE, SQUARE) vowels but not between (GOAT, THOUGHT). Having this classroom instruction suggests that the participants were referring to a phonemic distinction when they perceived and produced the first contrast. As for (GOAT, THOUGHT), it can be argued that little or no classroom instruction was given to highlight this contrast. The difference between both contrasts in classroom instruction can be argued to be a result of perceivable phonetic difference, i.e. there is enough phonetic difference between FACE and SQUARE to be discriminated and taught more than the difference between GOAT and THOUGHT.

Based on this suggested argument, the participants exhibited phonological (phonemic) perception similar to naturalistic L2 learners. However, since the perception and production of FL learners are not based on native L2 input, the outcome would be maintained phonemic contrasts but not necessarily native-like. Additionally, the FL participants exhibited phonetic perception similar to naive listeners, which they may have referred to when they failed to create a phonemic distinction, which was evident in the L2 patterns of (GOAT, THOUGHT): in the PAT, (GOAT, THOUGTH) were distributed over SA back vowels in general, whereas (FACE, SQUARE) were mapped mainly into a particular SA category. Thus, the participants can be argued to be able to overcome the irrelevant phonetic variations of the second contrast (perceived phonologically), but not the phonetic variations of the first contrast (perceived phonetically).

In conclusion, current L2 models (SLM, PAM) cannot account for FL speech unless they take into consideration the peculiarities of FL learners compared to naive and/or naturalistic L2 learners. Thus, a Foreign Language Model (FLM) is needed and it should take into account: i) FL learners have mainly phonological perception (phonemic unless learners receive further phonotactic/allophonic instructions); they also have phonetic perception, i.e. they can detect phonetic differences between L1 and L2 sounds or between two L2 sounds, if the differences are noticeable, or learners can be trained to respond to these differences via direct instruction, ii) the perceptual skills of FL learners are reflected in the distinctiveness of their L2 productions, iii) if the FL learners were taught phonetic differences between L1 and L2 sounds, a new phonetic category can be established for an L2 sound, however, phonetic instructions may not be native like, thus, the new category will not be native like.

Although, the target for English teaching is usually British English or American English, what is actually perceived and produced by FL learners does not match any of these models. The FL learners do not necessarily have the motivation or the need to be native-like. Thus, Jenkins (2000) suggested to set out a different target for such learners: the Lingua Franca Core (LFC), in which what matters is to maintain phonological consistency and distinctiveness. Bearing this in mind, being non-native like should not be counted as erroneous.

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