Can music help learners and teachers in word stress perception?

The benefits of music training, engagement in music activities and musical teaching methods on the perception of Dutch word stress by French speakers

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Abstract

Prosody is essential in foreign language (FL) proficiency but is not always easy to acquire, particularly when languages show different prosodic systems such as Dutch and French. Considering the acoustic and neurological parallelism between music and language, this study aims at analysing the impact of musical elements on the perception of Dutch word stress by French learners. More specifically, we examined whether the perception of Dutch word stress was positively influenced by (1) the different musical characteristics of the learners, such as music training, musical abilities or engagement in music activities, and (2) FL teaching methods using music (melodies or rhythm). 36 university students filled in a music questionnaire determining their musical characteristics and performed a XAB recognition task, in which stimuli where either spoken, either spoken on a beat, either sung. Results showed that there exist positive and significant correlations between some musical characteristics of the learners and the perception of Dutch word stress. Moreover, listeners detect word stress significantly better and faster when the words are sung than when they are naturally spoken or spoken on a beat. As such, our results suggest that the perception of Dutch word stress can be influenced by (1) personal musical characteristics, and (2) the use of melodies in FL teaching methods.

1. Introduction: Foreign language learning and music

1.1. *Acquiring foreign language prosody*

Prosody is essential in FL oral proficiency (Anderson-Hsieh et al., 1992), but is not always easy to acquire. One of the most problematic prosodic elements is word stress, whose wrong placement, absence or wrong perception can compromise speech intelligibility (Field, 2005; Hahn, 2004). Its acquisition is often difficult for French–speaking learners of Dutch (Michaux et al., 2013; Michaux & Caspers, 2013), since Dutch and French have different prosodic systems. Dutch is a variable-stress language in which stress has a lexical function and can be contrastive (e.g. *VOORkomen* ('to happen') / *voorKOmen* ('to prevent')), whereas French does not have lexical contrastive stress (for a discussion, see Di Cristo (2013)).

1.2. *Language and music*

Considering the importance of prosody for communication and the difficulty to learn it, more research on this topic and teaching techniques are needed.

In this way, it is interesting to analyse the potential benefit of music on prosody acquisition. Music and prosody show indeed an acoustic parallelism: both contain variations of frequency, rhythm and intensity. Moreover, recent neuro-imaging studies also state a neurological similarity: there seems to exist a neural overlap in processing music and speech, for example for the perception of rhythm (Besson & Faïta, 1995; Besson et al., 1997), intensity (Brancucci et al., 2005) or frequency (Magne et al., 2003).

Based on these parallelisms, recent research examined the influence of different musical elements on FL acquisition. Two main categories of musical elements have been analysed in this domain: the musical characteristics of the learner, among others music training or musical abilities (1.2.1) and the use of music as a didactic tool inside the classroom (1.2.2).

1.2.1. *The influence of musical characteristics of the learners on FL acquisition*

Most studies concentrate on the impact of either music training or musical abilities on FL acquisition.

As concerns the impact of **music training**, recent studies state that musicians outperform non-musicians in different proficiencies, such as word segmentation (François et al., 2012; Francois & Schon, 2011), discrimination of segmental contrasts (Parbery-Clark et al., 2012) or processing of supra-segmental variations. Among these, music training seems to enhance the perception of pitch variations (Magne et al., 2006; Marques et al., 2007), non-native lexical tones (Alexander et al., 2005), duration variations (Sadakata & Sekiyama, 2011), the ability to extract prosodic information from spoken utterances (Thompson et al., 2003) or sentence stress perception (Degrave et al., 2011).

Musical abilities, which can be developed or acquired outside formal music training, also seem to influence language development. This is for example the case for the acquisition of phonemes (Degrave, 2014; Milovanov et al., 2004; Slevc & Miyake, 2006) or of supra-segmental elements, such as lexical tones (Delogu et al., 2010).

This way, music training and musical abilities seem to impact different FL proficiencies, but little is known about word stress perception in particular. A link between music and word stress perception has been shown for L1 perception (Hausen et al., 2013), but not yet for FL word stress perception.

As described above, studies about the link between music and language proficiency often examine the musical training or the musical abilities of learners. However, **engagement** in musical activities (e.g. time and money spent on music) could maybe also influence language abilities.

The first objective of the present study is thus to examine whether the perception of Dutch word stress is influenced by three musical characteristics of the learner, namely: 1/music training; 2/ musical abilities; and 3/ music engagement.

1.2.2. *The use of music as a didactic tool*

The use of music inside the FL classroom is generally limited to learning new vocabulary in an original and culture-related manner, which can, under certain conditions, be an effective method (Ludke et al., 2014; Racette & Peretz, 2007). However, other language skills could also be trained by melodies and rhythmic activities. In this way, Schön et al. (2008) observed that music can help learners to segment unknown words. With respect to the acquisition of prosody, some FL teachers use intuitively songs and rhythm to 'teach' pronunciation. Different teachers have published their musical didactic methods. Fischler (2005) reported a four-week project involving six students participating in an intensive summer pronunciation course, learning both sentence and word stress using rap music. The results of this study indicate improvement in stress placement by the end of the four weeks. But as Checklin (2012)

mentions: “While this innovative approach is to be applauded, it is unclear whether using rap music is any more beneficial than using other word stress teaching methods in an intensive program” (p.7).

Carolyn Graham, an English teacher, created the Jazz Chants, “a rhythmic presentation of natural language, linking the rhythms of spoken American English to the rhythms of traditional American jazz” (Grulich et al., 2011). Concretely, teachers accentuate the prosody clapping their hands and using melodies.

Even if the authors observe an improvement of stress acquisition of the learners when using these different musical techniques, the effectiveness of this kind of methods on word stress acquisition has not been analysed in a systematic way. Therefore, the second objective of the present study is to examine whether Dutch word stress perception is facilitated when using rhythm or melodies.

2. Research questions

2.1. *Can musical characteristics of the learners help French speakers to perceive Dutch word stress?*

The first aim of our study is to examine the influence of different musical characteristics of French learners on the perception of Dutch word stress.

More precisely, we will examine whether there exists a positive correlation between the perception of Dutch word stress and different personal musical characteristics stated by a standard musical

questionnaire (the GOLD-MSI – see below for a more detailed description), namely:

1. the self-reported musical abilities of the learners, e.g. accuracy of musical skills (listening and singing);
2. the music training of the learner, e.g. amount of formal musical training received;
3. the active musical engagement of the learner, e.g. how much time and money spent on music.

2.2. *Does the use of music as a didactic tool facilitate the perception of Dutch word stress by French speakers?*

The second objective of our research is to analyse whether the use of melodies or rhythm in a perception task of Dutch word stress allows the learner to obtain

1. higher results;
2. shorter reaction times to correct responses.

3. Method

To answer these questions, a perception test has been created. The musical characteristics of the learners have been established by a specific music questionnaire and the impact of the use of music as a didactic tool has been analysed through different kinds of stimuli the participants heard.

3.1. *General design*

The perception test was a recognition task containing 96 stimuli. Each stimulus consisted of three words whose stress fell on the first or second syllable of each word (e.g. *VOORkomen* (‘to happen’) / *voorKOmen* (‘to

prevent'), *VOORkomen*). The first word was pronounced by a man, the next two pronounced by a woman. Participants had to mention, as quickly as possible, which word said by the woman had the same word stress as the word said by the man. The participants selected an answer in a given list containing five possibilities: the first word, the second word, none of the words, both words, I don't know.

3.2. *Stimuli*

In order to analyse the impact of the use of music as a didactic tool, three kinds of stimuli were presented: 32 stimuli were spoken in a natural way, 32 stimuli were spoken with a beat on the stress, 32 stimuli were sung. The 96 stimuli were randomized and started automatically when the previous answer was given.

The words given in the stimuli contained all 3 syllables and their stress fell on the first or second syllable. Half of the stimuli consisted of existing Dutch words with variable stress position which changes the meaning of the word (e.g. *VOORkomen* ('to happen') / *voorKOmen* ('to prevent'). The 48 other stimuli were non-words created from a randomization of the syllables of the existing words. This distinction words/non-words aimed at analysing the impact of the eventual lexical knowledge on stress perception.

All the words were recorded by two Dutch native speakers, a man and a woman, in a quiet room with a *Tascam-07 MKII* recorder and a *Sennheiser PC131* head-set microphone. The man is an amateur musician; the woman is a professional violinist.

The recorded spoken words were analysed with *Praat* (Boersma & Weeninck, 2009), in order to extract the melodic contours of the words and to create the melodies for the stimuli that were sung. In the melodies, each syllable corresponds to one note. The unstressed syllables are equally long (a sixteenth note) and are low, whereas the stress syllable lasts twice as long (an eighth note), has an accent and is higher than the unstressed syllable. The given tempo was defined in order to correspond to the mean tempo of the spoken words. The melodies were on three different keys (C major, F major and B flat major). This way, the pitch intervals between the syllables of the stimuli were identical – respectively to their stress pattern.

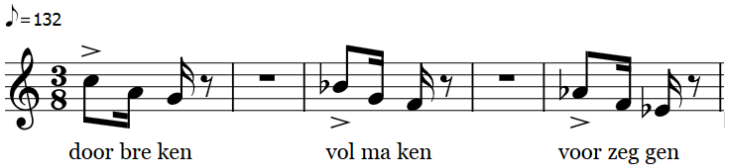

Figure 1 Music score for the words with the stress on the first syllable

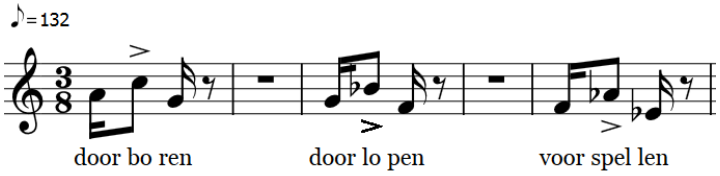

Figure 2 Music score for the words with the stress on the second syllable

To record the sung stimuli, the speakers received the musical score containing the different words. They could make use of a piano and of a metronome to make sure that they sing in tune and in time.

To create the stimuli with the beat, a sound of 440 Hz and of 0.150 sec. was added on each stress of the recorded spoken words. All the stimuli lasted between 2.9 and 3.299 sec. (mean: 3.098 sec.).

3.3. *Questionnaires*

To get the musical characteristics of the learners, participants filled in the *Gold-MSI questionnaire* (Müllensiefen et al., 2014), an instrument to assess self-reported musical skills and behaviours on multiple musical dimensions. These are (1) active musical engagement, (2) perceptual abilities, (3) singing abilities, and (4) musical training.

Moreover, in order to select the test subjects (see 3.4), participants filled in the *Dutch Lextale*, which rates their level of Dutch proficiency (Lemhöfer & Broersma, 2012) and a general form about their learner and musician profile, compiled from different music (Bidelman et al., 2013; Wong & Perrachione, 2007) and language history (Li et al., 2006; Marian et al., 2007) questionnaires.

3.4. *Participants*

We tested 77 university students at the end of classes. Within this sample, we selected 36 subjects (33 women/3 men – aged between 18 and 25 (mean age = 20.4)) who met the following criteria:
1. They have no hearing problem.
2. French is their only L1.
3. They followed Dutch as a FL (mean number of years of learning = 10.1; *SD* = 4,7 – mean self-reported proficiency levels = 4.6/10 ; *SD* = 1.8).
4. They have obtained min. 55% on the Lextale-Dutch (*M* = 65.3%; *SD* = 5.8).

Within the 36 selected persons, 17 were students in speech therapy and 19 were students in Germanic languages. The proficiency in the perception test of the two groups is not significantly different ($t(34) = 2$; $p < 0.05$).

3.5. *Procedure*

The subjects took the test in a quiet computer laboratory under the supervision of the author of the study at the end of a class. Participants were not remunerated, but were offered the opportunity to register for a purchase voucher of €100.

Each participant was assigned his or her own computer and headphones. The trial phase started after an instruction and training session similar to the trial. After the perception test, participants answered questions of 1/ the Dutch Lextale; 2/ the Gold-MSI and 3/ the general profile questionnaire.

3.6. *Data analysis*

For the perception test, each participant received one point for a correct answer but zero point for an incorrect answer or for the “I don’t know” option. The total amount of points (/96) was afterwards transformed in percentages.

Each participant obtained also a score for proficiency in Dutch (via the Lextale questionnaire) and 4 scores for musical characteristics established from the Gold-MSI questionnaire, namely (1) active musical engagement, (2) perceptual abilities, (3) singing abilities and (4) musical training.

4. Results

4.1. *General results*

The mean score of our sample *(N* = 36) is 80.93%. The lowest score is 59.38% and the highest score is 96.88% (*SD* = 10.97%; *Mdn* = 82.29%).

To control the influence of the knowledge of Dutch on the perception task, words and non-words were given. According to a student test for paired samples, the difference of perception of the words (mean score = 81.94% - *SD* = 11.97) and the non-words (*M* = 79.92% - *SD* = 10.98) is not significant (*t* (35) = 1.79; *p* = 0.083)).

4.2. *The influence of musical characteristics of the learners on word stress perception*

Our first research question aims at analysing the influence of different musical characteristics on the perception of Dutch word stress.

These characteristics have been established by the Gold-MSI questionnaire, from which we examined four aspects: (1) the self-reported perceptual musical abilities; (2) the self-reported singing abilities; (3) the music training; and (4) the active musical engagement.

We first analysed the correlation between these musical aspects with the perception of Dutch word stress.

The correlation between the perception of Dutch word stress and the self-reported perceptual abilities is not significant (*R* = 0.147, *p* = 0.196), nor is the correlation between the perception of Dutch word stress and the self-reported singing abilities (*R* = 0.228, *p* = 0.091). However, both

the correlations between the perception of Dutch word stress and (1) the music training level (R = 0.342, p = 0.021) and between the perception of Dutch and (2) the active musical engagement (R = 0.338, p = 0.022) turned out to be significant.

Based on these results, several simple linear regressions were performed to analyse the influence of these musical characteristics on the perception of Dutch word stress, as the dependent variable.

4.2.1. *Music training*

Music training significantly predicted the perception of Dutch word stress (β = 0.342, t(34) = 2.119, p = 0.041), and accounts for a significant proportion of variance (r^2 = 0.117, F(1,34) = 4.491, p = 0.041).

4.2.2. *Active musical engagement*

The perception of Dutch word stress is significantly predicted by active musical engagement (β = 0.338, t(34) = 2.095, p = 0.044), which explained a significant proportion of variance (r^2 = 0.114, F(1,34) = 4.389, p = 0.044).

4.3. *The use of music as a didactic tool*

Our second research question focuses on the use of music as a teaching method for Dutch word stress acquisition.

In order to analyse the difference of perception of Dutch word stress with and without the use of music (song and rhythm), participants heard three kinds of stimuli: stimuli naturally spoken, stimuli spoken with a beat on the stress, and sung stimuli.

The use of melodies or rhythm seems to help the learner. Results show that the mean percentage of correct perception of Dutch word stress is the highest when the stimuli are sung (*M* = 91.15%), and that the percentage of correct perception of spoken stimuli on a beat is higher (*M* = 78.30%) than the percentage of correct perception of naturally spoken stimuli (*M* = 73.35%).

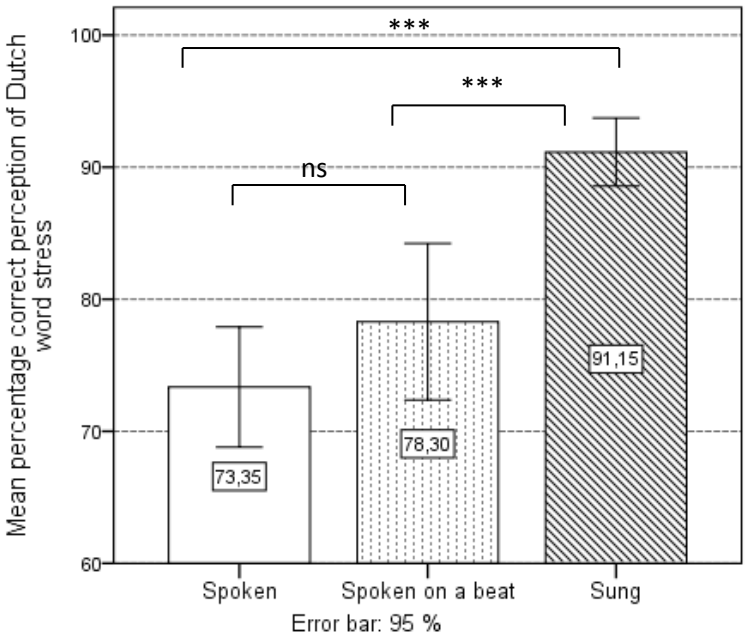

Figure 3: Mean percentage correct perception of word stress location for the three kinds of stimuli

The data have been treated with a repeated measures **ANOVA**. There is a significant difference between the kinds of stimuli with an effect on the perception of word stress location (*F (2.66*) = 32. 82, *p* = 0.000). The

effect is 0.48 (η^2). The pairwise comparison (Bonferrroni test) mentions that the difference of percentage of correct perception between the stimuli naturally spoken and those spoken on a beat is not significant (p = 0.068), whereas the differences between the other categories (sung/naturally spoken & sung/spoken on a beat) are both significant (p = 0.000).

Furthermore, as shown in Figure 2, the analysis of reaction times to correct responses shows that learners answer faster when the stimuli are sung (847 ms) than when they are spoken on a beat (1014 ms) or than when they are naturally spoken (1086 ms).

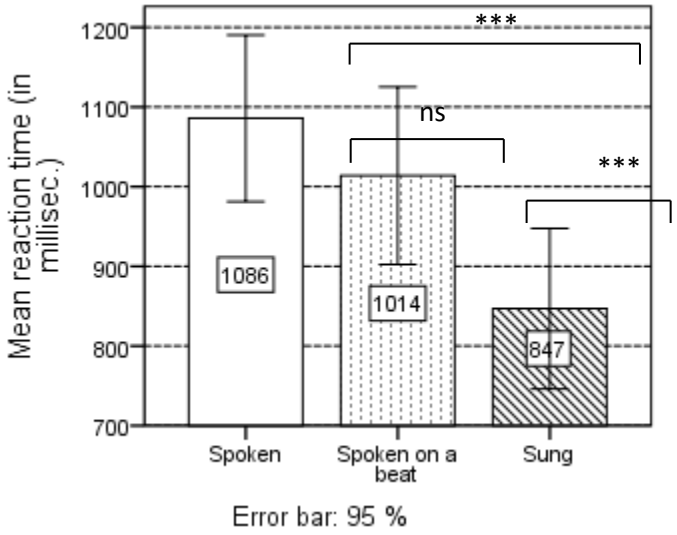

Figure 4: Mean reaction time (ms.) to correct responses for the three kinds of stimuli

The repeated measures **ANOVA** mentions that the difference between the reaction time of the three types of stimuli is significant with an effect on the perception of 0.36 (η^2) ($F(2;70) = 19.65$, p = 0.000).

The difference of reaction time is not significant between the spoken stimuli and the stimuli spoken on a beat (p = 0.202), but is significant between the spoken stimuli and the sung stimuli (p = 0.000) and between the stimuli spoken on a beat and the sung stimuli (p = 0.001).

5. Discussion

Considering the importance of prosody in FL proficiency and the frequent difficulties to acquire it, our study aimed at examining whether the perception of word stress of a FL can be influenced by (1) musical characteristics of the learner and (2) the use of melodies or rhythm in teaching methods. According to our analysis, both elements seem to facilitate the perception task.

On the one hand, the musical characteristics *musical training and active engagement in music* correlate positively with the perception of Dutch word stress and influence this perception ability. These findings confirm the hypothesis that music training and language abilities are linked, also for word stress perception in particular. Moreover, the influence of engagement in musical activities gives a new indication, since little was known about the influence of this musical characteristic on linguistic tasks. However, no significant correlation has been found between the self-reported musical abilities and the perception task. Other studies about the link between musical abilities and linguistic tasks did find a positive correlation, but contrary to these analyses, the musical abilities of the participants of our study have not been tested, but self-evaluated. More research is therefore needed to analyse the impact of *tested* musical abilities on FL word stress perception.

On the other hand, the use of music in the perception task also seems to facilitate the detection of the FL word stress: subjects obtained significantly more correct responses and answered faster for sung stimuli than for stimuli naturally spoken or spoken on a beat. This way, the present results provide experimental evidence that singing can support L2 learning, in particular for FL word stress perception. Didactic FL methods using music, such as described by Fischler (2005) or Graham (2011), effectively facilitate language perception.

All these findings represent an important contribution to the literature, because they state that word stress perception is facilitated by musical elements. The results not only confirm the link between music training and linguistic tasks – already observed for other language abilities - , but also establish the influence of engagement in musical activities and experimentally validate the support of singing for L2 perception.

Concretely, these results can encourage reflection about how to help learners and teachers in prosodic proficiency. First, being aware of the benefits of musical characteristics on linguistic tasks, learners can use their non-linguistic training and interests to sustain their learning of FL elements, such as word stress, which are often difficult to acquire. Secondly, the use of music or songs, which is generally limited to learn vocabulary or culture inside the classroom, seems to be a useful method for FL prosodic elements too.

Further studies are however needed to explore this topic in depth. First of all, a larger sample of subjects is currently being tested to confirm the obtained results. Furthermore, analysis of the perception of word stress by professional musicians and non-musicians would give us more precise results about the impact of music training on the detection of FL word stress. Finally, while our study concentrates on the perception of FL

word stress, research about the influence of music on production tasks would be needed to evaluate the potential benefit of musical characteristics and musical teaching methods on the production of FL word stress.

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