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A computational analysis study of children's songs from different countries

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ABSTRACT

Children's musical repertoires can be surprisingly rich, varied and musically interesting. This paper sets out to examine children songs from six different countries/nations of Europe, looking for regularities and patterns. In an attempt to find out what musical characteristics are shared between countries, and what makes each country's music stand out, we calculate several melodic and rhythmic viewpoints, some of which use a pre-existing manual segmentation of the pieces (segmental viewpoints). Results are presented and discussed in terms of their musicological and ethnomusicological validity.

I. INTRODUCTION

Music plays a fundamental role in children's everyday lives. It is not only a means to entertainment and feeling expression, but also to socialisation and education.

One can assume that songs written specifically for children or songs produced/written/sung by children are simple in form and content. Usually, such songs share characteristics connected with primal music fundamentals like the voice and gestures, as well as the motions during the games played while singing (Romet, 1980).

Although children's music has been explored from various perspectives and in a variety of settings, such as cultural and educational, there has been scant research on analysing the actual music and looking for regularities and patterns that emerge. Such a process, would exploit the same tools and methods with which adult music is studied. Moreover, a content-based study can shed light in which musical features are cross-cultural (or shared among some cultures), and which differentiate one culture's songs from the other's.

Multiple Viewpoints (Conklin & Witten, 1995) have been successfully used to represent music texture, in the context of many symbolic music processing tasks such as melody prediction and generation (Conklin & Witten, 1995), melody segmentation (Pearce, Müllensiefen and Wiggins, 2008) and others. The structure of the viewpoint formalism, especially along with the functions (constructors) *link* and *thread* that can be applied to basic viewpoints, offer a great deal of abstraction levels that one can model a melody.

Strategies to discover multiple viewpoint patterns (Conklin and Anagnostopoulou, 2001) have been used earlier for folk melody classification (Conklin, 2013).

Segmental viewpoint patterns (Conklin and Anagnostopoulou, 2006), that is patterns whose elements are melodic segments rather than notes, can emerge in the analysis of a piece segmented to musically meaningful phrases.

In this paper we will start by describing the musical corpus used for the analysis. Section III describes the methodology employed, the viewpoints selected and the pattern discovery approach. Section IV presents some results found, while the paper concludes with a discussion on the results from an ethnomusicological point of view.

II. THE CORPUS

The corpus consists of 100 traditional children's songs from six different countries/nations across Europe: Catalunya (15 songs), England (15 songs), France (15 songs), Greece (20 songs), Spain (15 songs) and Turkey (20 songs). The corpus was collected, used and studied previously in (Anagnostopoulou, Giraud & Poulakis, 2013). Songs that were oldest and more traditional were included, based on information by native speakers of each nation's songs. The songs are segmented based on the lyrics, with a segmentation point at the end of each lyrics' phrase. The original dataset also included some (15) Swedish songs, which, for technical reasons we couldn't process.

The songs were encoded in MIDI format. Consulting the segmentation in the scores, we slip-streamed end-of-segment "dummy" MIDI messages in order to process the files easier. We should note here that exact repetitions were encoded in the songs only in cases of the same melody accompanying different lyrics of the same verse.

III. METHOD

A. Multiple Viewpoints

For each song and each segment, we calculated two kinds of multiple viewpoints. The first set consists of viewpoints derived from basic ones (such as pitch, onset time e.t.c.):

- *rhythm contour*: whether the note value increases or decreases.
- *weighted contour*: referred as weighted pitch code in (Schmuckler, 2010). This contour representation is basic melodic contour notation elaborated by each pitch's durational component, so that each contour symbol is repeated as many times as the number of quavers which it includes (for an example, refer to **Figure 1**).
- *link(contour, rhythmContour)*: linked viewpoint of the pure contour and the afforementioned rhythm contour.

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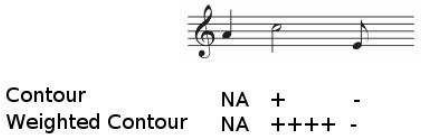
- *stepLeap*: this is a more abstract interval representation which indicates whether the interval of the previous note is a step or a leap.
- *ffon*: whether the interval from the previous note is a perfect fourth or a perfect fifth.

Figure 1. Example of weighted pitch code (example adopted from (Schmuckler, 2010)). In our study, a weighted contour sequence is a simple contour sequence with the contour symbol repeated as many times as the duration of the note (counting in quavers).



The second set consists of segmental viewpoints:

- *thread(contour, high)*: for each segment we select the highest-pitch note. For the selected notes, the contour patterns are examined.
- *thread(contour, low)*: for each segment we select the lowest-pitch note. Same as before, we examine the contour of these notes.
- *thread(contour, highestDuration)*: for each segment we select the highest-duration note and examine their contour.

The intuition behind the above segmental viewpoints is that in simple songs as children songs, notes with higher note value might be more significant than others, or more memorable. We hypothesised that children's songs may not include very challenging sequences of leaps or large intervals; thus we examined the step/leap viewpoint. Finally, a last hypothesis was that one could expect many easy-to-memorize intervals, such as fifths or fourths; hypothesis to be checked with the ffon viewpoint.

B. Discovery of patterns

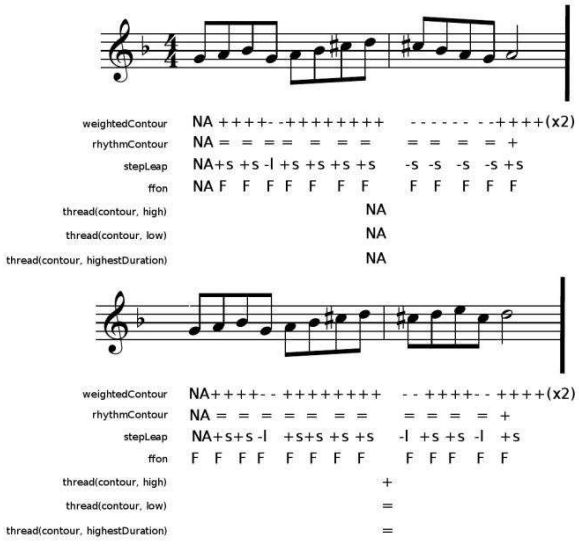
To discover interesting patterns, we followed the approach described in Conklin, 2010. A distinctive pattern is one that is overrepresented in a corpus compared to an anti-corpus. The measure of overrepresentation is the likelihood ratio between the observed count in the corpus and the expected count given the anti-corpus probability.

In our analysis, we used two different corpus/anti-corpus schemata:

- each nation's songs are a corpus *(schema a)*. When examining patterns from a song from one nation, we regard all the songs belonging to this nation as the corpus and all the other songs as the anti-corpus.
- nation groups *(schema b)*. We formed nation groups, based on the hypothesis that countries with geographical (and correspondingly cultural) proximity may share musical texture features. Examples of such groups are *Greek and Turkish* and *Catalan and Spanish.* We followed the same approach as above, but regarding the group's songs as the corpus and all the other songs as the anti-corpus.

For each pattern we computed the probability of appearance in the corpus. We discarded patterns that appear less than ten times in the whole corpus and studied the patterns that were at least two-fold overrepresented in a country compared to others.

Figure 2. Example of multiple viewpoint analysis with the used viewpoints. The weightedContour is reported in semiquavers.



IV. RESULTS

Prior to delving to more thorough analysis, we examined the pieces in terms of Huron shapes (Huron, 1996) by determining the shape for every segment. Quite expectingly, most Greek, Spanish and Turkish songs begin with an "ascending" shape and end with a "descending" shape. Most Catalan songs begin and end with a "convex" shape and most English ones begin with a "convex" and end with a "descending" shape. Commenting on the sequences of shapes, when examining sequences of two shapes, we get the results of **Table 1**. Interestingly, in the Spanish songs, the most popular sequence is descending-descending, which suggests that the overall convex shape should realizes itself in bigger than two-segment parts.

Table 1. The most prominent two-segment sequences of Huron shapes for every nation's songs. In Turkish songs, there was a tie, so both sequences are reported.

song's origin	first	second
Catalan	convex	convex
English	convex	convex
French	convex	convex

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Greek	concave	descending
Spanish	descending	descending
Turkish	concave	concave
	convex	convex

Table 2 lists some indicative patterns found by the aforementioned method and are found to be distinctive in a single nation (schema a). **Table 3** lists some examples of patterns distinctive for a group of nations (schema b).

In those tables, the patterns of a linked viewpoint *link(a, b)* are noted as {[a], [b]} and the values of the *ffon* viewpoint are one of {F, T} domain, where F denotes false (not a perfect fourth or a perfect fifth interval) and T denotes true (a perfect fourth/fifth interval).

Results suggest that each nation's songs present different contour patterns, thus differentiating from others. Moreover, countries which are geographically close such as Spain and Catalunya or Greece and Turkey, seem to share more common patterns, suggesting a projection of their cultural similarities in children's songs.

Table 2. Indicative patterns reported distinctive in a single nation (using *schema a*).

viewpoint	pattern	nation
thread(contour, high)	= = = =	Catalunya
thread(contour, low)	+ – –	Turkey
thread(contour, highestDuration)	= = = =	Catalunya
link(contour, rhythmContour)	{=,=}{+,=}{–,=}{–,=}	Spain
link(contour, rhythmContour)	{–,=}{=,=}{+,=}{–,=}	Catalunya
link(contour, rhythmContour)	{+,=}{–,=}{=,=}{+,=}{–,=}	Catalunya
weightedContour	– – – – – + + + + – – – – – –	England
weightedContour	+ + + + + + + + + + + + +	Turkey
stepLeap	–s –s +s +s –l	England
stepLeap	+s –s –s –s +s	Spain
ffon	F F F F F F F T	France
ffon	T F F F F F F F F	England

Table 3. Indicative patterns reported distinctive in a group of nations (using *schema b*).

viewpoint	pattern	nation group
thread(contour, high)	+ – +	Catalunya - Spain
rhythmContour	= + – = = =	Turkey - Greece
rhythmContour	= = = = +	Catalunya - Spain
link(contour, rhythmContour)	{+,=}{+,=}{–,=}	Turkey - Greece
link(contour, rhythmContour)	{=,=}{+,=}{–,=}	Catalunya - Spain

In the figures that follow some examples of the patterns found and their respective viewpoint sequences are presented:

Figure 3. The pattern {+,=}{+,=}{–,=} in link(contour, rhytmContour) in a Turkish song.

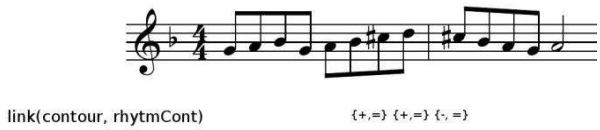

Figure 4. The pattern +s –s –s –s +s in stepLeap in a Catalan (first) and a Spanish (second) song.

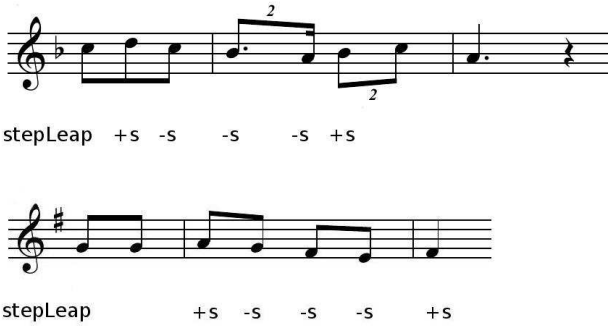

Figure 5. The pattern = + – = = = in rhytmContour in a Greek (first) and a Turkish (second) song.

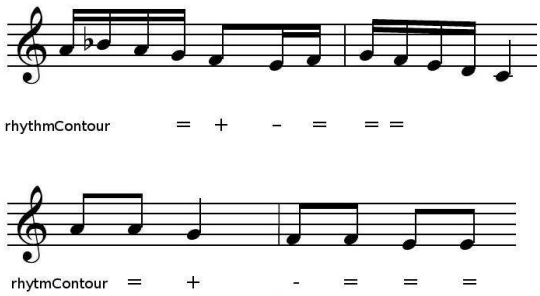

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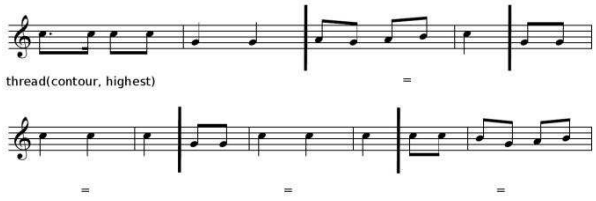
Figure 6. The pattern + – + in thread(contour, high) in a Spanish (first) and a Catalan (second) song.

Figure 7. The pattern = = = = in thread(contour, high) in a Catalan song.



V. DISCUSSION

In general, we observe significant rhythmic repetitions inside the songs' phrases and an extensive, repeated use of notes with the same duration – a basic characteristic of children's songs, since they have to be repetitive, vivid and easily memorized.

Discussing the patterns of **Table 2** in the context of the *link(contour, rhythmContour)* viewpoint there are several patterns which highlight a mutual feature of children's songs spread throughout the corpus: the slight melodic development along with a stable rhythmic configuration. Specifically, most patterns correspond to a smooth melodic ornamentation around a significant note – a kind of an enlarged gruppetto or mordent – or to a more adventurous melodic progress in the form of broken chords like a small arpeggio. A noteworthy issue is that all these patterns keep the same note duration – most of the times a small one.

The *weightedContour* viewpoint actually indicates pitch-duration contours between specific notes. Commenting on the = = = = pattern of the *thread(contour, highest)* viewpoint, we could say that most segments in Catalan songs seem to have a consecutive repeated high note, i.e. the tonic, or another important note of a small scale, i.e. a note of a tetrachord.

Comparing English songs with all other songs, we have found out the preponderance of a convex "weighted contour", which probably serves as a finishing motif that ends up in a long duration note. On the other handAt the same time, Turkish songs appear to be heavily founded on ascending motifs of smaller duration notes. Analysis of songs using the *stepLeap* viewpoint illustrates that their fundamental melodic move is the step, which ensues from their unsophisticated linear schema and the prevention of larger melodic intervals.

The above remark about the abscence of large intervals is also highlighted with the *ffon* viewpoint, as the most significant patterns (FFFFFFFT and FFFFFFFFT) appear respectively in French and English songs, which seem to be quite different, if not a little more refined and "modernized", compared with their anti-corpora songs. Contrary to what one would expect, fourths and fifths are not – as a general rule – widely used in children's songs (and in fact they are much less used in Turkish and Greek songs).

Commenting on the patterns shown in **Table 3,** we could say that the + – + pattern, overrepresented in Catalan and Spanish songs, employing the *thread(contour, highest)* viewpoint, appears to have a high occurrence. From a musicological point of view, concerning basic morphological elements of the songs, this is generally explained through the simple 4-part phrasing of the segments, according to a classic 8-bar song form (ABAB or ABAC etc.).

Greek and Turkish songs reveal an interesting pattern of durations = + – = = =, as a result of major repeats of rhythmic motifs. Spanish and Catalan songs also share a common and widely emerged pattern for the *rhythmContour* viewpoint, which is the = = = = + pattern. This pattern most of the times comes up in accordance with a strict phrase repetition as well as a specific phrase formation based on notes of the same duration that end up at a significant note of longer duration, probably also connected with the assignment and phrasing of the song's lyrics.

The = = = = = pattern of the *thread(contour, highestDuration)* viewpoint indicates that Catalan and Spanish songs include many segments with the same note durations – for example quavers – or that they are constructed on exact repetitions of the same segments or phrases. We should note here that exact repetitions were encoded in the songs only in cases of the same melody accompanying different lyrics of the same verse.

VI. CONCLUSION AND FUTURE WORK

The computational music analysis carried out in the corpus of children songs suggests that there are differentiating patterns throughout the songs of different nations that can potentially be linked to national and cultural particularities of children's songs, and also patterns that seem to be common in some groups of countries. At the same time, there are many common attributes which are associated with global music norms and universal (transnational and transcultural) connotations.

As a result, some of the viewpoints used in this music analytic study could be used to represent the songs in the context of a machine learning application, such as a classifier.

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However, the efficiency of computational analysis should not leave aside fundamental musical factors that affect our reception and perception of children's songs.

It is obvious that a larger corpus of data with more songs from different countries could bring to light better examples and provide enhanced results. In this respect, it is of particular importance to know how and for what purpose the transcriptions of the songs have been made.

Another direction for future work could be to harvest a more diverse corpus by including adult songs of similar genre, in order to be able to efficiently compare the adult and children music. Such a study could contribute towards the statement that children music is a special musical culture of its own merit.

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