ARE FRENCH SPEAKERS ABLE TO LEARN TO PERCEIVE LEXICAL STRESS CONTRASTS?

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ABSTRACT

The aim of this research is to examine whether French speakers are able to store and retrieve lexical stress information, using a task in which shapes and Spanish pseudowords are matched. The role of the acoustic correlates of lexical stress in the integration of the accentual information was also studied. Results do not seem to support the hypothesis of 'stress deafness'.

Keywords: 'stress deafness', lexical stress contrasts, acoustic correlates, French, Spanish L2

1. INTRODUCTION

French speakers learning Spanish as a second language (L2) tend to place the lexical stress in the last syllable of a word or phrase. Since French is a fixed-stress language in which stress generally appears in final position, an accentual transfer seems to occur when French speakers attempt to pronounce proparoxytone or paroxytone words in a free-stress language such as Spanish. This difficulty might be explained by the effect of a 'phonological filter' [9] that would cause an insensitivity to perceive, and therefore, an inability to produce, contrastive stress differences.

Along the same lines, the notion of 'stress deafness' has been put forward by Dupoux and his coworkers [4, 5, 6], whose studies, using different experimental procedures, suggest that sensitivity to stress placement depends on the cognitive load required by the task and on the phonetic variability and the lexical status of the stimuli. Taken together, these experiments lead to the conclusion that French speakers are unable to encode contrastive stress in their phonological representations although they might be capable, in certain tasks, to make use of the acoustic cues which are present in the speech signal.

This research aims at shedding more light on the hypothesis of 'stress deafness' in French speakers. More precisely, the first goal is to determine whether French speakers are able to learn to perceive lexical stress contrasts, i.e. whether they are capable, after training, to store and retrieve accentual information. The second goal is to define the role of the acoustic parameters (F_0, duration and amplitude) in the storage of the accentual information.

The experiment involved two phases. During the first phase (*Training* session), participants learned triplets of pseudowords with accentual contrasts by associating these pseudowords to visual shapes (see [3] for a similar experimental design). In the second phase (*Test* session), participants performed the same task on the same pseudowords that they had learned during the training phase but with acoustic manipulations of F_0, duration, and amplitude.

2. METHOD

2.1. Participants

Twenty-two native speakers of French (from the French part of Switzerland), aged between 18 and 26 (mean = 20.4), with no knowledge or contact with Spanish or Italian (hereafter 'non-natives', 'NNs'), and 22 bilingual Spanish/Catalan speakers aged between 18 and 31 (mean = 20.7), with no knowledge or contact with French (hereafter 'natives', 'Ns') participated in the study.

2.2. Materials

Six trisyllabic Spanish pseudowords were taken from the material used in [7]. Each triplet consisted of a proparoxytone (PP; e.g. ***lú**guido*), a paroxytone (P; e.g. *lu**gui**do*) and an oxytone (O; e.g. *lugui**dó***). Following [3], 6 visual shapes were also created and were randomly pairwise associated with the pseudowords.

2.3. Acoustic stimuli

The acoustic stimuli were taken from [7]. For the training session, the 6 stimuli were used in their original form, with no acoustic manipulation. In the test session, the 6 stimuli were used in their manipulated forms, which resulted in a shift to the right of the accentual information. More precisely, in proparoxytone and paroxytone pseudowords (i.e. ***lú**guido* and *lu**gui**do*), F_0, amplitude and duration values for each vowel were replaced by the corresponding F_0, amplitude and duration values found in the equivalent paroxytone and oxytone pseudowords, respectively (i.e. *lu**gui**do* and *lugui**dó***), which leads to the *PP>P* and *P>O* manipulated stimuli. The values were modified not only individually, but also simultaneously, obtaining seven possible combinations of manipulated parameters, which allows the study of the effects of each acoustic cue both in isolation and in combination with the others.

2.4. Procedure

The *Training session* consisted of five blocks: four with feedback on the correct response followed by one with no feedback. This final block allowed to evaluate participants' performance at the end of training.

The structure of the training was as follows. First, a fixation point appeared for 1500 ms on the screen. Next, four shapes were presented on the screen, and participants heard one of the six pseudowords. They were instructed to click on the shape that they thought corresponded to the pseudoword (they had 3000 ms to do it). In the first four blocks, after each response, the three distractor shapes disappeared, leaving only the correct shape for 3000 ms, and the pseudoword was presented again. In the last block, all four shapes disappeared after 3000 ms, and the next trial started.

Each training block consisted of 36 trials. Within each block, each of the 6 pseudowords appeared as target 6 times (e.g. ***lú**guido*). Of the three distractor shapes in each trial, one was the shape associated with one of the other two members of the triplet (e.g. *lu**gui**do*). The other two were selected from the three shapes of the other triplet (e.g. ***má**ledo* and *ma**le**do*), so that each shape appeared the same number of times per block. Moreover, all shapes appeared the same number of times in each of the four positions of the screen.

The *Test* session consisted of one block (84 trials) in which participants were instructed to answer as quickly as possible and did not receive feedback. Each manipulated pseudoword (e.g. PP>P) was presented with the shape corresponding to the original pseudoword (i.e. with stress on the original position; e.g. PP) and with the shape corresponding to the stress-shifted pseudoword (i.e. with the intended shifted stress; e.g. P). The other two shapes were selected from the three shapes of the other triplet, so that each shape appeared the same number of times. Again, all shapes appeared the same number of times in each of the four positions of the screen.

2.5. Data analysis

Some participants (natives and non-natives) had to be excluded because of memorization difficulties and/or an important number of missing data caused by very slow responses. The entire data set of eight non-natives and six natives was removed from the analysis, which leads to 14 non-natives and 16 natives.

Analyses were performed on the correct/incorrect participants' responses. *Correct* in the analyses of the test data means that the participant has perceived the stress shift, and thus has clicked on the shape corresponding to the intended position of stress (for example, on the shape of *lu**gui**do* with PP>P manipulated stimuli).

We analyzed the data by means of mixed-effects regression models [1], in which participants and pseudowords were entered as random terms. Statistical analyses were run with the statistical software R and mixed-effects models were computed with the package lme4 [2]. For clarity's sake, the results and figures are presented in percentages, although all statistical analyses have been performed on raw data.

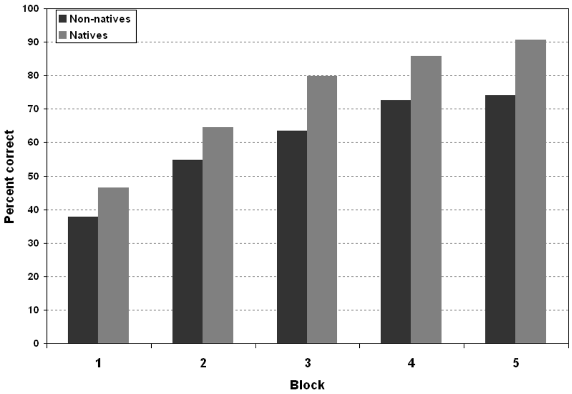
3. RESULTS AND DISCUSSION

3.1. Training

The first aim of this research is to determine whether French speakers are able to learn to perceive Spanish lexical stress contrasts and, if this is the case, how far are their performances from native Spanish ones.

To this end, we examined whether the response (correct vs. incorrect in the training session) is influenced by group (natives and non-natives), block (1, 2, 3, 4 and 5) and pattern (PP, P, O), or by an interaction between these variables. Figure 1 presents the results. As pattern has no effect on the responses, the PP, P, and O data are grouped together.

Figure 1: Percent correct responses (in the training session) as a function of group and block.



Despite the difference observed between non-natives (60.36%) and natives (73.25%), group does not have a significant impact on the responses (F(1, 5043)=3.34, n.s.). On the other hand, the model shows an effect of block (F(4, 5043)=127,08, p<0.001), reflecting the learning progression along the training session, whatever the group may be. More interestingly, an interaction between group and block is observed (F(4, 5043)=5.39, p<0.001), indicating that the difference between both groups is not similar across all the blocks. While there is no significant difference between natives and non-natives in the two first blocks, natives performed significantly better in the last three ones (Block 3: β=0.91, z=3.04, p<0.01; Block 4: β=0.87, z=2.8, p<0.01; Block 5: β=1.29, z=4.01, p<0.001), suggesting that the learning process is similar for both groups at the beginning of training, but that, after a phase of familiarization, natives present less difficulties in performing the task than non-natives.

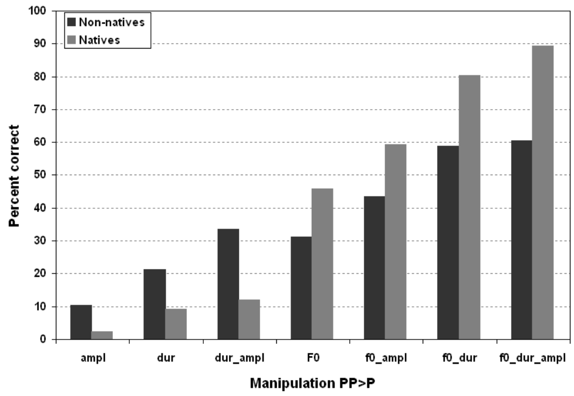
Moreover, it is interesting to note that the performance in the fifth block (with no feedback) differs significantly from the fourth one for natives (90.5% and 85.58%, respectively; β=0.53, z=2.68, p<0.01), but not for non-natives (73.94% and 72.38%, respectively; β=0.10, z=0.67, n.s.). Two reasons might explain the absence of difference in non-natives. Firstly, the pressure caused by the absence of feedback might have interfered with their performance progression. Secondly, non-natives might have reached a ceiling effect, which would suggest that their performances can not be improved beyond this stage.

3.2. Test

The second aim of this experiment is to examine the role of the acoustic correlates of lexical stress (F_0, duration and amplitude) in the storage of accentual information in French speakers.
To this end, we studied whether the response (correct vs. incorrect in the test session) is influenced by group (natives and non-natives), pattern (PP>P, P>O) and manipulation, or by an interaction between these variables. As pattern significantly interacts with group (F(1, 2177)=24.64, p<0.001) and with manipulation (F(6, 2177)=3.99, p<0.001), we ran two separate models for each of the patterns (PP>P and P>O), with response (correct vs. incorrect) as dependent variable and with group and manipulation as factors.

Figure 2 presents the results for the PP>P stimuli used in the test session. While there is no effect of group (Ns=41.44%; NNs=36.19%; F(1, 1090)=1.48, n.s.), results show an effect of manipulation (F(6, 1090)=27.88, p<0.001) and, more interestingly, a clear interaction between group and manipulation (F(6, 1090)=9.79, p<0.001).

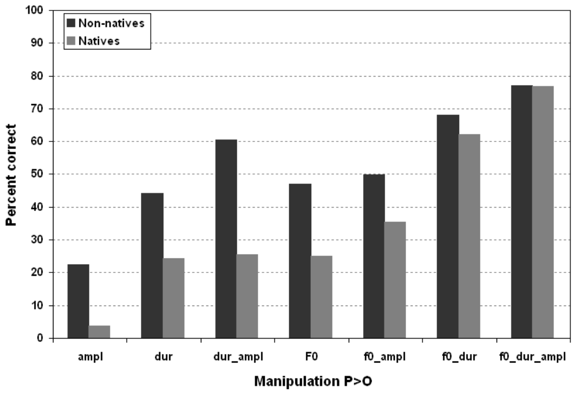
Figure 2: Percent correct responses for PP>P stimuli as a function of group and manipulation.



Non-natives are equally sensitive as natives to the manipulation of F_0 alone (NNs=30.95%, Ns=45.73%; β=-0.63, z=-1.44, n.s.) and to F_0 combined with amplitude (NNs=43.21%, Ns=59.17%; β=-0.66, z=-1.49, n.s.), but they are significantly less sensitive than natives to the manipulation of both F_0 and duration (NNs=58.57%, Ns=80.10%; β=-1.54, z=-3.22, p<0.01) and to the simultaneous manipulation of the three parameters (NNs=60.24%, Ns=89.17%; β=-2.27, z=-4.19, p<0.001). Inversely, non-natives are more sensitive than natives to the isolated manipulation of duration (NNs=20.95%, Ns=9.06%; β=1.38, z=2.39, p<0.05), of amplitude (NNs=10.24%, Ns=2.08%; β=2.00, z=2.28, p<0.05) and to the combined manipulation of duration and amplitude (NNs=33.33%, Ns=11.88%; β=1.43, z=2.83, p<0.01).

Figure 3 presents the results for the P>O stimuli used in the test session. We observe an effect of group (F(1, 1081)=3.91, p=0.05), with better performance for non-natives (51.67%) than for natives (35.45%), suggesting that French speakers have less difficulties in perceiving an oxytone stress than Spanish speakers, maybe as a consequence of the oxytone nature of stress in French.

Figure 3: Percent correct responses for P>O stimuli as a function of group and manipulation.



Results also show an effect of manipulation (F(6, 1081)=26.72, p<0.001) and an interaction between group and manipulation F(6, 1081=5.26, p<0.001), indicating that both group are not equally sensitive to all manipulations. Indeed, there is no difference between both groups when F_0 is combined with duration (NNs=67.78%, Ns=61.88%; β=-0.19, z=-0.37, n.s.), with amplitude (NNs=49.63%, Ns=35.21%; β=0.75, z=1.51, n.s.) and with duration and amplitude (NNs=76.85%, Ns=76.67%; β=-0.72, z=-1.27, n.s.), suggesting that, with these manipulations, non-natives perceive stress shift like natives do. On the other hand, non-natives perceive better the accentual shift with isolated manipulations of duration (NNs=44.07%, Ns=24.06%; β=1.60, z=2.96, p<0.01), F_0 (NNs=46.85%, Ns=24.79%; β=1.14, z=2.21, p<0.05) and amplitude (NNs=22.22%, Ns=3.65%; β=2.24, z=2.54, p<0.05), and with a combined manipulation of duration and amplitude (NNs=60.37%, Ns=25.21%; β=1.96, z=3.52, p<0.001).

4. CONCLUSION

Results show that French speakers are able to learn lexical stress contrasts. In other words, they have the capacity to integrate (at least, temporarily) and retrieve the accentual information although their performances are not as good as those of Spanish native speakers. Thus, our results do not seem to support the conclusions of Dupoux and collaborators [4, 5, 6] concerning ‘stress deafness’. French speakers performed reasonably well in the shape/pseudoword matching task, which implies not only acoustic strategies, but also the storage and the retrieval of accentual information.

As for the acoustic parameters involved in the integration of lexical stress information, French speakers tend to be more sensitive to duration and amplitude than Spanish speakers. In fact, French speakers show more sensitivity to forms that are little deviant from the ones they have stored during the training session, while Spanish speakers, used to such variations, do not perceive them.

In conclusion, taken together with the results of [8] showing that French speakers are able to develop acoustic strategies in their perception of Spanish lexical stress, this research casts doubt on the existence of ‘stress deafness’ in French speakers.

5. REFERENCES

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