PERCEPTION OF METER SIMILARITY IN FLAMENCO MUSIC

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1. INTRODUCTION

Flamenco music is characterized by hand clapping patterns whose underlying meter is composed of a pattern of soft and accented claps. A mathematical analysis of the five 12/8 metric patterns used in flamenco music was recently conducted to establish several musicological hypotheses [1]. This analysis relied on the similarity between the metric patterns. Such similarity was measured with two different rhythmic similarity measures, namely, the *chronotonic* measure and the *directed swap* distance. Presented in this paper are the results of a listening test conducted to evaluate the perceived similarity of the five metric patterns used in flamenco music. The goal of this experiment includes testing out the validity of those measures from a perceptual point of view. Twelve subjects participated in three experimental sessions, corresponding to three tempi (slow, medium, fast). In each session, participants were asked to rate the dissimilarity of all non-identical pairs of the five MIDI-generated patterns, presented twice in counterbalanced order. Dissimilarity ratings were analyzed using multi-dimensional scaling and phylogenetic analysis. The perceptual measures of similarity were then compared with mathematical measures of rhythmic similarity used in [1] to determine which measure best matches human judgments.

2. METHOD

2.1 Participants

12 listeners (mean age: 25, S. D. 4) with an average of 3 years of musical training were recruited from the student population at McGill University. They received 10$ for their participation.

2.2 Stimuli

The listeners listened to the following rhythms (in box notation): (1) Fandango: [x . . x . . x . . x . .]; (2) Soleá: [. . x . . x . x . . x]; (3) Bulería:[. . x . . . x x . x . x]; (4) Seguiriya: [x . x . x . x . . x . .]; (5) Guajira: [x . . x . . x . x . x .]

The sound files were generated using the music notation software Finale. The output was MIDI-generated sounds of hand clapping (channel 10, key 39) produced through the native instruments audio unit of Finale. The rhythms were generated at three different tempi, namely, 50, 70 and 90 dotted quarter notes per minute, respectively (or 400 ms, 285 ms and 222 ms between consecutive claps).

2.3 Procedure

The graphical interface was programmed in Java on a MacPro computer. The experiment took place in an acoustically treated room. Sounds were presented over headphones (AKG 240) after digital-to-analog conversion and amplification (Motu 828 MKII). The experiment consisted of 3 sessions corresponding to the aforementioned tempi. In each session, participants were first asked to listen to the 5 rhythmic patterns presented in the experiment to become familiar with the range of variation. After 3 randomly chosen practice trials, they were asked to rate the dissimilarity for all possible non-identical pairs of the 5 patterns (10 pairs). Pairs were presented twice in counterbalanced order, resulting in 20 trials in total. The order of presentation was randomized across trials within each session. The order of presentation of the 3 sessions was counterbalanced across participants using a Latin square design. Dissimilarity ratings were made with the mouse on a scale presented on the computer screen with end points labeled "very similar" and "very different". Scale values were digitized on a 0 to 100 scale. Listeners were allowed to listen to the patterns as many times as desired before entering their ratings. They were requested to keep their rating strategy as constant as possible. After the experiment, they were asked to freely describe the differences between the sounds presented and explain how they made their ratings.

3. RESULTS

3.1 Phylogenetic analysis

A dissimilarity matrix was created for each participant based on their ratings. These values were averaged for every participant to symmetrize the matrix. A global dissimilarity

matrix was obtained by summing individual matrices across the 12 participants. Afterwards the BioNJ phylogenetic program [3] was used to construct the phylogenetic tree for each tempo (see Figure 1 and 2).

It can be seen that there is very little difference between the trees for each tempo. Guajira and fandango always form one cluster, soleá and bulería form another cluster, and seguiriya is isolated from the others. Bulería comes out as the most different from all the rhythms, according to the chronotonic distance, and guajira and fandango come out as the two most similar.

3.2 Comparison with mathematical measures

The results confirm the mathematical results from [1]. Specifically human judgment matches the similarity measures using the chronotonic distance more than that using the directed swap distance [2].

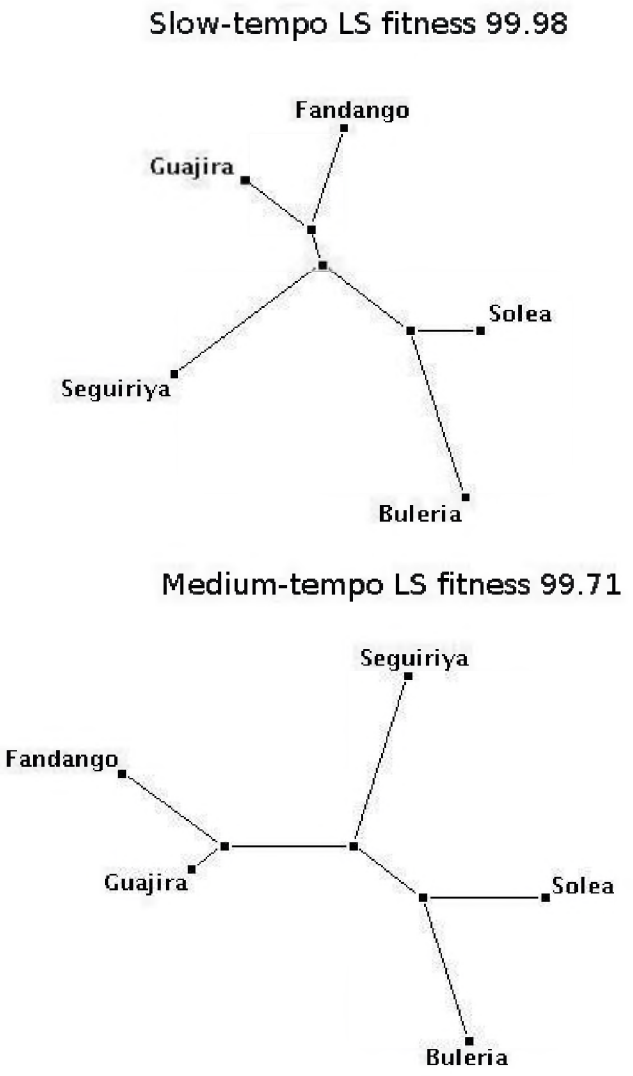

Fig 1: Phylogenetic trees for the slow and medium tempi

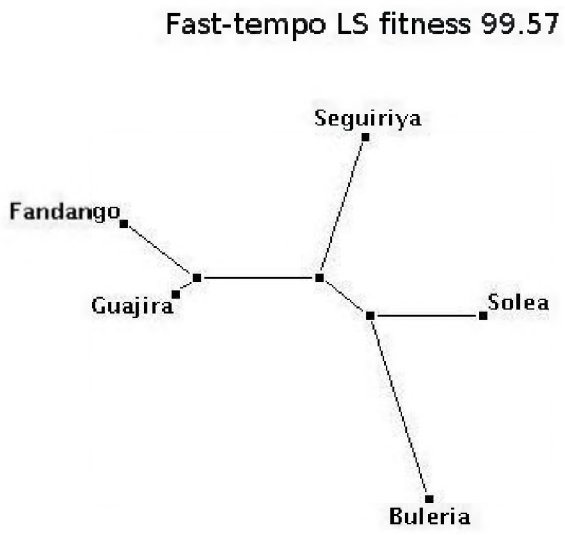

Fig 2: Phylogenetic tree for the fast tempo.

4. FUTURE DIRECTIONS

For future research, we will analyze the effect of the order of the three tempi during the counterbalanced presentations to investigate potential learning effects. We will also replicate the study with the same rhythmic patterns repeated a number of times to evaluate the effect of repeated presentation. Furthermore, we will carry out the study with classically trained musicians and flamenco players to investigate the effect of expertise on perceived rhythmic similarity.

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5. REFERENCES

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