Using music in a word stress processing task: Does it favor learners with a musical background?

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Previous studies have reported that the use of music in foreign language methodologies (e.g. hand-clapping or songs) can help learners to acquire foreign languages. It remains unclear, however, whether this kind of method helps every learner equally or whether it is more beneficial for learners with a musical background, such as musical practice, musical abilities, or engagement in musical activities. In order to answer this question, we tested 80 French speakers whose musical background was evaluated using a questionnaire. They performed a word stress processing task in Dutch containing spoken stimuli, spoken stimuli with a beat, or sung stimuli. The results show that learners with some musical characteristics obtain higher scores than other learners and that the use of music in the task can favor learners with a musical background.

Keywords: music, songs, musical background, word stress, foreign language prosody

1 Introduction

Studies have shown that the increasingly popular use of musical activities in foreign language teaching can improve foreign language proficiency (Degrave, 2019; Werner, 2020). The question arises, however, whether these musical methods are beneficial for every learner, or whether they are especially helpful for learners who have a musical background, for example through their musical practice, their musical abilities, or their engagement in musical activities (such as attending music events, listening to music, writing about music, etc.). The very few studies examining this issue have focused on musicians: Larrouy-Maestri, Leybaert and Kolinsky (2013), and Degrave (2020) have shown that the use of music in a linguistic task benefits musicians more than non-musicians. In the present study, we want to explore this question further and aim to analyse whether there is an interaction between the use of music or rhythm in a linguistic task and various musical characteristics of learners. These characteristics are not only musical practice, but also musical abilities and engagement in musical activities (e.g. attending concerts, listening to music, writing about music, etc.). We will therefore focus on foreign language prosody acquisition, more specifically word stress processing. The following section first concentrates on word stress acquisition and then reviews studies about music and prosody, more particularly word stress processing.

1.1. Word stress acquisition

The term stress refers to “the degree of force used in producing a syllable” (Crystal, 2008, p. 454). Word stress acquisition in a foreign language is important, since word stress helps to segment speech into groups of words or into sentences (i.e. phrasing function) and it can provide lexical information (e.g. in Dutch *VOORnaam*, first name, vs. *voorNAAM*, respectable). Moreover, incorrect word stress placement leads to a foreign accent, which contributes to the intelligibility and comprehensibility of speech (Degrave, 2021).

The difficulties learners may encounter while acquiring foreign language word stress depend on different factors. One is their native language and the similarities and differences between L1 and L2. For example, the perception of English stress placement has been shown to be more difficult for French speakers (a language without variable stress) than for Dutch native speakers (a language that uses variable stress), since speech processing is shaped by native listening experience (Cutler, 2012). Some researchers even speak about stress ‘deafness’ to describe the difficulties some speakers may encounter in detecting word stress in a foreign language (Dupoux et al., 2008). Another influencing factor that has often been analyzed is foreign language exposure: Studies have shown that learners with a considerable amount of L2 experience and exposure have higher abilities to perceive and produce word stress than other learners (Tremblay, 2009; Trofimovich & Baker, 2006). In addition to these factors related to the learner, the task itself can influence word stress perception. Dupoux, Peperkamp and Sebastián-Gallés (2001) have reported that "stress 'deafness' is shown to crucially depend upon a combination of memory load and phonetic variability in F0" (p. 1606). Indeed, French speakers had no difficulties in a same-different task in which non-words differed only in stress position (e.g. *BOpelo-boPElo*). However, stress 'deafness' was found in tasks that were memory loaded (e.g. longer stimuli, longer interstimulus interval) and that used phonetic variability (e.g. different speakers, different tokens, variation in pitch).

In short, difficulties in perceiving and processing foreign language word stress depend on several factors that are related to the characteristics of the learners (such as L1 or L2 exposure) or to the task (e.g. memory load, phonetic variability). Since word stress acquisition can be influenced by different factors, the question arises whether music, either as a characteristic of the learner (e.g. musical practice or musical abilities) or of the task (namely, the use of music in a linguistic task), also influences word stress acquisition. Previous studies have in fact shown that learners' musical characteristics or the use of music in linguistic teaching tools can support prosody acquisition. The following section reviews studies in the field.

1.2. Prosody and music

Word stress is a prosodic element. The link between music and prosody seems obvious: Prosody is the "music of language and speech" (Boutsen, 2003) and, like music, is characterized by variations in pitch, length, and loudness. Based on this acoustic parallelism, we could imagine that learners with musical practice or musical abilities and who are able to detect and produce fine melodic and rhythmic variations in music, also show advantages in prosodic abilities. Moreover, we may ask whether prosody learning is facilitated when musical or rhythmic activities are used in foreign language methodologies. Several studies have addressed these issues, examining the effect of musical training, musical abilities, and the use of music in foreign language methodologies on prosody acquisition.

Regarding musical practice, researchers have analyzed whether musicians outperform non-musicians in perception as well as in production tasks. At the perception level, many studies have shown that musicians obtain higher scores than non-musicians in perception tasks of F0 in tonal languages (such as Mandarin Chinese). This has been found in same-different tasks (Alexander, Wong, & Bradlow, 2005; Gottfried, Staby, & Ziemer, 2004; Marie et al., 2011), as well as in matching tasks (Alexander et al., 2005; Lee & Hung, 2008). Besides pitch perception, research has shown that musicians outperform non-musicians in their perception of the intonation of foreign language prosody (Dankovicová et al., 2016; Thompson, Schellenberg & Husain, 2003), and in the processing of word stress in particular, whether they are professional musicians (Kolinsky et al., 2009) or amateurs (Degrave, 2020). At the production level, various studies have assessed the imitation of foreign language prosodic elements by musicians and non-musicians. Gottfried et al. (2004) tested English speakers who had to repeat Mandarin syllables in different tones, Pastuszek-Lipińska (2007) evaluated the imitation of phonology and intonation of English by Polish native speakers, and Christiner and Reiterer (2015) asked German natives to repeat Hindi sentences. The results all point in the same direction: Musicians were rated as being closer to native-speaker production than non-musicians.

In addition to research about language learning and music practice, some studies have examined the link between language acquisition and musical abilities. Results suggest a positive correlation between musical abilities and prosody perception or production. Delogu, Lampis and Belardinelli (2006, 2010) observed that Italian adults and children with high scores in a musical test obtained better results in a tonal discrimination test in Mandarin than subjects with lower musical scores. As far as production is concerned, Ezquerra (2012) examined speech comprehensibility in Spanish by English speakers, Gralińska-Brawata and Rybińska (2017) analyzed word stress production by Polish learners, and Coumel, Christiner and Reiterer (2019) investigated French accent faking by German speakers. The results of these analyses all show a significant positive correlation between the results in musical ability tests and foreign language prosody production. Recently, Cason et al. (2020) focused on the relationship between prosody acquisition and musical rhythmic skills in particular. They observed that reproduction of stress placement in English by French speakers was predicated by the participants' musical rhythmic skills. Besides behavioral studies, there is also growing interest in the neural interplay between musical aptitude and language skills (Turkey & Reiterer, 2021), in an attempt to shed some light on the nature of the relationship between music and language aptitude.

Aside from the potential effect of the musical characteristics of the learner (i.e. practice or abilities) on prosody acquisition, it is also interesting to analyze whether the use of music in the foreign language classroom can positively affect foreign language prosody learning. Different teaching methods have been developed, such as "Jazz Chants" in English (Graham, 1993) or "Taalriedels" in Dutch (Deen, Van Veen & Schutte, 2014), to help learners get a better feel for "the music" – the prosody – of the target language using music and rhythm. Empirically grounded research on the effectiveness of musical teaching methods to support foreign language prosody acquisition is scarce, but provides some interesting results. Schön et al. (2008) analyzed whether the use of melodies can help learners to segment speech in a nonsense language. The results showed that adding a melody to an unknown language – particularly when there is mapping between the pitch and the syllable – can help listeners to group syllables, which results in enhanced segmentation. Zhang, Baills and Prieto (2020) analyzed the effect of hand-clapping on foreign word pronunciation. The authors observed that learners who received pronunciation training with hand-clapping show a greater improvement for word pronunciation (accentedness and duration of the stressed syllable) than learners who received training without hand-clapping.

Taken together, the studies reviewed in this section show that music, being either a characteristic of the learner (i.e. musical practice or musical abilities) or a teaching tool (i.e. using songs or rhythm in the foreign language classroom), can have a positive influence on prosody acquisition, particularly at word stress level. However, several issues remain under-researched.

First, studies about the effect of learners' musical characteristics on language acquisition have focused on either musical training or musical abilities. However, it has not been clarified whether other musical characteristics could influence language learning. For example, we could ask whether learners who are engaged in musical activities (e.g. who attend music events, listen to music, etc.), but who have never practiced music and have no particular musical abilities, obtain higher scores in language tests than learners with no particular engagement in music. Moreover, as outlined above, studies have mainly examined the effect of musical characteristics separately. It is therefore still not known whether musical practice and musical abilities influence prosody acquisition equally, or whether one characteristic has a larger influence than the other.

Second, concerning the use of music in language teaching methodologies, very few studies have analyzed whether music-based language teaching methods help all learners, or whether they are mainly beneficial for people with a musical background, such as musical experience, musical abilities, or engagement in musical activities. Degrave (2020) has shown that the use of melodies or beat in a word stress processing task benefits musicians more than non-musicians. Larrouy-Maestri et al. (2013) administered Schön et al.'s (2008) test, which examines the effect of using melodies to segment unknown speech (see above), to music experts, language experts, and non-experts. They stated that there was a significant interaction between the experiment (with/without melody) and expertise: Only music experts obtained higher scores for sung sequences. These two studies suggest that the use of music is more beneficial for musicians than for non-musicians, but the question has not been examined for other musical characteristics of learners (e.g. musical abilities or engagement in musical activities).

Third, as mentioned by Werner (2020) concerning music-based classroom activities, many studies on the link between music and language focus on English as a target language. Experiments with other languages can give a more comprehensive picture of the topic.

In view of these different elements, the purpose of this paper is to examine whether:

(1) there are musical characteristics of learners other than musical practice or musical abilities that can influence word stress processing in a foreign language, namely engagement in musical activities (e.g. attending music events or listening to music);

(2) the use of a melody or rhythm in a word stress processing task benefits all learners equally, or whether it is more beneficial for learners with a musical background (i.e. learners with musical practice, musical abilities, or engagement in musical activities).

2 Present study

In order to examine these issues, we used the material designed by Degrave (2020), a word stress processing task using spoken stimuli, spoken stimuli with a beat, or sung stimuli – see below under "Material". Degrave (2020) administered this test to two groups of French speakers with opposite musical profiles (i.e. musicians vs. non-musicians). In our study, we aim to administer the test to French-speaking learners of Dutch who are not selected according to their specific musical profile, but whose level of various musical characteristics (e.g. musical practice, musical abilities, and engagement in musical activities) will be evaluated using a self-reported questionnaire.

2.1. Participants

First-year university students enrolled in the Bachelor's program in Modern Languages (with Dutch as a major language) from three different Belgian French-speaking universities (University of Louvain (UCLouvain), University of Liège (ULiège), and University of Namur (UNamur)) were tested during one of their classes. Participation was voluntary, but the respondents could optionally take part in a prize draw to win a voucher worth €100. In total, 120 students took part in the experiment. Within this sample group, we selected only data from students who were monolingually raised with French as their native language (N = 96) and discarded data from participants who reported hearing, language, or attention deficiency (N = 16). The final sample group consisted of 80 respondents (14 men and 66 women; 73 right-handed and 7 left-handed). They were between 18 and 24 years old (M=18.76, SD = 0.945).

2.2 Material

The material used for the word stress processing test was the same as in Degrave (2020). This test is an *XAB* discrimination task in which the participants hear 96 stimuli that contain three Dutch words or non-words in which word stress falls on the first or second syllable (e.g. *DOORbreken*, *doorBREken*, *DOORbreken*). The first word is pronounced by a man, the last two by a woman. The items are either spoken, spoken with a beat on the stress, or sung. The participants have to indicate which of the last two words (spoken by the woman) corresponds to the first word (spoken by the man). There are four possible correct answers: the first word, the second word, none or both. The participants may also select "Don't know" as an answer in order to avoid the situation where they might guess the right answer. The 96 stimuli are split into three blocks with stimuli characteristics represented in each block. The practice session at the beginning of the experiment contained six other items, which had the same characteristics as the items in the test. For a detailed description of the material used and a complete list of the stimuli and their characteristics, see Degrave (2020).

After the processing test, the participants completed the French version (Degrave & Dedonder, 2018) of the *Goldsmiths Musical Sophistication Index (Gold-MSI)* (Müllensiefen et al., 2014). This self-report inventory attempts to take into account a wide range of musical abilities and to measure expertise not only through instrumental training but also through a variety of musical activities. The questionnaire comprises 38 items and assesses self-reported musical skills and behaviors on five musical subscales and one general musical factor:

(1) Active Engagement, e.g. how much time and money are spent on music;

(2) Perceptual Abilities, e.g. accuracy of music listening skills;

(3) Musical Training, e.g. amount of formal musical training received;

(4) Singing Abilities, e.g. accuracy of one's own singing;

(5) Emotions, e.g. ability to talk about emotions that music expresses;

(6) General Musical Sophistication, i.e. a general factor that incorporates aspects from all five other subscales.

The scores on the five subscales (Active Engagement, Perceptual Abilities, Musical Training, Singing Abilities, and Emotions) are measured by the answers to different items, whereas the score for the general factor (General Musical Sophistication*)* is based on the answers to 18 items that are already part of other subscales. Since the general factor is based on 18 items also used for other subscales, this characteristic will not be taken into account in our analysis in order to avoid redundancy. Moreover, since we have no hypothesis about a link between ability to talk about emotions that music expresses and ability to process word stress, the "emotions" factor will not be examined in our analysis.

The final scores are based on self-evaluation, but according to Müllensiefen et al. (2014), these self-reported levels positively correlate with musical abilities. Indeed, in their study, Müllensiefen et al. (2014) "compared scores from the Gold-MSI self-report inventory with the results of two specific listening tests across a large sample to assess the correlation between musical abilities and self-reported levels of musical sophistication" (p. 10). The authors concluded that "the general musical sophistication scale indexes both listening tasks positively" (p.10).

After this questionnaire, the participants answered different questions concerning their general, language, and musical profile and experience, compiled from different language (Li, Sepanski, & Zhao, 2006; Marian, Blumenfeld & Kaushanskaya, 2007) and musical (Bidelman, Hutka & Moreno, 2013; Wong & Perrachione, 2007) history questionnaires.

2.3. Procedure

The participants were tested in a computer room at their universities. They were seated at a table in front of a personal computer, with an Azerty keyboard, headphones, and a mouse. All instructions, stimulus presentation, and data collection were conducted using a computer, via a website developed by a UCLouvain researcher. A password was provided to access the website. Responses were stored on one of the UCLouvain servers.

The experiment started with the perception task. The participants were asked to listen to the stimuli and to identify, as quickly as possible, which of the last two words (pronounced by a woman) corresponded to the first (pronounced by a man). They answered by clicking on the correct answer in a five-answer list, using their mouse. The respondents were made aware that the test contained Dutch words and non-words and that the stimuli would be spoken, spoken with a beat, or sung. They were also made aware that the melody or the beat could help them to answer; this was to avoid a situation where participants who were used to experimental tests automatically regarded the melody or the beat as distractors. There was a practice session of six trials at the beginning of the experiment, after which the participants received feedback on their responses. No feedback was provided during the rest of the experiment. After the test, the participants filled out the two questionnaires online. The participants were tested in a single session, which lasted about 30 minutes.

2.4. Data analysis

The dependent variable is the participants' response accuracy for the 96 stimuli. One point is given for a correct answer, and zero for an incorrect or "Don't know" answer. These results for the 96 stimuli were then recalculated as a percentage of correct answers. The data for the dependent variable are normally distributed. The within-subject independent variable is the type of stimulus (spoken, spoken with a beat, sung). The between-subject independent variables are the four musical characteristics measured by the Gold-MSI questionnaire (Active Engagement, Perceptual Abilities, Musical Training, and Singing Abilities). The Gold-MSI questionnaire gives continuous scores for the musical characteristics. In order to perform the required statistical analysis for this study, we recoded these continuous variables into categorical variables. The Gold-MSI scores have therefore been split into two in order to make two groups for each musical characteristic (lower level – higher level). Table 1 indicates the Gold-MSI scores for each group.

Table 1 Gold-MSI scores for the two groups (lower/higher) for each musical characteristic

	Lower level	Higher level
Active Engagement Perceptual Abilities (the Gold-MSI questionnaire gives scores from 9 to 63)	Scores 9 to 36	Scores 37 to 63
Musical Training Singing Abilities (the Gold-MSI questionnaire gives scores from 7 to 49)	Scores 7 to 28	Scores 29 to 49

3 Results

The first purpose of this study was to examine whether the musical background of the participants – more specifically their level of musical practice, musical abilities (perceptual or singing), and engagement in musical activities – can help them in a word stress processing task. The following graphs illustrate the mean results in the word stress processing task according to the level of musical characteristic (lower – higher) of the participants, for the four musical characteristics we examined (namely, Active Engagement (Figure 1), Perceptual Abilities (Figure 2), Musical Training (Figure 3), and Singing Abilities (Figure 4)).

Figure 1 Mean percentages correct answers of learners with low or high level of Active Engagement in music. Error bars represent 95 % confidence interval - * represents p-value < .05, ** represents p-value <.01, *** represents p-value <.001

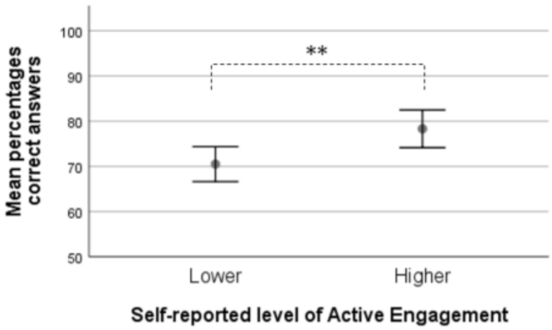
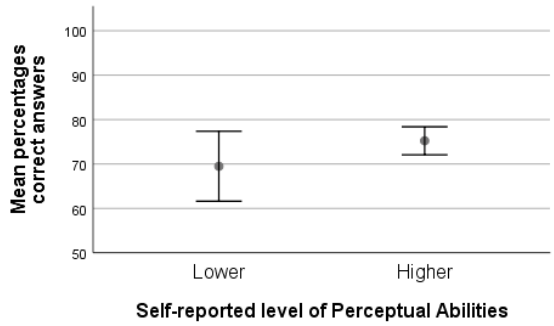


Figure 2 Mean percentages correct answers of learners with low or high level of Perceptual Abilities. Error bars represent 95 % confidence interval - * represents p-value < .05, ** represents p-value <.01, *** represents p-



	Active Engagement	
	Lower (N = 42)	Higher (N = 38)
Correct answers M % (SD)	70.51 (12.40)	78.32 (12.70)
Min/Max	41.67/94.79	46.87/96.87

Perceptual Abilities	
Lower (N = 14)	Higher (N = 66)
69.49 (13.64)	75.22 (12.82)
46.87/87.46	41.67/96.87

Figure 3 Mean percentages correct answers of learners with lower or higher level of Musical Training. Error bars represent 95 % confidence - * represents p-value < .05, ** represents p-value <.01, *** represents p-value <.001interval.

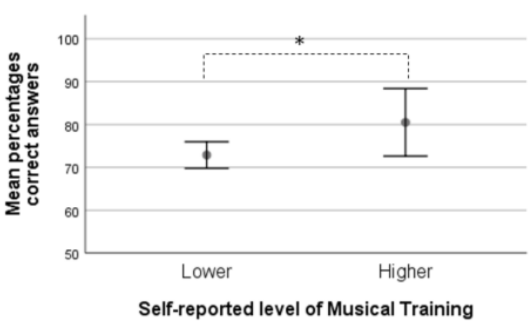
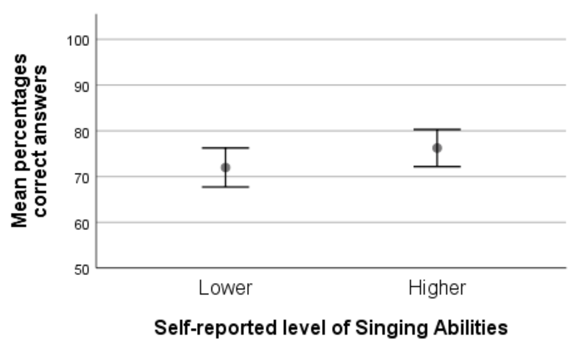


Figure 4 Mean percentages correct answers of learners with lower or higher level of Singing Abilities. Error bars represent 95 % confidence interval - * represents p-value < .05, ** represents p-value <.01, *** represents p-value <.001



	Musical Training			Singing Abilities	
	Lower (N = 66)	Higher (N = 14)		Lower (N = 38)	Higher (N = 42)
% correct answers					
M (SD)	72.89 (12.64)	80.51 (13.66)		71.98 (12.96)	76.24 (12.98)
Min/Max	41.67/94.79	59.38/96.87		41.66/94.79	41.66/96.87

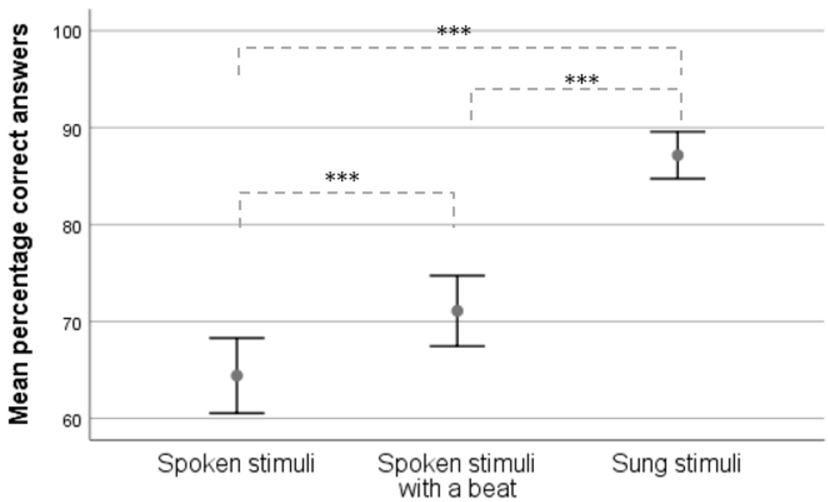
We can see that for the four musical characteristics, participants with a higher musical level obtain higher mean scores in the test than participants with a lower musical level.

The results of the independent-samples t-test show no significant difference between the lower/higher groups for the characteristics Perceptual Abilities and Singing Abilities. However, a significant difference was found between the learners with a lower level of Musical Training and a higher level of Musical Training, $t(78) = 2.021$, $p = .047$. Cohen's effect size value ($d = 0.58$) suggests a moderate effect. A significant difference was also found between the participants with a lower level of Active Engagement and a higher level of Active Engagement, $t(78) = 2.780$, $p = .007$, Cohen's effect size value $d = 0.62$.

The second purpose of this study was to examine whether the use of a melody or rhythm in a word stress processing task is equally beneficial for all learners or whether it benefits those who have a musical background more (i.e. musical practice, musical abilities, or engagement in musical activities).

In order to answer this question, we first have to analyse whether participants obtain higher scores when the stimuli contained a melody or a beat than when they were just spoken – as has been found in previous research (Degrave, 2020; Schön et al., 2008; Zhang et al., 2020). Figure 5 shows the percentages of correct answers for each type of stimulus.

Figure 1. Mean percentages of correct answers for each type of stimulus (spoken/spoken with a beat on the stress/sung) - error bars represent 95% confidence interval - * represents p-value < .05, ** represents p-value <.01, *** represents p-value <.001



	Spoken stimuli	Spoken stimuli with a beat	Sung stimuli
M	64.41	71.09	87.15
SD	17.39	16.35	10.88
Min.	28.13	34.38	43.75
Max.	96.87	100	100

We performed a repeated measures ANOVA, with the type of stimulus as the between-subject independent variable. The condition of sphericity was met (χ^2 (2) = 4.065, p = .131). The results show a significant difference between the types of stimuli with an effect on the scores in the word stress processing task (F (2;150) = 123.96, p < .001). Post hoc tests using the Bonferroni correction indicate that participants obtain significantly higher scores when the stimuli are sung (M = 87.15%, SD = 10.88) than when they are spoken with a beat (M = 71.09%, SD = 16.35) (p < .001) or spoken (M = 64.41%, SD = 17.39) (p < .001). Moreover, the respondents make significantly fewer errors when the stimuli are spoken on a beat than when the stimuli are spoken ($p < .001$). The effect size is 0.611 (partial eta squared).

Since the participants obtain significantly higher scores when the stimuli are sung or spoken with a beat than when they are naturally spoken, we can now analyse whether the use of a melody or rhythm in the stimuli is beneficial for every learner, or whether it helps learners with a higher level of musical background more. Figures 6 to 9 illustrate the mean percentages of correct answers for the three kinds of stimuli in the word stress processing task (spoken, spoken with a beat on the stress, sung) according to the participants' musical characteristic level (lower or higher), for the four musical characteristics we analyzed. We can see that the participants with a higher level of musical characteristics obtain higher mean scores for the sung stimuli and the spoken stimuli with a beat than the participants with a lower level of musical characteristics. Participants with a higher level of Active Engagement and Musical Training get even higher scores for the spoken stimuli than participants with a lower level for these two musical characteristics.

Figure 6 Mean percentages correct answers for each kind of stimuli for learners with lower or higher level of Active Engagement in music

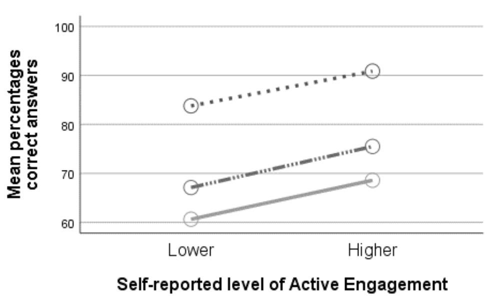
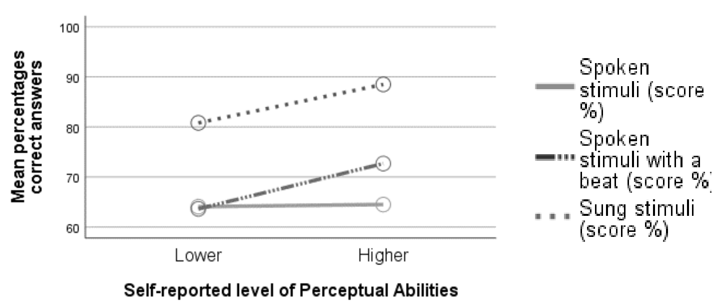


Figure 7 Mean percentages correct answers for each kind of stimuli for learners with lower or higher level of Perceptual Abilities



	Self-reported level of Active Engagement		Self-reported level of Perceptual Abilities	
	Lower (N = 42)	Higher (N = 38)	Lower (N = 14)	Higher (N = 66)
Spoken M (SD) Min/max	60.64 (16.45) 34.37/93.75	68.59 (17.66) 28.12/96.88	64.06 (18.17) 37.50/90.62	64.49 (17.37) 28.13/96.88
Spoken with a beat M (SD) Min/max	67.11 (16.78) 34.38/100	75.49 (14.86) 46.88/96.88	63.62 (16.97) 37.5/87.5	72.68 (15.90) 34.38/100
Sung M (SD) Min/max	83.77 (10.81) 43.75/100	90.87 (9.81) 56.25/100	80.80 (10.17) 56.25/93.75	88.49 (10.62) 43.75/100

Figure 8 Mean percentages correct answers for each kind of stimuli for learners with lower or higher level of Musical Training

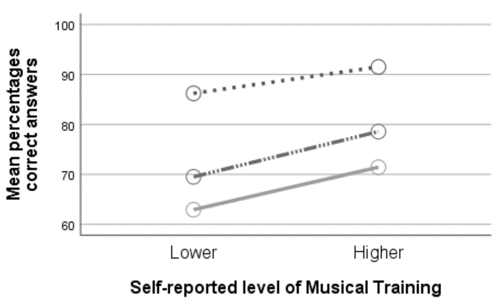
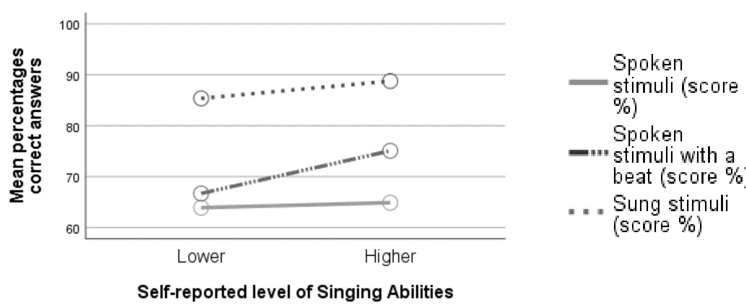


Figure 9 Mean percentages correct answers for each kind of stimuli for learners with lower or higher level of Singing Abilities



	Self-reported level of Musical Training		Self-reported level of Singing Abilities	
	Lower (N = 66)	Higher (N = 14)	Lower (N = 38)	Higher (N = 42)
Spoken M (SD)	62.93 (16.89) 28.13/93.75	71.43 (18.62) 43.75/96.88	63.90 (17.43) 34.38/93.75	64.88 (17.55) 28.13/96.88
Spoken with a beat M (SD)	69.51(15.91) 34.38/96.88	78.57 (16.93) 50/100	66.69(16.22) 34.38/90.63	75.07 (15.61) 43.75/100
Sung M (SD)	86.22(11.25) 43.75/100	91.52 (7.89) 78.13/100	85.36 (10.51) 56.25/100	88.76 (11.09) 43.75/100

We performed four mixed ANOVAs with the results for the three kinds of stimuli (spoken stimuli, spoken stimuli with a beat, and sung stimuli) as the within-subject independent variable and the level of musical characteristic (lower – higher) as the between-subject independent variable. We performed one mixed ANOVA for each musical characteristic (i.e. Active Engagement, Perceptual Abilities, Musical Training, and Singing Abilities). Conditions of normality and homogeneity of variance were met for each mixed ANOVA. The results show that a significant interaction between the kind of stimulus and the level of musical characteristic is only found for the characteristic Singing Abilities (Figure 9), F (2) = 3.315, p = .039. The effect size is 0.041 (partial eta squared). The interactions between the kinds of stimuli and the level of the other three musical characteristics (Active Engagement, Perceptual Abilities, and Musical Training) are not significant.

4 Discussion

In this experiment, we examined the potential effect of various musical characteristics of learners, namely musical practice, musical abilities, and engagement in music, on a word stress processing task and aimed to analyze whether the use of a melody or rhythm in the linguistic task benefits every learner equally or participants with a musical background more. We therefore administered the material used by Degrave (2020) in an experiment with musicians and non-musicians, to a larger sample group, which had not been selected for their specific musical background, but whose musical characteristics were assessed using a questionnaire. The present experiment yields results consistent with previous work, as well as new observations in the field.

The present paper confirms that the use of a melody or a beat in a word stress processing task has a positive effect on stress discrimination. Our results do indeed show that the participants obtain significantly better results for the sung stimuli than for the spoken stimuli with a beat on the stress, as well as better results for the stimuli with a beat on the stress than for the spoken stimuli. These results are in line with previous observations that the use of songs or rhythmical activities can facilitate word stress discrimination (Degrave, 2020), or speech segmentation (Schön et al., 2008). The facilitating effect of the use of music in language tasks could be explained by different factors. First, using music can sustain attention (Wolfe & Noguchi, 2009) and increase motivation (Mishan, 2005), which in turn can have a positive effect on linguistic performance. Second, the use of melodies or beat can provide extra musical and rhythmical cues, emphasizing the phonetic aspects of the verbal information. This might explain why participants get higher scores for the sung stimuli than for the other stimuli: In the sung stimuli, the phonetic aspects are emphasized by both rhythmical and melody cues, unlike the spoken stimuli with a beat in which only extra rhythmical cues are given. For further research, it would be interesting to determine whether similar results are obtained in a real learning situation (e.g. using songs or hand-clapping in the classroom), since the present study was based on a task performed in experimental conditions. Moreover, since this experiment concentrates on short-term memory, it would be useful to analyze whether the use of a melody and rhythm also has a long-term effect in acquiring word stress in a foreign language.

This paper also reveals new observations. One of the purposes of our study was to examine the influence of various musical characteristics of learners on word stress processing. Previous studies have mainly focused on the influence of either musical practice or musical abilities on language proficiency (Chobert & Besson, 2013; Zeromskaite, 2014; Nardo & Reiterer, 2009), but there are no data about the influence of other characteristics, such as engagement in musical activities, and no data comparing the effect of these different characteristics on language tasks. In this study, we examined various musical characteristics of learners using the self-reported Gold-MSI questionnaire (namely, Active Engagement in musical activities, Perceptual Abilities, Musical Training, and Singing Abilities) in order to analyze whether results in a word stress processing test differ depending on the learners' level of musical characteristics. The results show that learners with a higher level of Musical Training or Active Engagement obtain significantly higher scores in the test than other participants. This is the first study showing that engagement in musical activities (without necessarily practicing music), and not only musical training or musical abilities, can positively influence foreign language acquisition. Concerning the other characteristics (i.e. musical training and musical abilities), our results are partially in line with previous studies. As shown in earlier studies (see review above), our results confirm that participants with a high level of musical training obtain higher scores than other participants. The reason why musicians outperform non-musicians in linguistic tasks is still widely debated. Some researchers argue that there could be pre-existing differences between musicians and non-musicians (e.g. cognitive, genetic, or sociocultural) (see Mosing et al., 2016; Norton et al., 2005) that influence test-taking abilities in linguistic domains. Studies have also suggested that there would be positive effects of musical practice on executive and auditory functions, which in turn enhance linguistic performance (Amer et al., 2013; Moreno & Bidelman, 2014). With regard to musical abilities, our study does not confirm that they can help learners in language learning, as stated in earlier studies (Nardo & Reiterer, 2009; Zeromskaite, 2014). This might be explained by the fact that the current results are based on only one self-reported questionnaire. Further studies are recommended in which musical abilities are evaluated by various questionnaires and tests (Chin & Rickard, 2012; Wallentin et al., 2010; Zentner & Strauss, 2017). Moreover, our sample groups are limited for some subgroups, particularly in the characteristics Perceptual Abilities and Musical Training. This could explain why some results are not significant. Research with larger sample groups is therefore required.

Another aim of this paper was to consider the potential interaction between the kinds of stimuli heard (spoken, spoken with a beat on the stress, sung) and the participants' musical characteristics in order to see whether the use of a melody or rhythm in a linguistic task favors learners with a musical background. Overall, we see that participants with a higher level of musical characteristics obtain better results than other participants, particularly for the musical and rhythmical stimuli (sung and spoken with a beat, respectively). Moreover, a significant interaction was found between singing abilities and the type of stimulus, but not between the other musical characteristics and the kinds of stimuli. This shows that using music or rhythm in a language task can favor some learners who have an extensive musical background. However, the interaction between musical training and the kinds of stimuli, which had been reported by Degrave (2020), is not confirmed in this experiment. This result may be explained by the fact that the criterion of musical training is not the same in the two experiments: Whereas Degrave (2020) selected musicians and non-musicians on the basis of years of musical training and current practice, the present study defined the level of musical training using different items in a self-reported questionnaire. In further studies, it would be useful to define the various musical characteristics of the learners (training, abilities, and engagement in activities) in more detail, through different tests and questionnaires, to see whether learners with a high musical profile show advantages in language tasks containing music or rhythm, compared with other learners. Moreover, since the interaction between musical profile and the use of music in language tasks has not been widely studied, further research, with larger sample groups and in various linguistic tasks, is needed to develop a full picture of the interaction.

5 Conclusion

The present results confirm that music as a characteristic of the task (use of melodies or a beat) or as a characteristic of the learner can facilitate word stress processing. More specifically, this experiment shows that not only musical practice or musical abilities can positively influence language acquisition, but also active engagement in musical activities. Furthermore, our study suggests that the use of a melody or rhythm in a language task can favor learners with a musical background.

Such empirical evidence is relevant for educational practice for several reasons. Teachers often lack theoretical grounding to support the use of music in the FL classroom (Engh, 2013). Our results confirm previous findings showing that the use of music or rhythm in a linguistic task supports foreign language acquisition. Using musical or rhythmical activities based on pop music in the foreign language classroom could therefore have a positive effect on the learning process, not only in terms of motivation, but also at the linguistic level. However, our results also suggest that various musical characteristics of learners can influence language learning and that using music in the foreign language classroom can be more beneficial for learners with a musical background. Being aware of music-related differences between learners, of their effect on language acquisition, and of their potential interaction with the teaching methods can help teachers provide appropriate exercises, in line with the personal abilities and interests of the learners. We believe, furthermore, that our results open up interesting research avenues for further experimental work. Replication studies with larger and more balanced sample groups (e.g. concerning the different musical characteristics or the gender) would be needed to confirm the present findings. Moreover, it would be interesting to test participants who do not have any knowledge of the target language, as this study examined French speakers with a good knowledge of Dutch. Finally, since this study was conducted in experimental conditions, classroom intervention studies using rhythmical and musical activities based on pop culture would be required to complement the present experimental findings.

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