

INFLUENCE OF TEMPO AND SUBJECTIVE RATING OF MUSIC IN STEP FREQUENCY OF RUNNING

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ABSTRACT

The objective of this work was to study how the tempo and subjective motivational rating of personal music influence in step frequency during an exercise session. The participants (n=8) were requested to bring their own music to the test and rate it according to the motivational effect of each song. The test was conducted on a sports field where the participants were asked to perform a 30 minute exercise without paying attention to the test setup. Significant correlation was found between the subjective motivational rating of music and step frequency, while tempo did not have any influence.

1. INTRODUCTION

Along with the development of mobile music players and increased storage capacity, more attention must be paid to easy management of the music content. In a challenging context of use such as sport, correctly selected music may also maintain the exercising motivation. Music style and tempo have shown to have influence in the exercise. Tenenbaum et al. [7] presented results where music type seemed to have impact on motivation and performance of amateur runners. Inspirational music was found to be more motivating than rock, dance or silence. Meis [5] studied the effect of preferred, non-preferred and neutral music on a cycling task. The most significant differences were found in subjective Rating of Perceived Exertion (RPE), fatigue, tension and vigor. Effect of changing the music type during the exercise session was studied by Szabo, Small and Leigh [6]. It was reported that significantly higher workload was accomplished when music is arranged so that it becomes faster towards the end of the session.

Karageorghis, Terry and Lane [4] introduced a validation instrument for evaluating the motivational qualities of music, Brunel Music Rating Inventory (BMRI). The instrument divides the motivational qualities of music into 4 subgroups: association, cultural impact, musicality and rhythm response. A general problem of the instrument appeared to be the complexity of the musical qualities to be evaluated, which was the reason for not using the instrument in this test. The influence of the music rating in performance was studied by Elliott, Carr and Orme [3]. Listening to music during the exercise increased the distance traveled using a cycle ergo meter, but there were no observed differences between the motivational and non-motivational music conditions.

To increase running speed, more effort has to be made. The case is more complex with step frequency. When running, the speed is increased mostly by taking longer steps, not so much by increasing the step frequency [2]. Only in the higher speeds, the step frequency starts to increase more significantly. When walking, on the other hand, step frequency is more linearly proportional to the speed within the whole range [1]. However, the key question according to this study is: if there are variations in the step frequency during running, do they correlate with the variations in music motivational rating or tempo?

In this test, effect of music subjective motivational rating and tempo in step frequency was measured. The study emphasised on personal music selection and non-laboratory-like environment. The aim was to find out how much music can influence in the exercise intensity within the session. This could provide more insight on whether the user can be coached into a desired intensity profile only with music.

2. TEST ARRANGEMENTS

The main principles for the field tests were: a) The test should be arranged in as natural environment for exercise as possible b) the music to be used should be of participant's own personal choice.

The music playback device was a mobile phone, with headphones. Sensor hardware developed for the purpose provided a 3-dimensional acceleration signal and wireless connection to the mobile phone. The music player application in the mobile phone analysed the sensor signal and calculated the step frequency in 5 second intervals with an autocorrelation algorithm. Also, the application selected the tracks to be played during the session and saved the step frequency and current music track parameters into a log file for later analysis.

The participants (n=8) for the test were selected from a marathon club of Nokia Corporation in Helsinki region. Before the actual test the participants were asked to select 50 or more tracks of music that they usually listen to while running. They rated each songs motivational effect by answering the question: "How motivating is this track for your exercise?" The given scale for the rating was from 1 to 100 and participants were asked to use the range as widely as possible. The test was arranged outdoors in a sports field with 350m running track. The test duration was 30 minutes which enabled playback of 6-10 songs per session.

3. RESULTS

The numerical output of the field test was the log file produced by the music player application in the mobile phone, illustrated in Fig. 1.

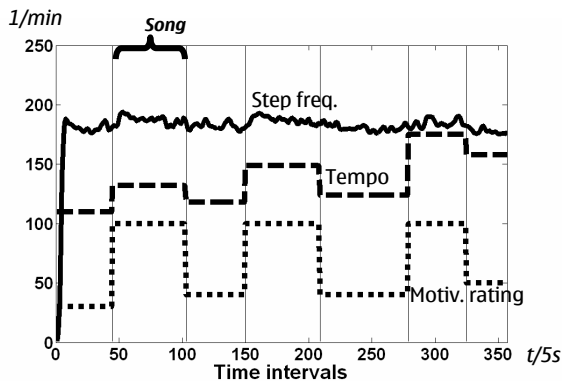


Figure 1. Log file illustration

The file contained details of each session sampled in 5 second periods including the average step frequency of the last 5 seconds (solid line), motivational rating (dotted line) and tempo (dashed line). First, the average step frequency during each song was calculated. Now, the unit of analysis was changed into a song instead of 5 second interval. In order to equalize the various ratings, tempos and step frequencies the data was scaled into range between -1 and 1 so that the minimum value of the session was set to -1 and maximum to 1 respectively. Finally, all the sessions were combined into one data set including all the songs of all 8 participants. The final data consisted of 58 items (songs) with corresponding motivational rating, tempo, and step frequency. In the obtained data, there was no significant correlation found between the tempo and step frequency. Correlation coefficient for the data was 0.19 while the tabulated threshold for significance is 0.273 ($p=0.05$, $n=58$). Instead, the subjective motivational rating proved to have a correlation with the step frequency (Fig. 2).

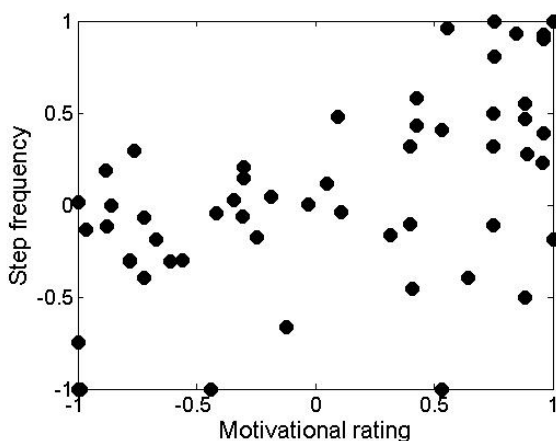


Figure 2. Step frequency as a function of subjective motivational rating.

Calculated correlation coefficient between these parameters was 0.62 which is clearly above the limit 0.273 ($p=0.05$, $n=58$).

4. SUMMARY AND CONCLUSIONS

In the test, a significant correlation was found between the motivational rating of songs and step frequency. Even though the finding seems clear, there are some considerations that should be taken into account before making further conclusions. Firstly, the selected participants were active marathon runners, which are trained for exercising certain way. Routine may cause a reduced influence of external stimuli into the performance, e.g. music type in the step frequency. Secondly, since the music was rated by the same person who attended the running test, the variations in the step frequency may be influenced by the commitment of the person to show that the rating is valid. However, the results of the study are clearly indicating that music rating has a strong influence in step frequency. More research with other objective measures such as speed and heart rate should be conducted.

5. REFERENCES

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