

Stress-melody alignment reflects language-specific cues for accentual prominence

Christina Domene Moreno and Barış Kabak
University of Würzburg

Studies on crosslinguistic unity and variation in prosodic systems require not only typological but also empirical evidence pertaining to the way prosody is used. Here, we take the interaction between language and music, as an instructive domain to investigate the ramifications of accentual prominence for the language user. Prosodic patterns in language have been shown to be reflected not only in instrumental music (Patel et al. 2006) but also in text setting, where prosodic features of song lyrics are aligned with musical rhythm and melody. Such an interplay between prosody and music is not coincidental but intuitive as a result of their sharing the same underlying structural units (Heffner & Slevc 2015). However, due to salient differences in word prosodic systems, different *degrees* and *types* of alignment are expected crosslinguistically. So far, research on individual languages has shown alignment between accented syllables and strong beats of the musical meter in lexical stress languages like English (Palmer & Kelly 1992), but also in French (Temperley & Temperley 2013), where stress is fixed to the final syllable of an (accentual) phrase (Jun & Fougeron 2002). Extending this line of research to Turkish, a language with a strongly predictable stress system, Kabak & Domene Moreno (2017) found that in Turkish children's songs, the degree of accent-meter alignment is stronger than in Tokyo Japanese but weaker than in French, suggesting the gradient nature of stress-meter correspondence across languages, possibly due to variable functions of stress and their interaction with other prosodic properties in individual languages.

Although there is considerable amount of work on the potential match of prosodic accent with musical *melody* in tone languages (see Schellenberg 2012 for a review), little attention has been paid to this type of alignment in non-tonal languages (see, however, Chen & Mok (2014) and Nichols et al. (2009), both of which found stressed syllables to be aligned with musical pitch in English). On the one hand, this is intuitive given that what is understood as accentual prominence in many non-tonal languages is realized as stress (excluding pitch-accent systems, which may be considered restricted tonal systems, e.g., Hyman 2006). Since stress is perceived as the relative phonetic prominence of syllables within a prosodic unit such as the word, tonal *transitions* do not convey linguistically-relevant information at that level in such languages. On the other hand, there are accounts in the literature for songwriters in these languages (Saunders 2008 for English; Satır 2008 for Turkish) that recommend the alignment of accented syllables with relatively high musical notes in text setting.

Here, we present the results of an empirical study of accent-melody alignment in Turkish and English, two languages with different representation and processing of stress. While English behaves mainly as a lexical stress language, the Turkish word accentual system can be characterized as more fixed and phonologically predictable since stress canonically falls on the word-final position albeit crucially modulated by various lexical and morphosyntactic properties that lead to the appearance of non-final word stress. It should be noted that presence of word-level stress in Turkish has been subject to scrutiny in recent intonation studies that classify the language as a pitch-accent system, dealing with word-final stress as an artefact of prosodic phrasing (Kamali 2011, Güneş 2015). Although Turkish has been shown to use pitch as the most reliable cue for stress, which is not necessarily the case for English (e.g., Sluijter & van Heuven 1996), the presence of word-level stress in Turkish is undeniable due to the way it interacts with other domains of grammar such as morphology and the lexicon but requires further independent evidence, such as from the way it interacts with music.

In this paper, we ask (a) whether and to what extent stress aligns with musical pitch in Turkish and English, and (b) what the possible crosslinguistic differences can tell us about the weighting of accentual cues. Additionally, we use music-melody alignment to resolve controversies surrounding the Turkish word-accentual system: We test whether stressed syllables in word-final position are treated differently from those in non-word-final position in text setting as a function of their supposedly different mental representations (e.g., Güneş 2015).

To this end, we analyzed Turkish (n=18) and English (n=18) children's songs written by different composers, all in 4/4 measure. Using the sheet music, the syllables in the lyrics were coded for various linguistic features such as accentedness (accented vs. unaccented) accompanied by the coding of the melodic property of music. For the latter, loosely following Thomassen (1982), we devised a bi-gram index to calculate the degree of the melodic peak for each musical note, henceforth the Melodic Peak Score (MPS), which combines measures of the pitch of each note relative to both the preceding and the following note. Using paired-sample t-tests, we determined whether MPS is significantly higher in stressed than in unstressed syllables. In case of significant alignment, we then determined its degree by computing the difference between MPS for unstressed and MPS for stressed syllables.

Our results show significant alignment of stress and musical pitch in Turkish ($p=.0002$, $\alpha=.01$), but not in English ($p=.04$, $\alpha=.01$). Furthermore, there is no distinction between stressed syllables in word-final vs. non-word-final positions in their MPS in Turkish, which we take to be evidence against the coexistence of two distinct stress systems in Turkish. The fact that we find alignment in only one of the two languages might be taken as evidence for the variable importance of the phonetic concomitants of accent in the two languages. Music, by nature, has strong pitch movements. If the primary cue for stress-accent is pitch in a language, it crucially needs to make use of melodic movements since misalignment would override the cue. So, the prevalence of accent-melody alignment in Turkish text setting as opposed to English is a result of pitch being the most reliable cue to accent in Turkish in comparison to English.

Considering the results of Kabak & Domene Moreno (2017), which show that the alignment of stress and musical *meter* is much stronger in English than in Turkish, we see that the type and degree of mapping in different languages reflect the weighting of different acoustic correlates for stress. Our study constitutes the first crosslinguistic empirical study that investigates the role of pitch in text setting in word-stress languages with a musically-informed scoring method, yielding theoretical and typological implications for prosodic typology, co-phonologies in individual accentual systems, and the role of phonetics in the language users' handling of prosodic cues when they cross over to other higher-level cognitive domains.