Original Article

THE INFLUENCE OF AUDIENCE ON SENSORYMOTOR PERFORMANCE IN UNIVERSITY STUDENTS

A INFLUÊNCIA DE PLATEIA SOBRE O DESEMPENHO SENSORIOMOTOR DE ESTUDANTES UNIVERSITÁRIOS

Simara Regina de Oliveira Ribeiro[1], Cristiane Alves Martins[1], Lidiane Aparecida Fernades[1], João Roberto Ventura de Oliveira[1]; Tércio Apolinário-Souza[1] e Guilherme Menezes Lage[1]

[1]Universidade Federal de Minas Gerais, Belo Horizonte – MG, Brasil.

RESUMO

O presente estudo investigou a influência de plateia sobre o desempenho sensoriomotor na aprendizagem do arremesso de dardo de salão. O experimento foi conduzido em dois dias distintos, cada um com uma condição específica: 1) com plateia (10 tentativas); 2) sem plateia (10 tentativas). Os 18 universitários de menor e maior desempenho foram divididos em dois grupos: prejudicado (GP) e beneficiado (GB). Nas análises de desempenho e escores de ansiedade-estado (IDATE), a ANOVA two way e *pairwise* identificaram interação entre grupo e condição, sendo GP com pior desempenho e maior IDATE e GB com melhor desempenho e sem alteração no IDATE na condição com plateia. Já na frequência cardíaca, não houve interação, porém efeito principal para o fator condição para ambos os grupos. Pode-se inferir que, a plateia influencia no desempenho sensoriomotor podendo ocorrer piora ou melhora a depender de características individuais.
Palavras-chave: Análise e desempenho de tarefas. Estresse psicológico. Ansiedade.

ABSTRACT

The present study investigated the influence of audience on the sensorymotor performance in learning the hall of javelin throwing. The experiment was conducted on two separate days, each with a specific condition: 1) with audience (10 attempts); 2) no audience (10 attempts). The 18 students of smaller and higher performance were divided into two groups: disadvantaged (DG) and benefited (BG). The performance and state-anxiety scores (IDATE), the two-way ANOVA and pairwise identified interaction between group and condition, and GP worst performing and most IDATE and GB with better performance and no change in IDATE provided with the audience. In the heart rate, there was no interaction but the main effect for the condition factor for both groups. It can be inferred that the audience influences the sensorymotor performance may cause worsening or improving depend on individual characteristics.
Keywords: Analysis and task performance. Psychological stress. Anxiety.

Introduction

The capacity the nervous system has to organize adequate and precise motor responses in the most complex, varied and unpredictable situations is notorious[1]. The training of such motor responses, through repetition, can provide even greater stability and efficacy to the executor[2]. However, even well-learned and automated motor actions seem to undergo changes when performed in situations of stress and anxiety[3].

The concepts of stress and anxiety have differences so subtle that they are sometimes used as synonyms. The term stress is used when it is possible to identify a cause that generates fear; anxiety, in turn, does not necessarily produce fear, but rather an expectation of something that is to come[4].

As described by Lieber and Morris[5], anxiety can be understood in the cognitive and somatic dimensions, with the first relating to the individual's perception of the situation, comprehending doubts and negative thoughts regarding his or her own ability to cope with the situation, and the second referring to responses from the autonomic nervous system, such as

increased blood pressure, heart rate, muscle tone, electrical conductance, and other neurovegetative responses.

The literature also presents another conceptual division of anxiety: a) Trait anxiety, referring to personality characteristics, being a tendency or behavioral disposition to perceive as threats a wide variety of circumstances that are objectively not dangerous; b) State anxiety, referring to an immediate emotional state characterized by a feeling of fear, apprehension, tension, and by an increase in the activity of the autonomic nervous system[6]. In this study, anxiety analyses were restricted to the state type.

In sports, for instance, some elite athletes perform better under emotional pressure, while others fail[3]. One of the factors that can cause external pressure, affecting the individual's performance, is the presence of a significant audience[7-9].

In a qualitative study conducted by Dias, Cruz and Fonseca[7], eleven professional athletes of different modalities, aged between 22 and 36 years old, participated in semi-structured interviews for the identification of the main sources of stress and anxiety during sports competitions. Among the sources reported, the three most frequent were: nature of the competition (importance, difficulty, novelty and level), mentioned by 81.8% of the subjects, external pressure (coach, friends, family, media, general public), mentioned by 72.7% of the subjects, and not performing as expected (not achieving goals, losing or not winning, and performance concerns), mentioned by 63.6% of the subjects. The same authors drew attention to the following concerns of those athletes: not disappointing, pleasing, impressing, and criticism directed at them by viewers.

In the study developed by Medeiros Filho, Pinto and Carvalho[8], a comparison was made of the percentage of free throw performance in basketball by 5 professional athletes (21-34 years of age), in a training environment (in the presence of the applicators and other athletes) and in real competition situations (with general audience). Results indicated that all athletes performed the throws better when training; however, the difference between the percentage of scores in training and competition situations was statistically significant only for two of those athletes. It was suggested for the case of those two athletes that the worst performance, in the competition environment, was due to personal characteristics (level of self-confidence and anxiety) that were different from those of the other three athletes. Goyen and Anshel[9] investigated sources of acute stress during a sports competition, including 65 adults (37 men and 28 women) and 74 adolescents (39 men and 35 women) athletes. Results indicated a higher intensity of acute stress in men and in adults, associated to performance-related stressors (eg., when making a physical or mental error) when compared to women and adolescents. However, for the stressor related to social assessment, women showed greater stress intensity when compared to men. Adolescents, in their turn, showed a higher level of stress than adults did due to the actions of other people (eg., relatives' attitudes, boos and criticism from viewers). The intensity of stress may vary according to gender, age and depending on the nature of the stressful event.

The influence of state anxiety on motor performance is understood as associated to changes in attention and concentration resources[10-13]. There is a common notion that, for a successful performance, the performer must consider information that is relevant to the task while ignoring irrelevant information[14]. Such a notion encompasses two general explanatory models: distraction models and internal focus models[14-16]. Distraction models suggest that some factors (eg., anxiety) are capable of diverting attention from information that is relevant to the task towards irrelevant cues (internal and external to the individual), thus reducing performance. The distraction model by Wine[17] is based on a difference in the focus of attention of highly anxious and little anxious people during the execution of a task to explain the effect of anxiety on performance. Highly anxious people oftentimes divide their attention

between variables that are irrelevant to the task (eg., self-evaluation concerns) and variables relevant to the task, while less anxious ones focus more on the task.

The internal focus model establishes that: factors such as pressure and anxiety increase self-awareness and evoke an internal focus of attention[18]. Increased internal attention can induce a conscious motor control, guided step by step, capable of interrupting the well-learned automatic processing of a task, thus causing a decrease in performance[19]. Such a process was called by Masters[18] the "conscious processing hypothesis". Conscious processing in this context would represent a temporary decline to a lower level of ability, or also the regression to an earlier stage of learning[16]. Said regression means greater cognitive control of movements, equivalent to what occurs in the early stages of learning when performance is ineffective and insecure.

In view of this, the present study aimed to investigate the influence of the audience on the sensorimotor performance of university students when it comes to learning dart throwing.

Considering the presence of audience as an emotional disturbance, our hypothesis was that there would be changes related to levels of state anxiety and heart rate and, consequently, changes in performance when compared to the conditions with and without audience.

Methods

Sample

Initially, the sample of this study included 25 subjects (18 men and 7 women), aged from 19 to 40 years old, right-handed, university students. Inclusion criteria were: not using psychoactive substances or psychotropic substances, not having sensory or motor disorders and not having practical experience in dart throwing. Such criteria were investigated by means of anamnesis. To participate in the investigation, the subjects signed a free and informed consent form. The study was approved by the Ethics Committee on Research Involving Humans of the Federal University of Vale do São Francisco (protocol 0010/121212).

Procedures

The participants were subjected to a dart throwing task, semiprofessional Nautika model. There was a circular target of 45 cm in diameter, fixed on a wall, at a height of 1.73 m from the ground to its center. From the periphery of the target to the center there were 9 circumscribed areas, which had values that increased from 1 to 9 points, with the maximum value of 10 points being attributed to when one scored at the center of the target. The participants should hit the darts as close to the center as possible to score higher. In order to execute the throws, the subject would stand 2.35 m away from the target. A standard hand and arm position was adopted for all the subjects' throws.

The subjects came to participate in the experiment on two days, that is, two different conditions: 1) with audience and 2) without audience. In the audience condition the procedures were performed in the presence of a set audience that could manifest freely and verbally during the task. In the no-audience condition the participant performed all procedures in the presence of the experimenter only in a silent environment. In each condition, 10 attempts were made and the score of each participant was the sum of the values obtained in each of the ten attempts. Before the 10 attempts the subjects became familiar with the task, being allowed to execute 3 throws from progressive distances with the last one being the real distance of the task. The order of subjection to one of the two conditions was randomized by means of draws, and counterbalanced, that is, half of the subjects started in the no-audience condition and the other half in the audience condition, arranged randomly.

The State-Trait Anxiety Inventory (STAI) was applied to each condition immediately before the performance of the dart throwing task to try to identify and compare exclusively the participants' anxiety states in each experimental context[20]. The inventory, under both conditions, was filled in a reserved space; however, in the audience condition, the participant filled it in after being faced with the presence of the viewers. It is a self-report scale that depends on the subject's conscious reflection in the process of evaluation of his or her anxiety state. The inventory consists of twenty multiple choice questions, with four answer alternatives ranging from 1 to 4 for each question, where 1 represents "absolutely not", 2 "a little", 3 "a lot" and 4 "too much". The subject's score is obtained by a specific sum of the values of the answers, which can reach a maximum value of 80 and a minimum of 20. Higher scores indicate more intense states of anxiety.

The frequency meter (Polar FT1) was activated immediately before the start of the task and was monitored every 30 seconds during the execution of the task.

After collection, 18 subjects (13 men and 5 women) were selected and divided into two groups: disadvantaged (n=9) and benefited (n=9), depending on whether the performance in the task, in numerical terms, had worsened or improved in the audience condition when compared to the no-audience condition. Such a difference was then tested and confirmed statistically. The data of the other subjects that presented non-statistically different performance between both conditions (5 men and 2 women) were excluded from the sample.

Statistical analysis

The two-way ANOVA was applied to verify whether the numerical differences referring to the dart throwing performance were significant, thus allowing to assume the existence of a disadvantaged and a benefited group. In this sense, the factors investigated were: group (disadvantaged X benefited) and condition (audience X no audience). The two-way ANOVA was also used for both STAI scores and HR values. In both cases the combined factors were: group (disadvantage X benefited) and condition (audience X no audience). Differences with a value of $p \leq 0.05$ were considered significant. Pairwise was used for complementary analysis.
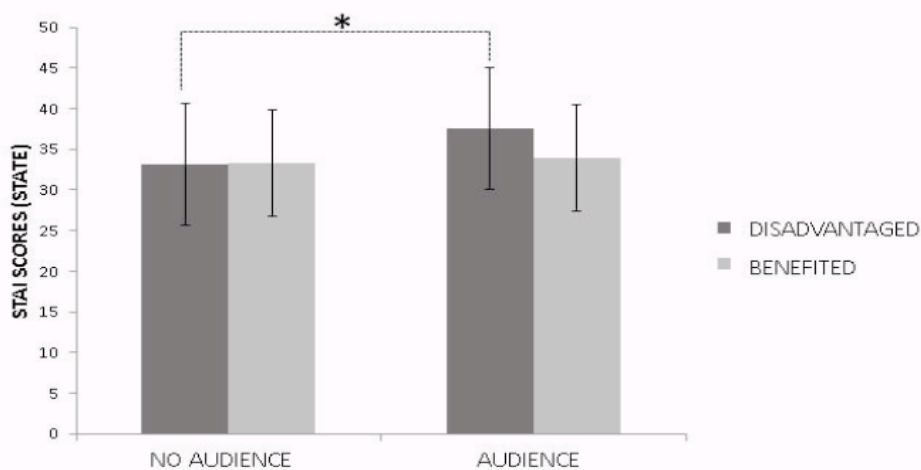
Results

In relation to the sensorimotor performance in the dart throwing task, a significant interaction was found between group and condition factors (F (2.16) = 10.45, p = 0.000). Complementary analysis (pairwise) indicated that the group classified as disadvantaged presented worse performance in the audience condition (45.11 points ± 14.44) when compared to the no-audience condition (56.67 points ± 12.65) p = 0.013. On the other hand, the group classified as benefited presented better performance in the audience condition (59.56 points ± 13.59) when compared to the no-audience condition (50.56 points ± 12.96) p = 0.014; see Figure 1. There was no main effect for group or condition.
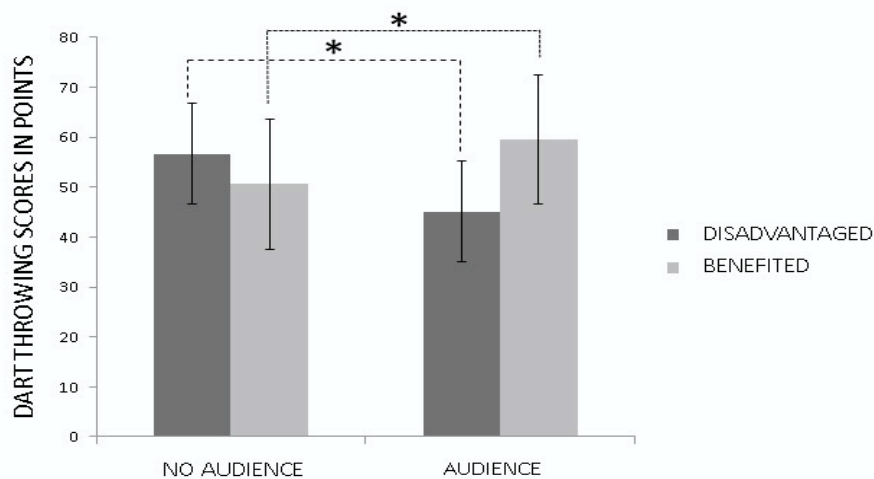
Figure 1. Mean and standard deviation of groups (disadvantaged and benefited) in the dart throwing task in the audience and no-audience conditions
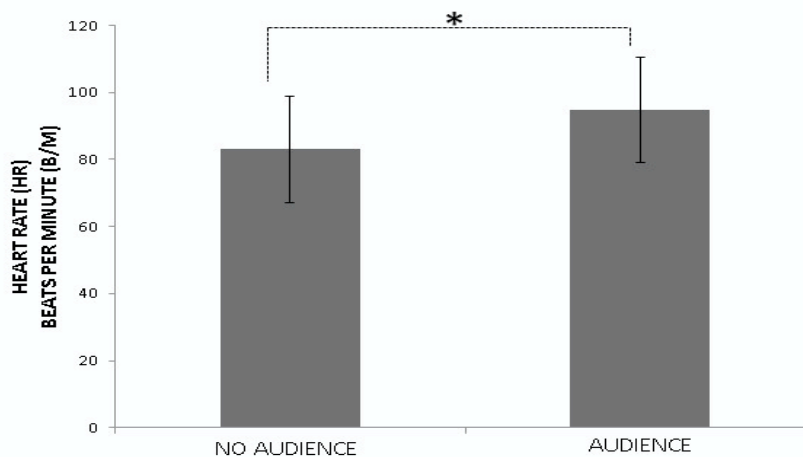Source: The authors.

Regarding STAI results, an interaction between group and condition was observed (F $(2.16) = 12.76$, *p* $= 0.013$). According to the complementary analysis (pairwise), the disadvantaged group obtained a higher average score in the audience condition (37.56 ± 9.51) when compared to the no-audience condition (33.11 ± 7.45) p $= 0.022$. The benefited group, in turn, presented no significant difference between the audience condition (34.00 ± 7.13) and the no-audience condition (33.25 ± 6.54) *p* $= 0.69$; see Figure 2. There was no main effect for group or condition.

Figure 2. Mean and standard deviation of the scores obtained in the STAI in the audience and no-audience conditions.
Source: The authors.

For HR results, there was no interaction between group and condition (p $= 0.75$). However, main effect was found for the condition factor (F $(2.16) = 24.64$, p $= 0.003$). The average HR value of both groups was higher in the audience condition (94.75 ± 19.05) when compared to the no-audience condition (83.02 ± 15.85), see Figure 3. There was no main effect for the group factor.

Figure 3. Mean and standard deviation of heart rate in the audience and no-audience conditions.
Source: The authors.

Discussion

The objective of the present study was to investigate the influence of an audience on the sensorimotor performance of university students when it comes to learning dart throwing. The hypothesis raised that there would be changes related to state anxiety levels and heart rate and, consequently, changes in performance when compared to conditions with and without audience was partially confirmed.

The results of this study showed significant interaction between the different groups and conditions. The disadvantaged group presented worse performance in the audience condition when compared to the no-audience condition. On the other hand, the benefited group showed better performance in the audience condition when compared to the no-audience condition. According to Medeiros Filho, Pinto and Carvalho[8], the insertion of an emotional disturbance may help or hinder performance. In the first case, there is a considerable improvement in the efficiency of behaviors, characterized as "fight or flight", promoting greater agility and precision of actions. As for in the second, neurophysiological adjustments may lead to failures when the challenge requires clear perception of discrete visual stimuli and precise motor response.

In this way, we can infer that, in the case of individuals in the disadvantaged group, there was a failure in the adaptation to the disturbance inserted in the audience condition, which made the execution of the task even more difficult. By contrast, the individuals in the benefited group showed better adaptation, with greater precision in their actions, using the disturbance imposed so efficiently that their performance improved.

From this perspective, this study corroborates with the findings of Leme[21] that showed that the crowd's interference with the behavior of young athletes can directly reflect on performance, being at times a motivating agent and, at times, a stressor, depending on factors related to the individual and the situation.

According to Gaudreau and Blondin[22], achieving performance goals and psychological wellbeing may depend on the individual's ability to deal efficiently with these different demands. In this study, psychological wellbeing was assessed through anxiety scores. In the results referring to state anxiety, an interaction between group and condition was observed. The disadvantaged group presented a higher average score in the audience condition when

compared to the no-audience condition. In turn, the benefited group showed no significant difference between conditions.

Associating the groups' performance results and state anxiety scores, we identified in the audience condition the disadvantaged group with the worst and highest anxiety levels. In turn, we observed the benefited group with higher performance, but without changes in anxiety levels. As described by Janelle[10], Landers[11] and Nideffer[13,23], the state of anxiety influences motor performance due to changes in attention and concentration resources. Based on the distraction and internal focus models by Beilock and Carr[15], Lewis and Linder[14] and Mullen and Hardy[16], it is possible to assume that the higher anxiety levels presented by the disadvantaged group before the beginning of the task were able, during the task, to divert the subjects' attention from relevant information towards irrelevant clues, causing a reduction in performance. The benefited group showed no anxiety changes and was able to handle better the information that was relevant to the task, enhancing performance in the audience condition.

Concerning results obtained through heart rate measurements, there was no interaction between group and condition; however, the mean heart rate of both groups was higher in the audience condition when compared to the no-audience condition. The audience condition led to an increase in emotional content and can be understood as an "emergency" situation and, for this reason, there was a mobilization of the sympathetic nervous system as well as neurophysiological adjustments in blocks[24].

In the association between anxiety levels and heart rate, in the audience condition, the disadvantaged group presented an increase in the rates of both variables when compared to the no audience condition, showing reliability between psychological and physiological data. However, in the benefited group, although an increase in heart rate was also measured in the audience condition, anxiety scores did not change between conditions. In this sense, it is necessary to point out that heart rate is an autonomic response indicative of stress[25]; nevertheless, self-reports, despite being the most direct method to access emotion, are not always the most informative and accurate ones[26].

Although no studies were found regarding the influence of crowds on the performance of sports tasks in beginners, some were found with athletes. What these studies show allows stating face the results found in this research that the presence of an audience influences the performance of sports tasks, which can be positive, when support and incentive from fans are observed, or negative, when fans oppose to and cheer for the team's or player's failure[21].

Another perspective related to the stress promoted by the presence of an audience is based on the so-called "Cognitive or Transactional Model of Stress", proposed by Richard Lazarus[27]. It seeks to observe dynamic interactions between individual variables, event-related variables and the cognitive evaluation that one does of the stressful situation, that is, considering the coping processes adopted by the individual: concomitant cognitive and behavioral efforts made so as to meet internal and external challenging demands provoked by the stressor.

From this perspective, stress is understood as an individualized process that can generate different coping strategies in the face of threatening situations, being *focused on problem solving* (searching for additional information for a more effective cognitive solution to the problem or to change the event actively) or *focused on emotional regulation* (emphasizing behavioral and cognitive techniques aimed at managing the emotional tension generated by the stressor, without necessarily removing the cause, but rather reducing the suffering generated by it).

Once the presence of an audience is understood as the stressor agent and, with this being a situation imposed in the study, in one of the conditions, without the possibility of the player completing the experiment without going through both conditions, coping strategies – *focused on solving problems* could not be understood as strategies to be used, since, regardless of the player's will, the audience would stay. However, coping strategies – *focused on emotional regulation* – can be understood as viable for the situation, since the player could appeal to this resource to balance himself or herself emotionally. Thus, the worsening/improvement in the performance of the task may be related to whether or not one can use appropriate coping strategies.

Conclusions

The findings of the present study extend the preposition of the literature regarding an audience's influence on sensorimotor performance. Emotional disturbances generated by the presence of an audience will differ from subject to subject, since each one will understand it, structure coping strategies and behave individually.

Thus, personal characteristics are strictly associated with an individual's performance in the presence or absence of an audience. While some can deal with the stressor influence in their favor, optimizing their results, others, however, for failing to create adequate strategies, tend to show worse performance than those in the presence of an audience.

In view of this, teachers/coaches should be attentive to individual characteristics of students/athletes and help them organize the best strategies in order to deal with the stress and anxiety caused by the presence of the audience. This caution can result in better attention and concentration resources and, consequently, more adequate and precise motor responses.

We suggest that further studies should use both state and trait anxiety scores and their correlations with performance.

References

1. Wolpert DM, Diedrichsen J, Flanagan JR. Principles of sensorimotor learning. Nat Rev Neurosci 2011;12(12):739-751.

2. Kantak SS, Winstein CJ. Learning-performance distinction and memory processes for motor skills: A focused review and perspective. Behav Brain Res 2012;228(1):219–231.

3. Pijpers J, Oudejans R, Bakker F. Anxiety-induced changes in movement behaviour during the execution of a complex whole-body task. Q J Exp Psychol 2005;58(3):421-445.

4. Lent R. Cem bilhões de neurônios? Conceitos fundamentais de neurociência. 2 ed. São Paulo: Atheneu; 2010.

5. Liebert RM, Morris LW. Cognitive and emotional component to test anxiety: a distinction and some initial data. Psychol Rep 1967;20(3):975-978.

6. Spielberger CD, Gorsuch RL, Lushene RE. Manual for the state trait anxiety inventory ('self –evaluation questionare'). California: Consulting/Psychology; 1970.

7. Dias C, Cruz J, Fonseca A. Emoções, stress, ansiedade e coping: estudo qualitativo com atletas de elite. Rev Port Cien Desp 2009;9(1):9-23.

8. Medeiros Filho E, Pinto P, Carvalho F. Influência do ambiente no desempenho de arremessos de lances livres no basquetebol profissional. Motriz rev educ fis 2007;13(4):273-279.

9. Goyen M, Anshel M. Sources of acute competitive stress and use of coping strategies as a function of age and gender. J Appl Dev Psychol 1998;19(3):469-486.

10. Janelle CM. Anxiety, arousal and visual attention: A mechanistic account of performance variability. J Sports Sci 2002;20(3):237-251.

11. Landers D. Motivation and performance: The role of arousal and attentional factors. In: Sport psychology. An analysis of athlete behavior. Ithaca: Mouvement Publications; 1980, p. 91-103.

12. Nideffer RM. Test of attentional and interpersonal style. J Pers Soc Psychol 1976;34(3):394-404.

13. Nideffer RM. The ethics and practice of applied sport psychology. Ithaca: Movement Publications, 1981.

14. Lewis BP, Linder D. Thinking about choking? Attentional processes and paradoxical performance. Personal Soc Psychol Bull 1997;23:937-944.

15. Beilock S. CT. On the fragility of skilled performance: What governs choking under pressure? J Exp Psychol Gen 2001;130(4):701-725.

16. Mullen R., Hardy L. State anxiety and motor performance: Testing the conscious processing hypothesis. J Sports Sci 2000; 18:785–799.

17. Wine J. Teste Anxiety and Direction Attetion. Psychol Bull 1971;76(2):92-104.

18. Masters R. The role of explicit versus implicit knowledge in the breakdown of a complex motor skill under pressure. Br J Psychol 1992;83(3):343–358.

19. Masters R. Theoretical aspects of implicit learning in sport. Int J Sport Psychol 2000; 31(4):530-541.

20. Biaggio AMB, Natalicio L. Manual para inventário de ansiedade - estado (IDATE). Rio de Janeiro: Centro de Psicologia Aplicada - CEPA; 1979.

21. Leme AF. Análise do comportamento de jovens atletas de futsal mediante interferências de torcedores durante competição. Rev Bras Futsal e Futebol 2013;5(17):213-220.

22. Gardreu P, Blondin J-P. Different athletes cope differently during a sport competition: a cluster analysis of coping. Pers Individ Dif 2004;36(8):1865-1877.

23. Marteniuk RG. Information processing in motor skills. New York: Holt: Rinehart & Winston; 1976.

24. Birkett MA. The Trier Social Stress Test protocol for inducing psychological stress. J Vis Exp 2011;56:e3238.

25. Ditzen B, Neumann ID, Bodenmann G, von Dawans B, Turner RA, Ehlert U, et al. Effects of different kinds of couple interaction on cortisol and heart rate responses to stress in women. Psychoneuroendocrinology 2007;32(2):565-574.

26. Gazzaniga M, Ivry RB, Magnum GR. Neurociência cognitiva: a biologia da mente. 2 ed Porto Alegre: Artmed; 2006.

27. Lazarus RS, Folkmam S. Stress, Appraisal, and Coping. New York: Springer publish compan; 1984.

Author address: Simara Ribeiro. Grupo de Estudos em Desenvolvimento e Aprendizagem Motora (GEDAM). Escola de Educação Física, Fisioterapia e Terapia Educacional (EEFFTO). Av. Pres. Antônio Carlos, 6627, Campus – Pampulha – Belo Horizonte – MG – CEP.: 31 270-901. Universidade Federal de Minas Gerais – UFMG. simararibeiro@gmail.com.