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Heart rate, a rating of perceived exertion and basic affective responses during different moments of a single *capoeira* progressive training session (CPTS)

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Abstract

Background & Study Aim: Little information is available on psychophysiological responses in martial arts which do not have the status of Olympic sport (such as judo, taekwondo) and yet are very popular. Lack of information about the impact of any effort on the human body means the lack of rational control over a given psychomotor human activity. The aim was the knowledge about heart rate (HR), rate perceived exertion (RPE) and basic affective responses during different moments of a single *capoeira* progressive training session (CPTS).

Material & Methods: Sixteen adults (10 male, 6 female) were evaluated to HR, rate perceived exertion (RPE 6/20), feeling scale (FS from 5+ to 5–) and perceived activation (PA six points scale). The CPTS lasted 60-min, being: 2-min/playing instruments; 2-min/singing; 8-min/warm-up; 8-min/*ginga* (the basic movement); 8-min/technical movements; 12-min/passive *capoeira*; 1-min/*capoeira* game. The remaining time was distributed in recovery during CPTS. A cycle ergometer test was performed starting at 25W/50W (female/male) with increments of 25W every 1min until exhaustion (50-RPM's) to anaerobic threshold (AT) and maximal power (P_{MAX}) determination.

Results: When compared to resting the HR (77 ±13 bpm) increased from warm-up (102 ±12 bpm) until *capoeira* circle (135 ±25 bpm), as well as differed from the total CPTS (117 ±13 bpm). The total CPTS occurred at 80 ±10%HR-AT and 65 ±7%HR-P_{MAX}. The RPE shows increase from resting (8 ±3 points) to *ginga* (12 ±2 points), technical movements (14 ±2 points), *capoeira* circle (14 ±2 points) and total CPTS (11 ±2 points). The PA increased from resting (3 ±1 points) to singing (4 ±1 points), *ginga* (4 ±1 points), technical movements (5 ±1 points) and *capoeira* circle (5 ±1 points).

Conclusions: A single CPTS increased the HR, RPE and PA responses, maintaining affective valence (FS) in the practitioners during the session. Besides, a CPTS may be an alternative physical activity modality to improve fitness and health of adults with physical activity intensity level (i.e., moderate-vigorous).

Keywords: emotions • exertion • ginga • internal load • perception • singing • workload

Conflict of interest: Authors have declared that no competing interest exists

Ethical approval: The study was approved by the Research and Ethics Committee of the Federal University of Vale do São Francisco (protocol no 0001/200813 CEDEP)

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INTRODUCTION

Capoeira is a Brazilian martial art that has spread worldwide [1]. Currently, *capoeira* is present in more than 150 countries [2], and different social groups have carried out its practice over the five continents [3]. It was originally created in colonial Brazil and as a modality can be defined as an athletic sport characterised by attack and defence systems [4, 5]. The main body movement of *capoeira* is called "*ginga*". Moreover, common actions of *capoeira* include dodge, unbalance, impact acrobatic movements [4], which are performed following *Angola*, *Benguela*, and *São Bento Grande* rhythms [6]. *Angola* and *Benguela capoeira* styles are more likely to rely on aerobic energy pathways, while *São Bento Grande* may alternate aerobic or anaerobic predominance, depending on the practitioner's training status. Also, it is important to highlight that *capoeira* styles have different techniques and movements speed execution [7]. The aerobic/anaerobic demand imposed to the practitioners [6] seems to be enough to induce chronic cardiovascular adaptations, such as decreased heart rate, and increased markers of autonomic parasympathetic tonus in male beginner practitioners [8].

Capoeira training can be organised from strategies with imposed and/or self-selected physical demand (to movements and pace) and rhythmic musical aspects. *Capoeira* progressive training characteristic session can be composed of *capoeira* techniques associated with rhythmic musical elements [4, 8]. The rhythmic musical elements must be produced by the characteristic percussion and development of the typical songs during a *capoeira* training session. The rhythmic element, as well as physical demand on capoeira practitioner, still needs to be investigated. However, it is speculated that these elements can bring an important motivational aspect during the *capoeira* training session because it is self-selected nature.

Little information is available on psychophysiological responses in martial arts and combat sports [9]. To the best of our knowledge, no studies have investigated the physiological and perceptual responses during a single *capoeira* training session. Regarding physiological response, heart rate (HR) is commonly used to assess and monitor physical activity intensity level [10], given its linear relationship with oxygen uptake [11]. As a practical perspective, a rating of perceived exertion (RPE) scale is a simple tool that also can be used to assess and monitor physical activity intensity level [12]. Both HR and RPE have been recommended by the American College of Sports Medicine (ACSM) [13] to prescribe and monitor physical activity intensity, and those moderate-vigorous activities have been recommended to improve fitness and health. Given that the internal load (i.e., stress imposed to the organism) during a *capoeira* training session is unknown it seems important to characterise its intensity using an integrative approach involving an objective (i.e., HR) and a subjective (i.e., RPE) marker of internal load [14].

In addition, to induce a moderate-vigorous internal load to the practitioners, the ACSM [13] has suggested that positive basic affective response (i.e., feeling of pleasure) during exercise/physical activity is a determinant of participation and adherence individual, as previously reported in observational studies [15, 16]. Thus, strategies to enhance the likelihood of gaining pleasurable feelings are likely to contribute to exercise maintenance and subsequent benefits to health and fitness. However, no information is available

Ginga – the basic movement of *capoeira* (the purpose of the *ginga* is not to offer the opponent a fixed target).

Capoeira – athletic sport composed of attack and defence systems created in colonial Brazil.

Colonial Brazil – comprises the period from 1500, with the arrival of the Portuguese, until 1815, when Brazil was elevated to a kingdom alongside Portugal.

Basic Programmed Lesson – practical method that allows the initiation of novices without any experience in *capoeira*.

Atabaque and **pandeiro** – characteristic rhythmic instruments of *capoeira* with the membrafonic design.

Singing capoeira – typical music of *capoeira*.

Chronic – *adjective* **1.** used for describing a disease or condition that lasts for a long time. Compare **acute 2.** used for describing severe pain [31].

Exertion – *noun* physical activity [31].

Perception – noun the process of using the senses to acquire information about the surrounding environment or situation [31].

Psychomotor – *adjective* relating to bodily movement triggered by mental activity, especially voluntary muscle action [31].

about the basic affective response during a single *capoeira* training session. It should be noted that RPE and the basic affective response are not isomorphic constructs. In particular, while the former describes "what" a person feels, the latter emphasises "how" a person feels [17].

In a practical perspective, integrative information considering physiological and perceptual responses during a single *capoeira* training session may contribute to better understand the potential of this modality to improve fitness and health. For example, does *capoeira* meet the physical activity intensity level (i.e., moderate-vigorous) recommended by the ACSM to improve fitness and health in apparently healthy adults [13]? If so, is *capoeira* perceived as a pleasant physical activity by beginners?

The aim was the knowledge about heart rate (HR), rate perceived exertion (RPE) and basic affective responses during different moments of a single *capoeira* progressive training session (CPTS).

We hypothesised that a *capoeira* training session would meet the physical activity intensity level recommended by the ACSM and the participants would report positive basic affective responses during its practice.

MATERIAL AND METHODS

Subjects

After signing an informed consent form, a total of 16 physically active adults (10 male and 6 female) were included in this study. The main characteristics of the participants are presented in Table 1. The exclusion criteria were: 1) having any kind of bone, muscle or joint impairment that would preclude participating in the study; 2) having any kind of circulatory or cardiometabolic disease reported in the former health history.

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Research and Ethics Committee of the Federal University of Vale do São Francisco (protocol 0001/200813 CEDEP).

Experimental design

To test our hypothesis, healthy adults were investigated from fifth visits in the Federal University of Vale do São Francisco. Aerobic fitness form of anaerobic threshold and maximal power during maximal aerobic incremental exercise test was evaluated. The method used to apply the *capoeira* progressive training session (CPTS) was based on movements of basic programmed lessons. The CPTS was divided into different moments in according to the basic needs of modality. Before and during the CPTS, the participants underwent continuous monitoring of HR and perceptual responses evaluation.

Aerobic fitness assessment

In a first visit, the participants performed a maximal aerobic incremental exercise test in cycle ergometer (CEFISE®; São Paulo, Brazil). The protocol is starting at 25 watts to female and 50 watts to male and had increments of 25 watts every one min until voluntary exhaustion. The participants maintained 50 RPM's during the entire test. The aerobic fitness indicators analysed were the workload corresponding to the anaerobic threshold (AT) as the aerobic capacity and the workload corresponding to the maximal power (P_{MAX}) as the aerobic power [18, 19].

To determination, the AT has adopted the method based on the HR variability threshold in according to Sales et al. [20]. The R-R (see glossary) intervals series was recorded by the HR monitor (*Polar*® model *RS800CX*, Electro Oy, Kempele, Finland) and filtered in the Polar Precision Performance (v. 4.0) software. This equipment offers high reproducibility and validity [21]. All analyses were run through the HRV Analysis version 2.0 *Kubios* software (Biosignal Laboratory, University of Kuopio, Finland). The HR variability (HRV) was identified through the responses of root mean the successive square difference between adjacent R-R intervals (rMSSD) and standard deviation of instantaneous beat-to-beat R-R interval variability (SD1) by considering the minute of each incremental stage and was named as AT_{HRV}. During the maximal aerobic incremental exercise test, the AT_{HRV} was determined when occurred a stabilisation point lower than three milliseconds for the vagal activity indices (SD1 and rMSSD), and the workload of this point was considered. The P_{MAX} was considered from workload at the moment corresponding to the end stage of the maximal aerobic incremental exercise test that the participant maintained a minimum of the 30s of exercise in according to the established protocol. The P_{MAX} can be considered as the exercise

Physical activity – *noun* exercise and general movement that a person carries out as part of their day [31].

Anaerobic threshold – *noun* same as the **onset of blood lactate accumulation** [31].

Internal – *adjective* **1.** located within or affecting the inside of something, especially the inside of the body **2.** between the members of a team [31].

Work *verb* **1.**to exert physical or mental effort in order to do, make or accomplish something, or make someone do this **2.** to move or exercise a muscle or part of the body, or be moved or exercised [31].

Load – *noun* **1.** a weight or mass which is supported **2.** the force that a body part or structure is subjected to when it resists externally applied forces **3.** the amount of something, usually weight, that a body part can deal with at one time [31].

RR – on the electrocardiography (ECG or EKG), instantaneous heart rate is calculated using the R wave-to-R wave (RR) interval and multiplying/dividing in order to derive heart rate in heartbeats/min. Multiple methods exist: HR = 1,500/(RR interval in millimetres); HR = 60/(RR interval in seconds); HR = 300/number of "large" squares between successive R waves; HR= 1,500 number of large blocks [*Wikipedia*].

Cardiorespiratory endurance – *noun* the body's ability to carry out prolonged exercise, taking into account both muscle strength and aerobic capacity [31].

intensity corresponding to the maximal oxygen consumption and is the best index to reflect the association between maximum aerobic power and economy of movement [18, 19].

Capoeira progressive training session (CPTS)

Previously in distinct days separated by a one week period each, the participants performed three sessions of *progressive capoeira* training to familiarisation with the movements and rhythmic requirement of the modality. The technical improvement naturally occurred every week, resulting in higher speed in movements execution.

In a fifth visit the CPTS experimental protocol, based on the modern styles of *capoeira* [22], as applied by an instructor with 17 years of experience in teaching *capoeira*. The protocol followed the directions of the basic programmed lesson in according to Moreira et al. [8]. This method allows the initiation of novices without any kind of experience in *Capoeira* and can be adapted to individuals in an intermediate and advanced level. The Figure 1 [8] shows the main movements adopted in the CPTS.

The CPTS experimental protocol composition, which lasted for 60 minutes, was from of (a) 2 minutes of playing rhythm instruments – for such an *atabaque* and *pandeiro* were used, which are characteristic rhythmic instruments of *capoeira* with membrafonic design; (b) 2 minutes singing typical songs of *capoeira*; (c) 8 minutes to warm-up with characteristic movements of the modality in a low intensity and static position; (d) 3 sets with 2 minutes of dynamic *ginga* with self-paced nature (main movement of *capoeira* shown in Figure 1 – *ginga*^{abc}) by 1 minute of recovery each set; (e) 3 sets with 2 minutes of technical movements interspersed with *ginga* (self-paced nature) following sequence of movements of the Figure 1 (*esquiva lateral* until *esquiva em diagonal*) by 1 minute of recovery each set; f) 12 minutes with passive participation in *capoeira* circle – at this moment the participants remained in a circle singing characteristics songs of *capoeira* and clapping to the rhythm of the music to watch the *capoeira* game between other two participants (to watch double game); g) 1 minute of *capoeira* active game in the circle with self-paced and self-selected movements – at this moment the participant performed freely several movements of

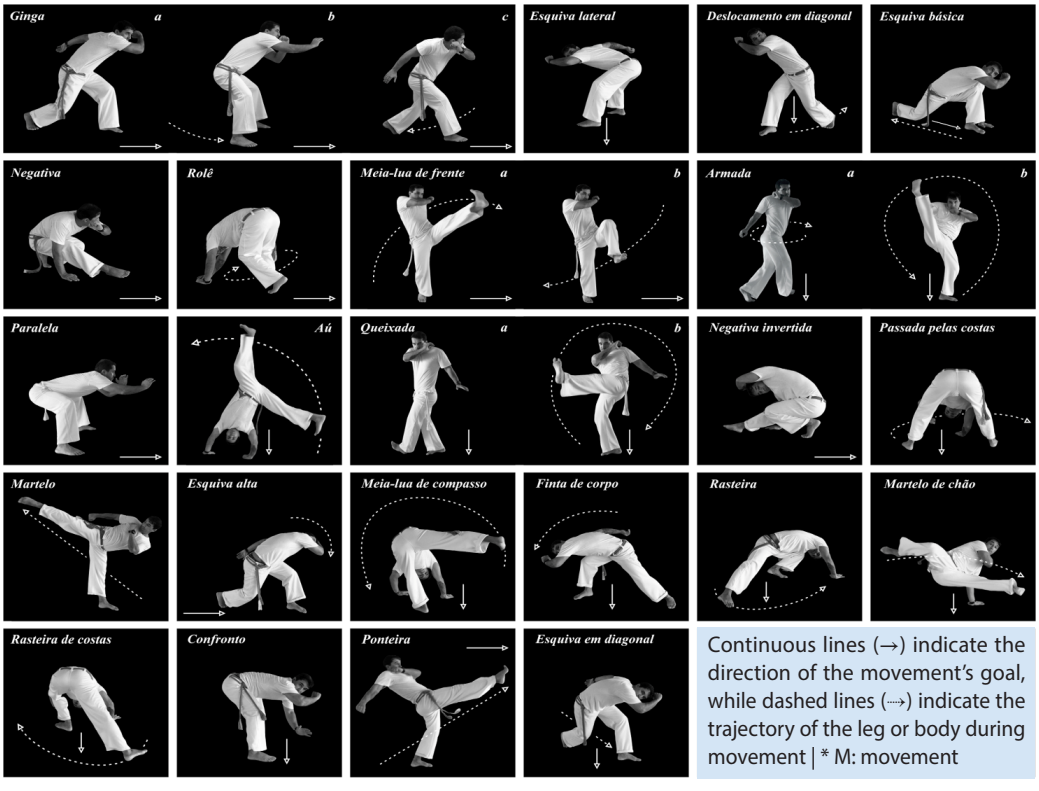

Figure 1. The main movements adopted in the basic programmed lesson of *capoeira*. Images from the instructor of *capoeira* progressive training session (adapted from Moreira et al. [8]).

capoeira (Figure 1) paired with another participant (to perform double game). The remaining time (23 minutes to complete the 60 minutes of the session) was distributed in recovery between the different moments during the CPTS.

Heart rate response

Ten minutes prior and during the *capoeira* progressive training session the HR was constantly obtained through the Zephyr™ mod. *BioHarness™* 3 monitoring system (Zephyr Technology Corporation, Annapolis, USA). The system enabled the monitoring of all participants during the CPTS, and it consists of a wireless sensor fixed on the chest of each participant by a strap (Zephyr™ mod. ZSFBH). The sensor transmitted the individual information of HR to a signal receiver (Zephyr™ ModFlex GateWay USB) connected to the personal computer and signal repeater (Zephyr™ repeater). Subsequently, the HR responses expressed in "bpm" were analysed moment by moment of CPTS through specific Zephyr™ software. Besides, the HR in the different moments of CPTS was calculated as a percentage of HR during the AT_{HRV} (%HR-$AT_{HRV)}$ and P_{MAX} (%HR-P_{MAX}).

Rating of perceived exertion

RPE was defined as the internal and subjective intensity of effort that was felt during exercise [23]. The whole-body perceived exertion during the CPTS was assessed using the Borg's RPE (6-20) Scale. Before the maximal aerobic incremental exercise test, the meaning of perceived exertion was explained to the subjects. Perceived exertion was defined as the subjective intensity of effort, strain, and/or fatigue that the subjects can feel during exercise [12]. The low and high perceptual anchors for the Borg's RPE scale were established during the maximal aerobic incremental exercise test. A rating of 6 (low anchor, "very, very light") was assigned to the lowest exercise intensity, while a rating of 20 (high anchor, "very, very hard") was assigned to the highest exercise intensity.

Basic affective response

The Feeling Scale (FS) is an 11-point bipolar scale ranging from +5 (plus) to −5 (minus), commonly used to measure the affective response (pleasure/displeasure) during exercise [17]. This scale presents the following verbal anchors: −5 very bad; −3 bad; −1 fairly bad; 0 neutral; +1 fairly good; +3 good; and +5 very good. The subjects received standard instructions regarding the use of the FS in the initial screening, before the maximal aerobic incremental exercise test, and before the CPTS, according to Hardy and Rejeski [17]. An individual participating in exercise it is quite common to experience changes in mood. Some individuals find exercise pleasurable, whereas others find it to be unpleasurable. Additionally, the feeling may fluctuate across the time. That is, one might feel good and bad a number of times during exercise.

The perceived activation (PA) scale was used to assess the arousal state of the participants [24]. The PA scale is a 6-point single-item measure, ranging from +1 (low arousal) to +6 (high arousal). This scale assesses how the participant felt activated, stimulated and motivated during different times of the study (before and during the CPTS). The affective valence measured by the FS is a fundamental component of the circumplex model of Russell [25], which incorporates affective valence and PA as an orthogonal and bipolar dimension of the affective space.

Finally, standard definitions of perceptual responses and separate instructional sets for scales were read to the participants immediately before the maximal aerobic incremental exercise test. The low and high perceptual anchors for the RPE, FS and PA scale were established during the maximal aerobic incremental exercise test. RPE, FS and PA values were evaluated randomly during the last 10 seconds of each stage of maximal aerobic incremental exercise test and immediately after the different moments of CPTS (after 10 minutes of resting and session moments).

Statistical analysis

Data are expressed as the mean and standard deviation (SD or ±). Data were tested for normality using the Shapiro-Wilk test. One-way repeated measures ANOVA reporting F-ratio, degrees of freedom and P-value were used to verify the main effects of time in the different moments of CPTS. Mauchly's test was analysed by assessing the data sphericity. In the case of sphericity assumption violation, the degrees of freedom were adjusted and reported using the Greenhouse-Geisser adjustment. Partial eta squared (η_p^2) was used to determine the effect size. When the interaction of time was found, Bonferroni-corrected multiple pairwise comparisons and adjusted P-values were reported.

Student's t-test for paired samples was performed to verify the effects of time from resting to *capoeira* total session results. Student's t-test for independent samples was performed to compare the general characteristics between male and female groups. As a result of the t-tests were reported t-value, 95% confidence interval and P-value. The level of significance adopted was set at p<0.05 and the software used for analysis was the SPSS 22.0 for Windows (SPSS, Inc., Chicago, USA).

RESULTS

Males presented higher values of AT_{HRV} (t = 4.838 [CI (confidence interval): −94.54, −36.46]; p<0.001) and P_{MAX} (t = 5.544 [CI: −130.60, −57.73]; p<0.001) than females. However, males and females had similar age (t = 1.132 [CI: −3.51, 11.38]; p=0.276), body mass (t = 1.510 [CI: −26.85, 4.66]; p=0.153), body mass index (t = 0.208 [CI: −4.43, 5.39]; p=0.838), and physical activity level (t = 0.556 [CI: −204.75,119.75]; p=0.586). The results of internal loads corresponding to aerobic fitness did not differ between the sexes,

Table 1. Mean and statndard deviation (±) of descriptive characteristics of the sample and aerobic fitness responses during the maximal aerobic incremental test.

Variable (indicator)	Total (n = 16)	Male (n = 10)	Female (n = 6)
General characteristics			
Age (years)	27.9 ±6.8	26.4 ±5.2	30.3 ±8.8
Body mass (kg)	75.3 ±14.8	79.5 ±12.8	68.4 ±16.5
Height (cm)	170.0 ±0.9	175. 0±0.4	**160.0 ±0.5***
Body mass index ($kg.m^{2(-1)}$)	26.1 ±4.3	25.9 ±4.0	26.4 ±5.1
Physical activity ($min.week^{-1}$)	306.3 ±142.6	322.0 ±119.3	280.0 ±184.6
AT_{HRV}			
Power (W)	141 ±41	166 ±31	**100 ±14*****
Heart rate (bpm)	146 ±10	144 ±12	149 ±8
RPE (rate perceived exertion)	12 ±3	12 ±3	12 ±2
FS (Feeling Scale)	1 ±3	1 ±3	1 ±3
PA (perceived activation)	4 ±1	4 ±2	4 ±1
P_{MAX}			
Power (W)	248 ±60	278 ±36	**183 ±26*****
Heart rate (bpm)	181 ±12	179 ±14	183 ±6
RPE (rate perceived exertion)	19 ±2	19 ±2	19 ±2
FS (feeling scale)	−2 ±4	−1 ±4	−3 ±4
PA (perceived activation)	6 ±1	6 ±1	6 ±1

AT_{HRV} anaerobic threshold measured by heart rate variability during the maximal aerobic incremental test; **P_{MAX}** maximal power obtained during the maximal aerobic incremental test; *p<0.05 and ***p<0.001 to male.

as noted in AT_{HRV} to HR (t = 0.834 [CI: −7.11, 16.18]; p=0.418), RPE (t = 0.620 [CI: −3.57, 2.20]; p=0.620), FS (t = 0.256 [CI: −3.59, 2.82]; p=0.801) and, PA (t = 0.720 [CI: −1.92, 0.95]; p=0.482) and in P_{MAX} to HR (t = 0.654 [CI: −9.03, 16.96]; p=0.523), RPE (t = 0.720 [CI: −2.38, 1.18]; p=0.483), FS (t = 0.510 [CI: −5.72, 3.52]; p=0.617) and PA (t = 0.366 [CI: −1.36, 0.96]; p=0.719) (Table 1).

The similarities between the sexes concern of the internal loads responses corresponding to the aerobic fitness, the absolute HR and relative HR to AT_{HRV} and P_{MAX}, in relation to the different moments of *capoeira* progressive training session (Table 2). When compared to resting was found a main effect of time to absolute HR ($F_{[3.262,48.926]}$ = 53.107; p<0.0001; η_p^2 = 0.780) and relative HR to AT_{HRV} ($F_{[3.407,51.099]}$ = 50.430; p<0.0001; η_p^2 = 0.771) and P_{MAX} ($F_{[3.393,50.893]}$ = 51.011, p<0.0001; η_p^2 = 0.773).

There was a main effect of time for RPE ($F_{[2.499,37.486]}$ = 45.774; p<0.001; η_p^2 = 0.753), whereas the FS did not change between the different moments of CPTS ($F_{[2.101,31.509]}$ = 1.703; p=0.197; η_p^2 = 0.102). Also, a main effect of time was observed for PA ($F_{[2.105,31.570]}$ = 15.857; *P=0.001*; η_p^2 = 0.514) with results in the resting (3 ± 1 points), statistically different (p<0.01) to moments singing songs (4 ±1 points), *ginga* (4 ±1 points), technical movements (5 ±1 points) and *capoeira* active game (5 ±1 points) (Figure 2).

When compared to resting was found statistically differences to absolute HR (t = −21.447 [CI: −43.21, −35.40]; p<0.0001) and relative HR to AT_{HRV} (t = −21.830 [CI: −29.49, −24.25]; p<0.0001) and P_{MAX} (t = −19.509 [CI: −24.26, −19.48]; p<0.0001). Besides, the Figure

Table 2. Mean and standard deviation (±) of absolute heart rate (HR) in different moments of *capoeira* progressive training session and corresponding HR to anaerobic threshold (%HR-AT_{HRV}) and maximal power (%HR-P_{MAX}) during the maximal aerobic incremental test (n =16).

Variable (indicator)	HR (bpm)	HR-AT_{HRV} (%)	HR-P_{MAX} (%)
Resting (10min)	77 ±13	53 ±10	43 ±7
***Capoeira* progressive training session**			
Playing instruments (2min)	87 ±13	60 ±9	48 ±7
Recovery (3min)	**88 ±10*****	**60 ±8*****	**49 ±5*****
Singing songs (2min)	84 ±14	58 ±10	47 ±7
Recovery (1min)	**88 ±11*****	**61 ±9*****	**49 ±6*****
Warm-up (8min)	**102 ±12*****	**70 ±1*****	**57 ±8*****
Recovery (2min)	**104 ±15*****	**72 ±1*****	**58 ±9*****
Ginga (8min)	**124 ±17*****	**85 ±13*****	**69 ±10*****
Recovery (6min)	**102 ±14*****	**71 ±12*****	**57 ±8*****
Technical movements (8min)	**134 ± 5*****	**92 ±12*****	**74 ±8*****
Recovery (7min)	**122 ±16*****	**84 ±13*****	**67 ±8*****
Capoeira passive game (6min)	**118 ±25*****	**80 ±15*****	**65 ±11*****
Capoeira active game (1min)	**135 ±25*****	**93 ±18*****	**75 ±13*****
Capoeira passive game (6min)	**129 ±17*****	**89 ±16*****	**72 ±10*****

***p<0.0001 to resting (adjusted p values by Bonferroni-corrected multiple pairwise comparisons).

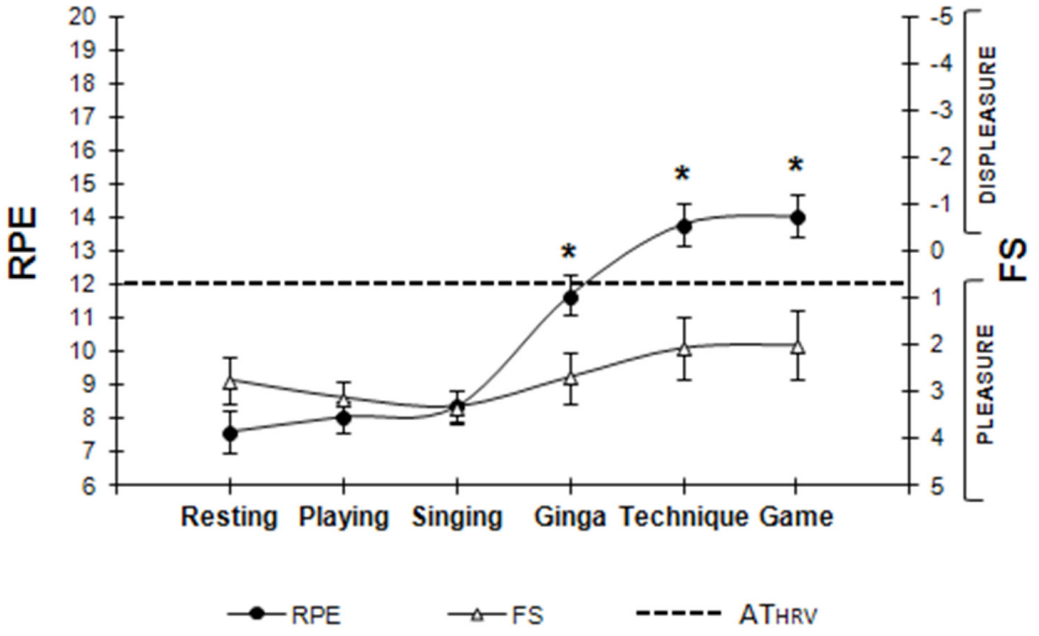

Figure 2. Mean and standard error (SE) of rate perceived exertion (RPE) and feeling scale (FS) responses during the *capoeira* progressive training session and corresponding value to anaerobic threshold (AT_{HRV}) during the maximal aerobic incremental test (n =16). *p<0.01 to resting (adjusted P-values by Bonferroni-corrected multiple pairwise comparisons).

3D and 3F show that the perceptual variables also increased in CPTS total when analyzed the RPE (t = −5.984 [CI: −4.84, −2.30]; p<0.0001) and PA (t = −5.238 [CI: −2.11, −0.88]; p<0.0001), whereas the FS (Figure 3E) remained unchanged from resting to CPTS total (t = 0.211 [CI: −1.02, 1.24]; p=0.836) (Figure 3).

DISCUSSION

Our initial hypothesis was confirmed. We highlight that this is the first study that used an integrative psychophysiological approach to characterise a *capoeira* progressive training session (CPTS).

Our results suggest that a regular *capoeira* training program may be an alternative form of physical activity to improve fitness and health. Three studies [6-8] involving *capoeira* exercise and HR responses were found in the literature. However, none of them presented acute responses during the CPTS in male practitioners. The CPTS elicited a mean of 65 ±7% of maximum HR (%HR-P_{MAX}) obtained in the maximal aerobic incremental exercise test (Figure 3-C) and 11 ±2 in the 15-point Borg scale (Figure 3-D). Also, during the session occurred a change between 47 ±7% and 75 ±13% of maximum HR of the sample (Table 2) and RPE between 8 ±2 and 14 ±2 in the 15-point Borg scale (Figure 2). The ACSM from its position stand [13] suggests a classification of exercise intensity for cardiorespiratory endurance, where moderate exercise intensity is represented by 64-76% of maximum HR or RPE between 12 and 13 in the 15-point Borg scale. In this way, it is possible that when frequently performed, a CPTS meets the assumptions to moderate exercise intensity and subsequently increasing physical fitness in apparently healthy adults [13]. However, a longitudinal study for this purpose needs to be developed.

Specifically, when analysed the RPE as a method to mark the exercise effort [12] in the different moments of CPTS, was possible to note a mean value to *ginga* at 12 ±2 and, technical movements and *active capoeira* game at 14 ±2 in the 15-point Borg scale (Figure 2). According to Garber et al. [13], the high-intensity effort (somewhat hard to very hard) is scheduled from 14 to 17 on the 15-point Borg scale. These findings, in addition to demonstrating the intermittent nature of CPTS, also suggests that from investigated moments the application of interval training models in the *capoeira* is possible (high intensity *vs* moderate intensity), and the use of the Borg scale can be

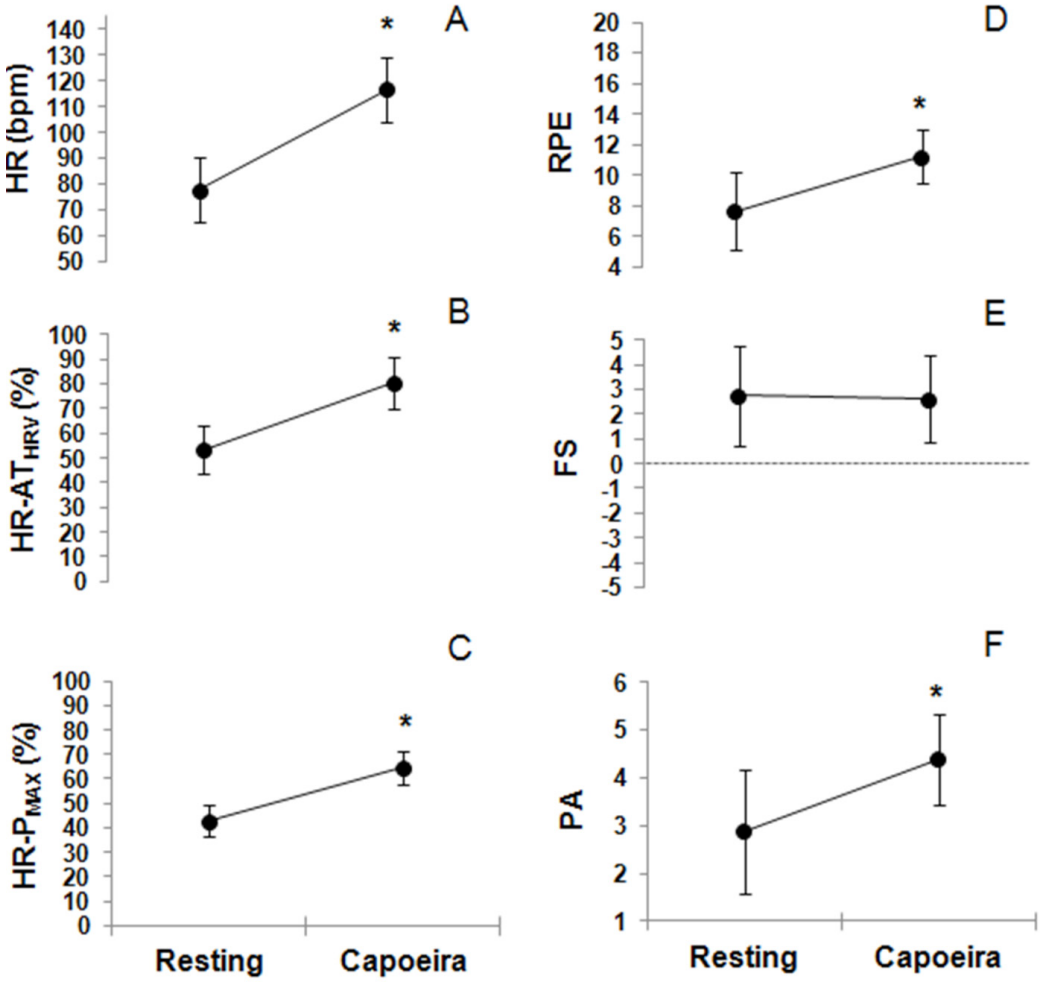

Figure 3. Mean and standard deviation (±) of absolute heart rate (HR), relative HR to anaerobic threshold (%HR-AT_{HRV}) and maximal power (%HR-P_{MAX}) during maximal aerobic incremental test, rate perceived exertion (RPE), feeling scale (FS) and perceived activation (PA) responses of *capoeira* progressive training total session (n =16): *p<0.0001 to resting.

a useful tool in order to control the training loads.

Regarding the basic affective responses, the mean value of the session was 3 ±2 (Figure 3), and values during the technical movements and *active capoeira* game were 2 ±3 (Figure 2). These values characterise a positive affective response during *capoeira* exercise (i.e., feeling of pleasure) without statistical difference compared to resting (p>0.05; Figures 2 and 3). These findings challenge the traditional model highlighted in the literature that shows that when exercise intensity increases, especially above to the ventilatory threshold, the basic affective response decreases gradually to negative values (i.e., feeling of displeasure). Ekkekakis [27] also suggested that the basic affect may decline due to both the high intensity perceived effort and the loss of autonomy inherent in an imposed exercise prescription. The CPTS was composed by rhythmic musical elements associated with *capoeira* techniques from self-paced nature movements (i.e., *ginga* and technical movements) and a moment with self-selected and self-paced movements (*active capoeira* game) as demonstrated by Moreira et al. [8]. In this last moment, the practitioners performed freely the *capoeira* movements (Figure 1) in a double game, whereas in the *ginga* and technical movements the practitioners performed such movements within a possible physical condition to your level (self-paced nature). Moreover, the game character/body challenge involved in the CTPS may be contributing to positive responses from basic affect [28], which might reduce the discomfort caused by the intensity of effort [29]. It is speculated that the highlighted characteristics of CPTS maintained positive affective response despite increased effort imposed

to the practitioners in different moments of the session (Figure 2). From this perspective, it highlights the results obtained with the PA during the CPTS, where it was found in the total session (4 ±1; Figure 3), as well as *ginga* (4 ±1), technical movements (5 ±1) and *capoeira* active game (5 ±1) higher values when compared ($p<0.01$) to the resting (3 ±1). These findings shows a higher arousal and/or motivation state of practitioners [23] during these moments of the CPTS, which together with affective valence (Figures 2 and 3) integrating the dimension of the affective space [25] and suggest the *capoeira* as a possible hedonic model of physical activity prescription, which aims to adherence of an individual to the regular physical exercise program [30]. However, a novel longitudinal study for this purpose needs to be developed.

From a practical perspective, the results support the fitness and conditioning professionals with the possibility of using CPTS to improve individual's fitness and health and maintain a long-term adherence. The CPTS prescription would be done according to the basic programmed lesson method (Figure 1) [8] and composed by 60 minutes with musical rhythmic elements (playing rhythm instruments as *pandeiro* and *atabaque* and singing typical songs of *capoeira*) associated with *capoeira* techniques from of movements within a physical condition level of practitioners (self-paced movements and moments with self-selected movements). However, throughout the possible training program, the CPTS may be gradually intensified through the natural gains in the velocity of movements that occurs in parallel to the improvement of technique.

Importantly, the present study presented a limitation related the lack of a measure of maximum HR during the *capoeira* exercise, which could contribute to greater precision in relation to percentage demand of CPTS. Accordingly, the lack of protocols in the literature that enables the assessment of maximum stress in *capoeira*, the maximum HR was obtained through a maximal aerobic incremental exercise test in cycle ergometer. Although not a specific test, enabled real and not estimates results of maximum HR, which make us believe on the basis of an estimate by the age of the sample that is very close to the possible values in *capoeira* (Table 1). However, a study suggesting a specific protocol within *capoeira* needs to be performed.

CONCLUSIONS

We concluded that a single CPTS increased the HR, RPE and PA responses significantly, maintaining affective valence (FS) even with increased intensity in the practitioners during the session. Besides, a CPTS may be an alternative physical activity modality to improve fitness and health of adults given that it meets the ACSM [10] recommendation regarding physical activity intensity level (i.e., moderate-vigorous); moreover, participants perceived it as a pleasant activity, which may enhance long-term adherence.

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