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MELODIC CONTOUR REPRESENTATIONS IN THE ANALYSIS OF CHILDREN'S SONGS

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ABSTRACT

Children's songs is a particular musical genre related to folk music, with its own musical characteristics. This paper sets out to explore melodic contour in children's songs from seven different countries/nations across Europe. We look for distinctive contour patterns which differentiate the songs of each country. For pattern representation we use different viewpoints related to melodic contour, two of which also relying on beat information. Preliminary results are presented, and some initial observations regarding the patterns found, the representations used, and the genre as a whole, are discussed.

1. INTRODUCTION

Music plays a fundamental part in children's everyday lives: Children socialise with each other, reveal their emotions and entertain themselves through music. Their musical interactions can be surprisingly rich, varied and musically interesting. During the second half of the 20th century, the increased interest on children's study as individuals brought attention to their musicality from a cultural point of view, namely their expressive musical creativity as well as their responses and reflections to music (Small 1977, 1998; Blacking 1973). In this framework, it is a well-established fact that the notion of "song" plays a fundamental role in both children's educational and performance practices (Opie & Opie 1985). These simple in form and content songs usually share common musical (melodic and rhythmic) cross-cultural characteristics based on primal music fundamentals like the child's voice and gestures as well as the motions during the games played (Romet 1980). Research on children's musical songs however, apart from a few examples (such as Campbell 1991, 2010), has so far largely focused on social and educational perspectives, often ignoring the analysis of the music itself.

Melodic contour is a particularly significant musical feature relating to melodic shape, which has been studied from several perspectives: Music analysis and composition (e.g. Adams, 1976), semiotics (e.g. Seeger, 1960), music cognition (e.g. Lindsay, 1996), mathematical music theory (e.g. Buteau and Mazzola, 2008), and various computational approaches which take contour as a feature of computational music analysis (e.g. Kranenburg et al., 2011; Conklin 2010). In terms of representation, contour can be studied either as a continuous function (e.g. Muellensiefen and Wiggins, 2011), or described symbolically with discrete events at various levels of abstraction. One of the most elegant representations and implementations of melodic contour has been proposed by David Huron (1996), where 9 melodic shape descriptions have been applied to the analysis of melodic phrases of Western folk songs. Huron computes the shape type by comparing the pitch of the first note of the phrase, the average of all in-between pitches, and the pitch of the last note of the phrase.

Symbolic approaches to contour, however, like Huron's, do not usually take into account information related to rhythm and meter, which in some cases may be important for the characterisation of basic melodic shapes in the further analysis of a musical piece. In this study we propose a multi-level representation for melodic contour which takes into account beat information in order to describe melodic phrases. We then set out to explore patterns of melodic contour in children's songs. We believe that the choice of melodic contour might be a particularly appropriate level of representational abstraction for the analysis of children's songs in order to see the general melodic shapes that are predominant and characteristic. We look for distinctive patterns (Conklin, 2010) which characterise the songs of each country, as opposed to the songs of other countries.

The rest of the paper proceeds as follows: The next section describes the musical corpus of children's songs. Section 3 describes the methodology employed, including the definition of the contour representations chosen and the discovery of distinctive patterns. Section 4 presents some preliminary results found, and the paper ends with a discussion on the results, as well as pointers to future research.

2. THE CORPUS

A total of 110 traditional children's songs was collected, from seven different countries/nations across Europe: Catalunya (15 songs), England (15 songs), France (15 songs), Greece (20 songs), Spain (15 songs), Sweden (10 songs), and Turkey (20 songs). We selected those songs that seemed the oldest and more traditional for each country, based on information given to us by native speakers, and in this study we have not distinguished between songs made for children and songs made by children.

Each song was encoded into MIDI, and segmented into phrases based on the songs' lyrics, with a segmentation point at the end of each lyrics' phrase, giving a total of 505 segments. When more than one alternatives were possible, the segmentation giving the smallest possible units was chosen.

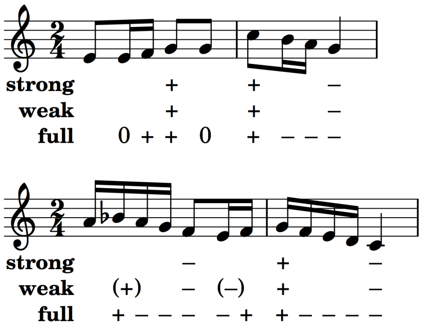

Figure 1. The three contour patterns on the first two segments of the Greek song “Πάνω στην κούνια”.

3. METHODS

3.1 The contour representations

Each phrase in the corpus is represented using three pattern representations related to melodic contour. Two of them take into account the beat information (see also Figure 1) :

- *a full contour pattern,* which includes the melodic direction between each consecutive pitch of the phrase and its previous one (starting with the second note).
- *a strong contour pattern,* relying on pitches on the beats, including upbeats that might exist in the score, which are considered to be important for the overall shape of a phrase. To compute the strong contour pattern, we simply discard all notes not occurring on a strong beat (except upbeats), and compute the full contour on this reduced score.
- *a weak contour pattern*, that includes the strong contour, and, enclosed in parentheses, all contour changes of value on notes between the beats that were not present in the strong shape.

Note that the weak contour pattern can be different than the full contour, as the contour change between the beats does not influence the strong contour (for some examples see Figure 1).

The reason for trying out different contour representations is that we believe that melodic arch shapes, such as Huron's (1996), are better based on a reduced score, that is on the main notes of a melody, which in most cases in this corpus are found on the beat. At the same time, the information on surface melodic patterns is just as important, especially when looking at the similarity between songs within a musical style or across styles, so we included a full contour representation in our experiments.

The three types of contour patterns (full, strong, weak) were computed on all 505 segments. For each contour type, when duplicate patterns found in the same song, only one occurrence was kept. This computation gave 92 different strong contours, 211 different weak contours, and 279 different full contours. As a reference, we also classified all the segments with Huron's original nine contour classes, comparing the first pitch, the last pitch, and the average of all other pitches.

3.2 Discovery of distinctive contour patterns

In our attempt to discover distinctive patterns in the corpus, we followed the approach described in (Conklin, 2010). A distinctive pattern is one that is overrepresented in a corpus compared to an anti-corpus. This can be asserted by computing the likelihood ratio between the observed probabilities in a corpus and an anti-corpus.

For each pattern and each one of the 7 countries, we thus computed the probability of appearance in the corpus (songs from that country) and the one in the anti-corpus (songs from other countries). We kept patterns with at least ten occurrences in all the corpus and that were at least 2-fold overrepresented in a country compared to other countries.

4. RESULTS

Table 1 lists all distinctive patterns found in the way described above. This resulted to four patterns for strong contour and five patterns for weak contour.

Pattern	Contour	Country
[–,–]	strong weak	Turkey Turkey
[+,+,–]	strong weak	Catalunya Spain
[–,–,+]	weak	Turkey
[+,–,+]	strong weak	Greece Greece, Sweden
[–,+,–]	strong weak	France France

Table 1. Distinctive contour patterns found in the corpus.

With the same criterion (2-fold overrepresented, at least 10 occurrences), no pattern with the full contour or with Huron's melodic shapes was found distinctive. Lowering the threshold to 5 occurrences, the pattern [–,–] was also reported as distinctive, as well as three Huron's melodic shapes – however, in all these cases, the low number of occurrences prevented us from further analysis.

We observe that we have three types of distinctive patterns found: With one direction, with two directions, and with three directions. With one direction we have the straight downward motion ([–,–]), with a particularly high statistical significance for Turkey. With two directions we have the [+,+,–] and [–,–,+], instances of a convex and of a concave shape. With three directions we have [+,–,+] and [–,+,–]. Figure 2 shows instances of the pattern [–,–], Figure 3 instances of the pattern [+,+,–] and Figure 4 instances of the pattern [+,–,+]. Since all phrases in children's songs are short, there were no longer patterns found with more than ten occurrences in the current corpus.

5. DISCUSSION AND FUTURE WORK

The pattern [–,–] (Figure 2) shows a very high statistical significance for Turkish songs in all types of contour representations. Looking at the instances found, we observe that often these patterns are located at the end of the songs, denoting a cadence, or at an even number of a phrase, again denoting a (smaller) cadence. There are however cases where this pattern is a first phrase, something we believe might be unique for Turkish songs. Further work could explore whether this overrepresentation could be explained by some linguistic or intonation characteristic of the Turkish language.

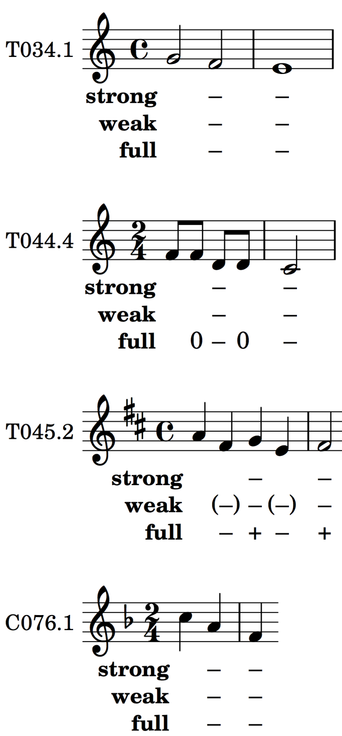

Figure 2. Strong contour [–,–] . This contour is five time over-represented in Turkish songs (9.1% of the Turkish segments) than in the rest of the corpus (1.8%).

Interestingly there were no distinctive patterns found in English songs. All patterns found, apart from one, belong to countries of the Middle (France) or South Europe (Turkey, Spain, Greece, Catalunya), a fact that points to their special musical style. The strong pattern [+,+,-] appeared in both Catalan and Spanish songs, and shows one important similarity between the two.

It is noted that the differences between strong and weak contour patterns were not as big as expected: as expected, most patterns which appear in the strong contour representation also appear in the weak, but no weak contour with contour modifications between the beats was found as distinctive. This could be because the corpus is not large enough to gather songs on these contour modifications.

As expected, full contour patterns with a high significance were very few, in fact only one found by lowering the threshold. Our contour representations on the reduced score show thus firstly that it is possible to spot distinctive patterns in these representations, often shared across countries, and secondly that the instances of phrases found share some obvious melodic similarities which would have not been captured otherwise. We thus argue that the strong contour representation may be a good compromise between a very abstract representation (such as the Huron's melodic shapes) and a very detailed representation (such as the full contour or the continuous functions described by Muellensiefen and Wiggins (2011)).

The strong distinctive patterns found, apart from one, end up in a downward melodic motion. Even when one looks at the cases of the strong pattern [+,–,+], which is the exception, one can see that in the full version of its instances sometimes a downward motion can be detected. Also, these patterns [+,–,+] tend to have a counter-phrase following, which ends on a – . The trend to end on a – can be partly explained because all the songs are strongly tonal (whatever tonal means in each case), and a downward motion at the end of the phrase often reaches the tonal centre.

One question that might arise would be on the criteria used to create the reduced score upon which the strong contour patterns were calculated. Notes on the beat can sometimes be suspensions or other melodic embellishments that are not the main note of the melody in a Schenkerian sense. This can indeed be the case, but in the particular corpus analysed here this phenomenon is rare.

In general, it can be observed that the songs analysed are based on short phrases, simple melodic lines, symmetries, circularities and repetitions. This can be potentially because musical learning, recalling, singing or playing needs to be enhanced. The ascending and descending directions of the melodies may have been shaped by various linguistic and kinetic factors, often simulating gestures, which relate to the context of musical performance of the songs. Further work is needed in order to compare children's songs as one corpus, with other folk song corpora.

Future work also includes the study of which contour shapes come at the various positions in the song (first, second phrase, etc). It also includes studying of sequences of shapes, to see what types of shapes follow each other. For example, by looking at phrases where the [+,–,+] pattern occurs, we have noticed that the next phrase ends with a downward motion. Inclusion of more features to describe the songs is also planned.

A systematic analysis of children's songs of various cultures can contribute towards an awareness of this music as a special genre with its own characteristics, and in viewing children as conscious musicians – especially if the approach takes children's music as its starting point.

6. REFERENCES

Adams, C.R. (1976). Melodic Contour Typology. *Ethnomusicology*, 20(2), 179-215.

Blacking, J. (1973). “How Musical is Man?” University of Washington Press.

Buteau, C. & Mazzola, G. (2008): Motivic Analysis Regarding Rudolph Réti: Formalization Within A Mathematical Model. *Journal of Mathematics and Music,* 2(3), 117-134.

Campbell, P. (2010). "Songs in Their Heads: Music and Its Meaning in Children's Lives". Oxford University Press.

Campbell, P. (1991). The Child-Song Genre: A Comparison of Songs by and for Children. *International Journal of Music Education,* 17, 14-23.

Conklin, D. (2010). Discovery of distinctive patterns in music. *Intelligent Data Analysis,* 14(5), 547-554.

Huron, D. (1996). The Melodic Arch in Western Folk Songs. *Computing in Musicology*, 10, 3-23.

Lindsay, A.T. (1996). Using contour as a mid-level representation of melody. Master's Thesis, MIT 1996.

Müllensiefen, D, and Wiggins, G. (2011). Polynomial functions as a representation of melodic phrase contour. *Systematic Musicology Empirical and Theoretical Studies*, 63-88, Peter Lang.

Opie, I. & Opie, P. (1985). The Singing Game. Oxford University Press.

Seeger, C. (1960). On the moods of a music logic. *Journal of the American Musicological Society*, 13, 224-261.

Romet, C. (1980). The Play Rhymes of Children: A Cross Cultural Source of Natural Learning Materials for Music Education. *Australian J. of Music Education,* 27, 27–31.

Small, C. (1977). Music, Society, Education. Calder.

Van Kranenburg, P., Biro, D.P., Ness, S., Tzanetakis, G. (2011). 'A computational investigation of melodic contour stability in Jewish Torah Trope Performance Traditions. *Proceedings of ISMIR 2011.*

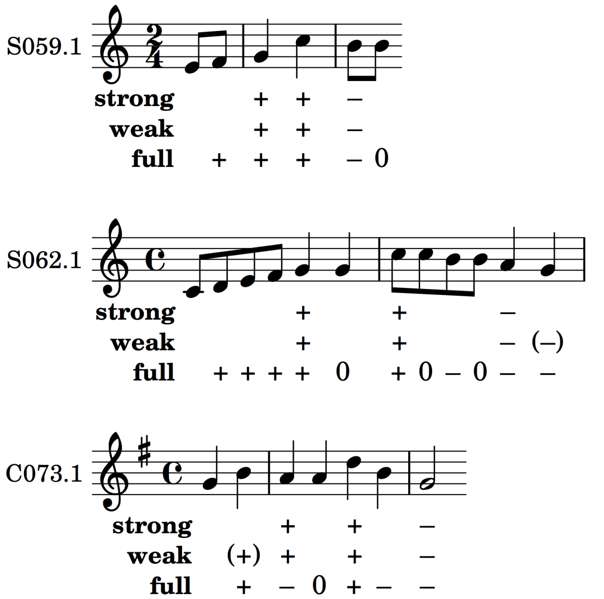

Figure 3. Strong contour [+,+,–], represented 2.4 times more in the Catalunya and Spain songs than in the rest of the corpus.

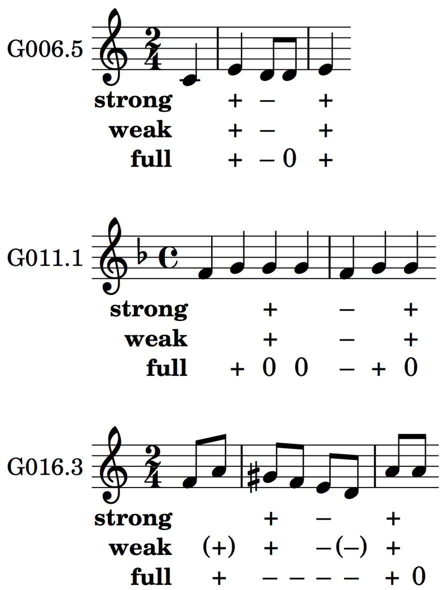

Figure 4. Strong contour [+,–,+], represented 4.8 times more in the Greek songs than in the rest of the corpus.