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MUSIC AND L2 PROSODY: THE ROLE OF MUSIC APTITUDE ON THE DISCRIMINATION OF STRESS CONTRASTS IN L2

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ABSTRACT

In this study, we investigated the effect of music aptitude on French and German listeners' performance at discriminating stress contrasts in Spanish L2, before and after a 4-hour perceptual training in Spanish. For the French listeners, results showed that the better the music aptitude the better the stress discrimination performance (before and after training). Regarding German listeners, music aptitude did not show any effect on the discrimination of stress contrasts in Spanish L2.

The link between music and L2 stress discrimination in French listeners (and its absence in German listeners) suggests that French and German listeners do not process stress information in the same way. It might be that, since French listeners, contrary to German listeners, are not used to stress encoding mechanism in their native language, they interpret information related to L2 prosody (such as lexical stress) in a more "musical way".

Keywords: music aptitude; L2 prosody; lexical stress; stress discrimination; stress 'deafness'

1. INTRODUCTION

Although initiated decades ago (e.g., [19]), the study of the existence of a link between language and music has considerably developed in the last years (e.g., special issue *Frontiers in Psychology* [8]). Among the extensive research dealing with this link, of particular interest for the purpose of the present research are the studies about the influence of musical expertise on pitch perception.

These studies have mostly dealt with the discrimination of fundamental frequency (f0) (i.e., acoustic correlate of pitch variations) in non-linguistic material (i.e., tones). The results showed that the discrimination of f0 variations was more accurate in musicians than in non-musicians. (e.g., [12]). Similar conclusions have been found in studies using linguistic material in native language (L1) or in foreign/second language (L2). For example, researchers (e.g., [14], [10], [11]) asked native and non-native musicians and non-musicians to hear sentences and to decide whether the pitch of the last word was correct or not. Taken together, their results revealed that musicians were more sensitive to small f0 variations than non-musicians, whether in L1 or L2.

In these studies, although f0 variations were examined in linguistic material, they did not convey a linguistic/semantic meaning (i.e., they did have any distinctive function). Yet, it is well known that f0 variations are used, in some languages, to signal differences in word meaning. For example, f0 variations are involved in the realization of lexical stress in languages like Spanish. A change in f0, coupled with changes in duration and amplitude, implies a change in the position of the stressed syllable (e.g., [13]) and thus a change in the word meaning (e.g., *número,* '(the) number' versus *numero*, 'I number' versus *numeró*, 'he numbered'; the stressed syllable is underlined). Thus, it is interesting to study, as we aim in the present research, whether musical skills enhance the perception of f0 variations when these convey linguistic meanings.

The examination of the effect of musical skills on the discrimination of stress contrasts in native French listeners is of particular interest. Since stress in predictable in French, French listeners present difficulties in discriminating stress contrasts in a second language that has unpredictable stress, like Spanish (e.g., [3], [4], [5], [16]). On the basis of these difficulties, researchers have even assumed that French listeners were phonologically 'deaf' to stress. (e.g., [4]). On the other hand, native listeners of unpredictable stress languages, like German or English, are not supposed to suffer from stress 'deafness' in a second language, since they are used to stress encoding mechanisms in their native language.

To our knowledge, only three studies have investigated the influence of musical expertise on the perception of lexical stress in L2 by French listeners (e.g., [9], [2], 15]). Using different experimental tasks (sequence repetition, discrimination of stress contrasts or identification of the stressed syllable), they all showed that musical expertise significantly helped French listeners to discriminate stress contrasts or to identify the stressed syllable in a second language with unpredictable stress (i.e., Dutch, English, Spanish).

Two aspects differentiate the present research from the aforementioned studies. First, participants in the aforementioned studies were classified in two

categories: musicians with many years of musical experience and non-musicians. In the present research, the participants' musical skills are not categorized into musicians and non-musicians, but are viewed as scores ranging from 0 to 100%.

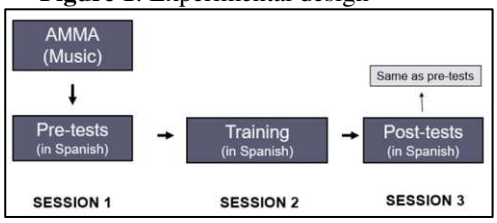
The second difference with previous studies concerns the participants' native language. In the present study, we investigate the impact of music aptitude on the discrimination of L2 stress contrasts in native listeners of a language with predictable stress (i.e., French) and in native listeners of a language with unpredictable stress (i.e., German).

Our research thus aims to examine whether there is a relationship between music aptitude and the discrimination of L2 stress contrasts, and to determine whether this relationship differs in French and German listeners.

2. METHOD

Participants took part in 3 experimental sessions (see Fig. 1). In session 1, they performed a music aptitude test (i.e., AMMA) and pre-tests. In session 2, participants were administered a perceptual training on Spanish lexical stress. In session 3, they performed post-tests (2 days after training), these tests being similar to the pre-tests they performed in session 1. All the tests (AMMA, pre-, post-tests, training) were run with Praat scripts ([1]).

Figure 1: Experimental design



2.1. Participants

Two groups of learners took part in the study. The first group was composed of 49 Swiss French listeners with no knowledge of Spanish or other Romance language (mean age: 22.29 years, stdev: 2, age range: 19-27 years). The second group was composed of 50 Swiss German listeners with no knowledge of Spanish or other Romance language, except French (mean age: 21.7 years, stdev: 2.29, age range: 17-26 years).

2.2. Music aptitude test

We adapted the Advanced Measures of Music Audiation test (i.e., AMMA) developed by [7]. Participants performed a discrimination task in which they heard 16 sequences of two melodies. They had to indicate whether the two melodies were identical or different. As in the original test, the differences between the two melodies were tonal or rhythmic.

2.3. Pre- and post-tests

Participants performed an Odd-One-Out task in the pre- and in the post-tests. They heard trials of three segmentally identical Spanish words (e.g., *numero*). Among them, two words presented the same stress pattern (e.g., stress on the penultimate syllable) and one (i.e., the *odd*) presented a different stress pattern (e.g., stress on the final syllable). Participants' task was to indicate which of the three words was the deviant word (i.e., 'odd-one-out'; [16]).

2.4. Training

Participants received a 4-hour training on Spanish accentuation, divided into eight 30-minute sessions over two weeks (see [17], for details). Half of the participants received an explicit training, while the other half received an implicit training. The former approximated the situation of a pronunciation course, where participants were given explicit explanations about the Spanish stress system and performed exercises commonly used in pronunciation courses (localization, discrimination and identification of stress patterns). The latter approximated a situation of immersion, where the participants received no explicit explanations and had to perform only one task during the entire training, namely, a Shape-Word Matching Task (see [18] for details).

2.5. Data analysis

As far as the music aptitude test was concerned, we calculated, for each participant, the percent correct as well as the d' measure taken from the Signal Detection Theory (see [6]). Regarding the pre- and post-tests, the percent correct was calculated as accuracy measurement for each participant. We also computed the participants difference score by subtracting his/her score at the pre-test from his/her score at the post-test.

Statistical analyses were conducted separately for French and German listeners. For each listener group, multiple linear regression models were run with the following dependent variables: percent correct in pre-test, percent correct in post-tests and difference score. The following factors were included in each model: Music aptitude (centered on the mean), Training method (explicit/implicit) and the interaction Music aptitude x Training method. Since the results were similar with both measurements of music aptitude (percent correct and d'), we present, in the next sections, the results related to music aptitude expressed in percent correct.

3. RESULTS

3.1. Preliminary analyses

In agreement with previous studies, the performance of the German listeners at pre- and post-tests (75% and 81%) was significantly higher than those of the French listeners (50% and 58%; pre-test: $t(97) = 8.28$, $p < .001$; post-test: $t(97) = 7.38$, $< .001$). The variability found in the performance of both groups was similar in pre-test (German stdev = 14; French stdev = 16; $F(1, 97) = 0.8$, $p = .77$), but was smaller in post-test for German than for French listeners (German stdev = 12; French stdev = 18; $F(1, 97) = 5.95$, $p = .02$). Moreover, German and French did not differ in their performance and variability in musicaptitude (German = 79%, stdev = 13; French = 77%, stdev = 11; $t(97) = 0.73$, $p = .47$; $F(1, 97) = 0.82$; $p = .37$).

3.2. French listeners

Given that the interaction Music aptitude x Training method was not significant in none of the analyses (pre-test, post-test, difference score), it was removed from the final models.

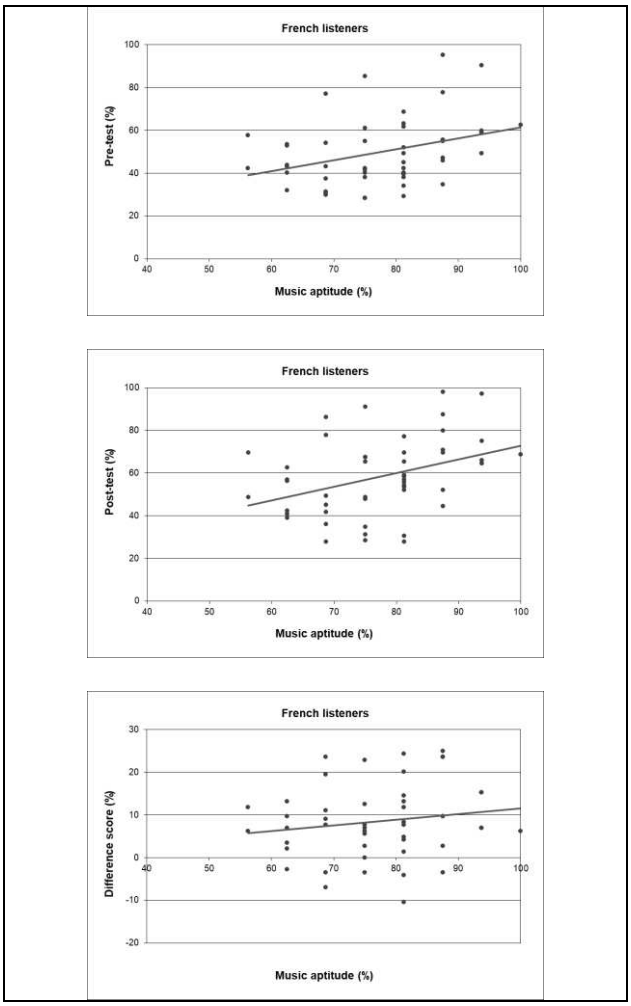
Regarding the performance at pre-tests (Fig. 2, top), a marginally significant regression equation was found ($F(2, 46) = 2.32$. $p = .09$) with an R^2 of 10%. Contrary to training method ($\beta = 0.35$, $p = .94$), music aptitude significantly predicted performance at pre-test ($\beta = .0.48$, $p = .03$). The better the music aptitude, the better the discrimination of stress contrasts in L2 in pre-tests.

As far as performance at the post-tests (Fig. 2, middle) was concerned, a significant regression equation was found ($F(2, 46) = 3.85$. $p = .03$) with an R^2 of 10.6%. Like in the pre-tests, music aptitude significantly predicted stress discrimination performance ($\beta = 0.64$, $p = .01$), whereas training method did not ($\beta = -2.06$, $p = .68$). Again, the better the music aptitude, the better the discrimination of stress contrasts in L2 in post-tests.

As for difference score (i.e., improvement between pre- and post-tests; Fig. 2, bottom), the regression equation was not significant ($F(2, 46) = 1.29$. $p = .29$) and the R^2 was 1.2%. None of the predictors significantly predicted the difference score (music aptitude: $\beta = 0.16$, $p = .21$; training method: $\beta = -2.41$; $p = 0.35$).

Since the amount of improvement may be affected by participants' pre-test scores, we ran an additional analysis on post-test scores with both pre-test and musical aptitude scores as predictors. A significant regression equation was found ($F(3, 45) = 50.6$. $p < .001$) with an R^2 of 76%. Whereas the pre-test scores significantly predicted the post-test scores ($\beta = 0.94$, $p < .001$), music aptitude and training method did not (music aptitude: $\beta = 0.19$, $p = .16$; training method: $\beta = -2.38$; $p = 0.35$). This finding indicates that the listeners' post-test scores were strongly related to their pre-test scores, which was also evidenced by the high correlation coefficient between the listeners' pre-and post-tests scores ($r = .87$, $p < .05$).

Figure 2: Percent correct at pre-test (top), at post-test (middle) and difference score (bottom) as a function of music aptitude in French listeners.



3.3. German listeners

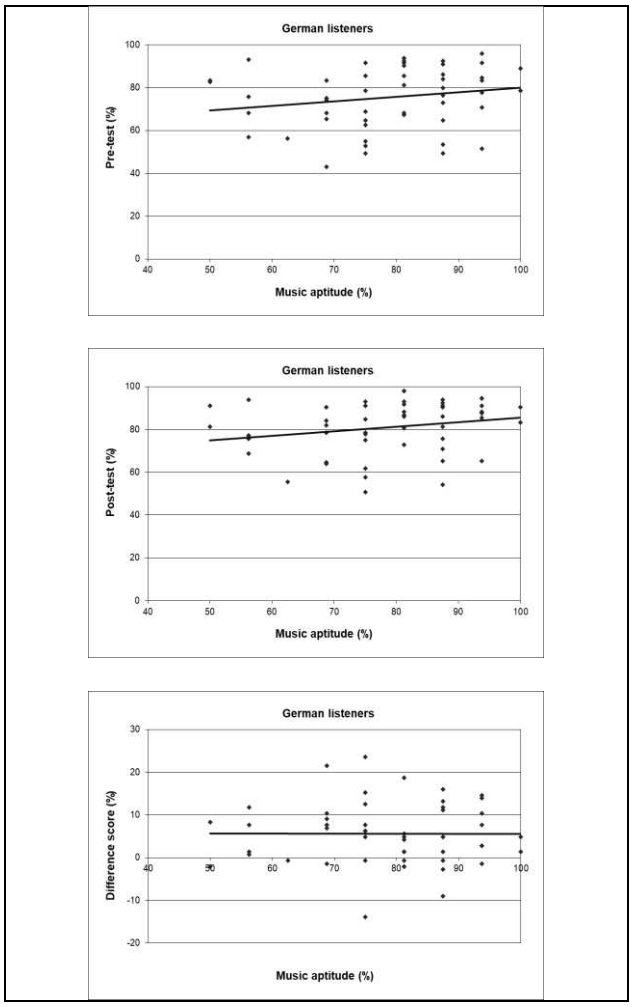
Given that the interaction Music aptitude x Training method was not significant in none of the analyses (pre-test, post-test, difference score), it was removed from the final models.

Regarding the performance at pre-, post-tests and for the difference score in German listeners (Fig. 3), the regression equation was not significant in any of the analyses ($F(2, 47) = [0.01\text{-}1.18]$. $p = [.32\text{-}.99]$, $R^2 = [0\text{-}4.80\%]$). None of the predictors significantly predicted the performance at pre- or post-tests or the difference score (music aptitude: $\beta = [-0.004\text{-}0.212]$,

p =[.14-.97]; training method: β = [-0.24-0.44]; p = [.91-.96]).

We also ran the additional analysis on post-test scores with both pre-test and musical aptitude scores as predictors. A significant regression equation was found ($F(3, 46) = 44.46$. $p < .001$) with an R^2 of 73%. Whereas the pre-test scores significantly predicted the post-test scores ($\beta = 0.73$, $p < .001$), music aptitude and training did not (music aptitude: $\beta = 0.06$, $p = .16$; training method: $\beta = -0.13$; $p = 0.47$). As for French listeners, this finding indicates that the listeners' post-test scores were strongly related to their pre-test scores ($r = .86$, $p < .001$).

Figure 3: Percent correct at pre-test (top), at post-test (middle) and difference score (bottom) as a function of music aptitude in German listeners.



4. DISCUSSION

The goal of the present study was to determine whether there was a relationship between the listeners' music aptitude (considered as a continuum) and their performance at discriminating stress contrasts in a second language. Two groups of listeners were under examination: a group of native listeners of a predictable stress language (i.e., French), who supposedly have difficulties in discriminating stress contrasts in L2 and a group of native listeners of an unpredictable stress language (i.e., German), supposedly without such difficulties. Contrary to previous studies, we considered music aptitude as a score ranging from 0% to 100%.

Regarding French listeners, we found that listeners with high music aptitude showed better performance at discriminating stress contrasts in L2. The fact that the relationship between music aptitude and performance was present in the pre and post-tests is not surprising knowing that the correlation between the listeners' performance in pre-and post-tests was high ($r = .87$, $p < .05$). On the contrary, we found no relationship between music aptitude and the amount of improvement after training. In other words, the link between the music aptitude and the ability to discriminate L2 stress contrasts in French listeners was present independently of the amount of their learning. Although this link was not strong (i.e., music aptitude explained 10% of the stress discrimination ability), it suggests that similar perceptual mechanisms might be called in the discrimination of musical melodies and in the discrimination of L2 stress contrasts, at least in French listeners, who do not use stress encoding strategies in their native language.

On the other hand, we found that German listeners did not show the link between music aptitude and the ability to discriminate L2 stress contrasts. The absence of such link might be explained by the fact that German listeners use stress encoding strategies in their native language. However, it might also be that the link is obscured by the German listeners' high performance, although not at ceiling (75% and 81% at pre- and post-tests, respectively). Thus, we can't rule out the possibility that the relationship between German listeners' musical aptitude and their discrimination of L2 stress contrasts would emerge with a more difficult task.

As a conclusion, our findings indicate that French listeners do not process stress information in the same way than German listeners, at least in a perceptual task that is difficult for the former and easy for the latter. Because of the predictable stress position in French, French listeners possibly compensate the absence of stress encoding mechanisms of their native language by interpreting L2 stress contrasts in a "more musical" way than German listeners whose native language has unpredictable stress position.

5. AKNOWLEDGMENTS

Our work was supported by the Swiss National Science Foundation (grant Ambizione PZ00P1_148036/1).

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