

Motor imagery and music: A function of arousal?

FERNANDO CASTELLAR¹ , PEDRO DUARTE-MENDES^{2,3}

¹University of Lisbon, Portugal

²Department of Sports and Well-being, Polytechnic Institute of Castelo Branco, Castelo Branco, Portugal

³SHERU - Sport, Health & Exercise Research Unit, Polytechnic Institute of Castelo Branco, Castelo Branco, Portugal

ABSTRACT

The study of imagery has been a central pillar in the Sports Psychology field, since athletes have reported the use of imagery techniques in order to mentally practice body movements and, therefore, improve the actual physical performance. Similarly, music plays a quintessential role in many sports as its influence on athletes' motivation, concentration, confidence and anxiety levels before and during the sporting practice has been widely reported and studied. The application of imagery and music combined has been reported to yield improvement in sporting performance. As a possible explanation, certain types of music have been considered as an element that decreases arousal levels in subjects, promoting a more effective use of imagery prior to performance. However, it has also been reported that subjects had better performance at tasks that assessed mental imagery processes after arousal increase after subjects' exposure to arousing music. Thus, this study has investigated whether two distinct musical stimuli (simple and complex music) affected arousal levels in participants, and consequently the performance in a mental imagery of body parts (henceforth: motor imagery) cognitive task, namely mental-rotation of bodily-related pictures. 30 Sports Science students completed this mental rotation of body pictures task after exposure to three different stimuli (silence, complex music and simple music). Although results showed arousal levels decrease after subjects were exposed to both complex music and silence, this decrease did not yield any effect on performance, casting doubt on the hypothesis that arousal decrease facilitates motor imagery processes. **Keywords:** Mental imagery; Motor imagery; Mental rotation; Subjective arousal.



Corresponding author. University of Lisbon, Portugal.

E-mail: fernandocastellar@campus.ul.pt

Supplementary Issue: Spring Conferences of Sports Science. International Seminar of Physical Education, Leisure and Health, 17-19 June 2019. Castelo Branco, Portugal.

JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202

© Faculty of Education. University of Alicante.

doi:10.14198/jhse.2019.14.Proc4.82

INTRODUCTION

Although the influence of both imagery and music on sporting performance have been thoroughly examined within the Sports Psychology literature (Kuan et al. 2018), the field lacks studies in which imagery and music are used concomitantly at pre-intervention treatment prior to sporting performances. In a 12-week treatment in which elite shooters combined the use of different types of music and a motor imagery script, Kuan et al. (2018) found out that participants who listened to relaxing music had more improvement at dart-throwing tasks compared to their counterparts who listened to arousing music or no music at all. The authors claim that this difference in performance enhancement between groups is due to greater decrease in arousal by participants exposed to relaxing music compared to the other groups. On the other hand, studies from Cognitive Psychology have reported that the enhancement in performance in cognitive tasks that assess mental imagery processes (i.e. Paper-folding and cutting, mental rotation of pictures, etc.) was due to arousal increase and enjoyment of the stimulus (Husain et al, 2012). Thus, by selecting musical stimuli with high and low levels of load information (simple music and complex music, respectively) that were expected to elicit different arousal levels in participants (Kriger, 1989), this study investigated how the exposure to musical stimuli and silence would influence participants' level of arousal and, then, their performances in a cognitive task that assesses motor imagery processes – a mental rotation of body parts-picture (Hamada et al., 2018).

MATERIAL AND METHODS

Participants

Participants were 30 voluntary Sports Science students from Instituto Politécnico de Castelo Branco (24 males and 6 females), aged 18-25 years (M: 20.21 years, SD= 3.20 years). All participants reported their hearing as normal. No participant had previous experiences with mental rotation tasks.

Measures

As criteria of exclusion, the MIQ-3 translated and adapted to European Portuguese (Mendes et al., 2016) was employed in order to assess participants' mental imagery abilities, yielding no exclusion. Arousal levels were assessed both before and after participants were exposed to musical stimulus by employing the Self-Assessment Manikin – SAM (Bradley and Lang, 1994). Response times and accuracy in mental rotation tasks were computed by E-Prime 2.0 Psychological Software.

Procedures

Participants gave their informed consent to participate in the experiment, which was approved by the ethics committee of the University of Lisbon. Participants were placed in groups of 5 subjects each (1 female per group) and were exposed to all three stimuli for three consecutive days. The order of stimuli to which participants were exposed was counterbalanced. For the musical conditions, participants listened to 8:25 minutes of either the original version of an instrumental piece with a steady and simple rhythmic pattern (Space Katzler, by Motorcitysoul), or to the edited version of the song, in which the rhythmic patterns varied to purposely make the piece as a high-information-load one (Kiger, 1989). Participants remained in silence for the same time under the silence condition. Also, participants were asked to create mental images about their own bodies and imagine how they would physically react to the music they were listening to or to the silence (i.e. imagine if they were dancing). Both before and after exposure to musical stimulus, participants responded to the SAM (Bradley and Lang, 1994) in order to have their arousal levels assessed at these two different times. After exposure to the stimuli, participants carried out a mental rotation task of pictures of hands and feet in different degrees of inclination (0°, 30°, 60°, 90°, 120°, 150°, 180°). Participants had to

indicate whether the hand/foot depicted on the screen belonged to the left/right part of the body by pressing either the left or right arrow keys of the keyboard to left or right stimulus, respectively.

Analysis

Firstly, The Kolmogorov-Smirnov test was employed in order to check whether data distribution was normal or not normal. The results showed that distribution was not normal; hence, non-parametric tests (Friedman test and a Wilcoxon test) were applied to carry out further data analysis.

RESULTS

A Friedman test yielded no significant differences neither in Response Times nor in Accuracy after exposure to the three different conditions (silence, music with simple rhythm and music with complex rhythm) in mental rotation task: $X^2(2, N = 30) = .467, p=0.792$ for Response Times, and $X^2(2, N = 30) = .883, p=0.643$. for Accuracy. A Wilcoxon test yielded significant decreases in arousal levels after participants were exposed to complex music and silence: $Z = -2.381, p = 0.017$, median score rating = 5.00 before and 4.00 after exposure to silence, and $Z = -2.325, p = 0.020$, median score rating = 5.00 before and 4.00 after exposure to complex music. However, the Wilcoxon test yielded no significant changes in arousal levels after participants were exposed to simple music: $Z = -1.827, p = 0.69$, median score rating = 5.00 before and 4.00 after exposure to simple music.

DISCUSSION

In line with the claims by Kuan et al (2018) and Kriger (1989), it had been hypothesized that exposure to music with low-information load (simple music) would result in participants' greater decrease in arousal levels and, consequently, a better performance in the task when participants were exposed to simple music than when exposed to high-information load music (complex music) and silence, respectively. The results did not confirm the hypothesis, suggesting that: 1) the hypothesis that music with low-information load decreases arousal compared to music with high-information load does not hold true, and 2) arousal decrease does not necessarily facilitate the motor imagery process. As there was no report of arousal increase, the hypothesis that arousal increase facilitates motor imagery processes remains to be clarified.

CONCLUSIONS

Results provided no support for the hypothesis that improvement in mental/motor imagery processes is a product of arousal increase/decrease, since changes in arousal levels did not influence performance in a mental rotation task of bodily-related pictures. Thus, more studies are needed in order to investigate whether music may improve mental/motor imagery processes in different circumstances and settings compared to those of the present study, and if so, the main reasons for such improvement.

REFERENCES

- Bradley, M. M., & Lang, P. J. (1994). Measuring emotion: The Self-Assessment Manikin and the semantic differential. *Journal of Behavior Therapy and Experimental Psychiatry*, 25(1), 49-59. [https://doi.org/10.1016/0005-7916\(94\)90063-9](https://doi.org/10.1016/0005-7916(94)90063-9)
- Hamada, H., Matsuzawa, D., Sutoh, C., Hirano, Y., Chakrabort, S., Ito, H., Tsui, H., Obata, T., Shimizu, E. (2018). Comparison of brain activity between motor imagery and mental rotation of hand tasks: a

- fMRI study. *Brain Imaging and Behavior*, 12(1), 1596-2006. <https://doi.org/10.1007/s11682-017-9821-9>
- Husain, G., Thompson, W. F., & Schellenberg, E. G. (2002). Effects of musical tempo and mode on arousal, mood, and spatial abilities. *Music Perception*, 20(1), 151-171. <https://doi.org/10.1525/mp.2002.20.2.151>
- Kiger, D. (1989). Effects of music information load on a reading comprehension task. *Perceptual and Motor Skills*, 69(1), 531-534. <https://doi.org/10.2466/pms.1989.69.2.531>
- Kuan G, Morris T, Kueh Y., and Terry P. (2018) Effects of Relaxing and Arousing Music during Imagery Training on Dart-Throwing Performance, Physiological Arousal Indices, and Competitive State Anxiety. *Frontiers in Psychology*, 9(1), 1-12. <https://doi.org/10.3389/fpsyg.2018.00014>
- Mendes, P. (2016). Tradução e Validação do Movement Imagery Questionnaire – 3 versão Portuguesa e as habilidades de Imagery em atletas de modalidades distintas (Doctoral Dissertation). Universidade da Beira Interior, Covilhã, Portugal. <https://doi.org/10.22355/exaequo.2017.36.10>



This work is licensed under a [Attribution-NonCommercial-NoDerivatives 4.0 International](https://creativecommons.org/licenses/by-nc-nd/4.0/) (CC BY-NC-ND 4.0).