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Original Article

Acute effects of listening to music and/or watching video clips on perceptual variables and performance during a high intensity exercise session

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Abstract:
Performing exercise at high intensity can improve health. However, there is a negative association between high intensity and pleasure while exercising. External resources, such as listening to music and/or watching video clips, can be used to enhance pleasure and performance. Nonetheless, results regarding the use of these tools during high intensity exercise are still controversial. Therefore, the aim of this study was to compare the acute effects of listening to music and/or watching musical video clips on perceptual variables and performance during a high intensity exercise session on a cyclergometer. Thus, a cross-sectional study was performed with a sample of 14 male participants (23.4 ± 3.1 years, 78.3 ± 12.3 kg; 1.7 ± 0.06 m; 26.2 ± 3.4 kg/m²) who randomly performed exercise sessions at 10% above the anaerobic threshold under three conditions: control (CC), listening to music (MC), and watching musical video clips (VC). Heart rate (HR) was measured before all sessions. During each session, every 3 min, participants answered a feeling scale (FS), perceived activation scale (PA), rate of perceived exertion (RPE), and had their HR measured. These variables were also measured every 5 min during a 30-min period after exercise. The results showed that the audiovisual resource promoted higher levels of pleasure during exercise. RPE, PA, and performance were not different among sessions ($p>0.05$). Thus, it is possible to infer that watching videos clips during high intensity exercise sessions attenuates displeasure due to the distraction promoted by the visual/auditory stimulus. It is concluded that watching musical video clips during high intensity exercise on a cyclergometer can be more pleasurable but does not increase performance nor decrease RPE.
Key Words: Audiovisual aids, Sports performance, Aerobic exercise, Pleasure

Introduction

High intensity exercise can offer a way of increasing energy expenditure and improving health indicators, such as aerobic capacity, body composition, and cardiometabolic parameters (Liguori & ACSM, 2020). These benefits have been observed in short-term exercise programs compared to low and moderate intensity exercise (Racil et al., 2013). Therefore, considering that several people refrain from exercising due to lack of time, performing low-volume high-intensity exercise sessions could be an interesting factor to attract practitioners (Haines et al., 2020; Jones, Stork & Oliver, 2020; Chu et al., 2021; Vella, Taylor & Drummer, 2017). However, the inverse association between exercise intensity and pleasure makes this type of activity less encouraging and can influence adhesion and long-term intervention maintenance (Ekkekakis, 2005).

According to Niven, Laird, Sauders & Phillips (2020), this could be explained by Ekkekakis' Dual Mode Theory (Ekkekakis, 2005) in which affective responses to exercise are based on cognitive parameters and intrinsic cues. When exercise is performed in high intensities (such as above ventilatory threshold), intrinsic cues are evidenced, and it becomes difficult to maintain a physiological steady state. Thus, there is an increase in displeasure and a tendency to stop exercise. Moreover, when exercising at high intensities, the rate of perceived exertion (RPE) often achieves close to maximum values, possibly contributing to decreased feelings of pleasure during exercise (Vasconcelos et al., 2019; Malik et al., 2017).

In this scenario, different resources, such as listening to music, have been used to enhance pleasure during exercise (Terry et al., 2012; Karageorghis et al, 2009; Karageorghis & Jones, 2014; Hutchinson & Karageorghis, 2013; Dyer & McKune, 2013). Due to its ability to increase pleasure and reduce the RPE (Carneiro et al., 2010) music has become a practical and easily acceptable tool used by the population during different types of exercise (Terry et al., 2020; Carlier, Delevoye-Turrel & Fun2move consortium, 2017). Moreover, the distraction promoted by listening to music can improve performance because it may be perceived

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as a diversion from unpleasant proprioceptive sensations that are related to exhaustion, reverberating in changes in physiological responses, such as heart rate (HR) (Fritz et al., 2013; Lee & Kimerly, 2014).

Watching videos with or without audio (video clips) is another resource that has been used before, during, and after exercise (Loizou & Karageorghis, 2015; Annesi, 2001; Lin & Lu, 2013, Bigliassi et al., 2016; Hutchinson, Karageorghis & Black, 2017). This tool has shown efficacy in improving performance (even more than music alone) due to the dissociation of focus promoted by both auditory and visual stimuli (Barwood et al., 2009). Loizou and Karageorghis (2015) also showed that videos are capable of increasing the motivational state of athletes before exercise.

The literature is not clear regarding the effects of music on performance during high intensity exercise. In maximal exercises, Atan (2013) observed that there was no improvement in anaerobic performance with the addition of music for both a cyclergometer and running. On the other hand, Stork, Kwan, Gibala, and Ka (2014) found a significant increase in performance when applying an auditory stimulus in a high intensity interval training session. Moreover, studies that have investigated post-exercise moments after using visual and auditory resources and their interference in pleasure/displeasure immediately after exercise have been scarce (Jones; Karageorghis & Ekkekakis, 2014; Hutchinson, Karageorghis & Black, 2017).

Therefore, research regarding the use of music and video clips during high intensity exercise is necessary since they are low cost, easy to apply, and can reflect the adherence to exercise and decreased abandonment. In this scenario, the aim of this study was to analyze the acute effects of listening to music and/or watching video clips on perceptual and performance variables during a high intensity exercise session.

Materials & methods

Participants

This study was a randomized counterbalanced control study and aimed to observe the performance and perceptual responses of physically active young male adults under three conditions: control (CC), listening to music (MC), and listening/watching musical video clips (VC). In all sessions, the participants performed high intensity exercise on a cyclergometer (10% above the anaerobic threshold).

The sample size calculation was performed using G*Power 3.0, considering an alpha of 0.05, a power of 0.80, an effect size of 0.51 (based on values of RPE from Yamashita et al.'s study in 2006), and a minimum of three measurements of the repeated measures using ANOVA (considering three conditions: control, music, and video clip). This calculation resulted in a minimum sample of 12 participants. In total, 19 volunteers were recruited, and five did not complete all experimental sessions (did not want to continue in the study), resulting in a final sample of 14 participants, with a statistical power of 0.86.

The inclusion criteria were being between 18 and 30 years of age, reporting being physically active, not presenting a known disease or any bone, joint, or muscle impairment, not smoking, not being hypertensive, and not using any drugs that could influence the autonomic nervous system, and therefore the variables investigated. The exclusion criteria were not completing all three experimental sessions and refusing to follow the recommendations and procedures of the tests.

The study was approved by the Research and Ethics Committee of the Federal University of Vale do São Francisco (Univasf) (CAAE: 57443216.7.0000.5196). The participants were informed about all procedures and signed an informed consent form agreeing to participate in the study, as required by Resolution n. 466/12 of the Brazilian National Health Council.

Measures

Participants were invited to show up at the laboratory to perform the research procedures in five visits. In the first visit, the volunteer answered the Physical Activity Readiness Questionnaire (PAR-Q) (LIGUORI & ACSM, 2020), the Brazilian short version of the International Physical Activity Questionnaire (IPAQ) (Matsudo et al., 2001), underwent anthropometric evaluation, and were familiarized with the cyclergometer. In the second visit, the participants performed a submaximal incremental test to identify the anaerobic threshold. In the third, fourth and fifth sessions, the participants performed, in a randomized order (simple draw), three experimental conditions on a cyclergometer: control (CC), music (MC) and video clip (VC). An interval of at least 48 h was given between sessions. All sessions were carried out at the same time of day and under the same environmental conditions.

HR was measured using a heart rate monitor (RS800CX Polar®, ElectroOy, Finland) at the end of 10 min of rest, every 3 min during the experimental sessions, and every 5 min during recovery (HR5, HR10, HR15, HR20, HR25, HR30).

RPE was measured every 3 min during the experimental sessions and every 5 min during recovery (RPE5, RPE10, RPE15, RPE20, RPE25, RPE30) using a rate of perceived exertion scale (from 6 to 20 points), in which 7 corresponded to the lowest intensity and 19 to the highest (Kaercher et al., 2018).

FS was measured every 3 min during the experimental sessions and every 5 min during recovery (FS5, FS10, FS15, FS20, FS25, FS30). This instrument is quantified from −5 to +5 scale, corresponding to the sensations felt during exercise (−5 = very bad, while +5 = very good). In addition to the extreme values, the scale also presents other intermediary descriptors: +3 = good; +1 = reasonably good; 0 = neutral; −1 = reasonably bad; −3 = bad (Alves et al., 2019).

PA was also measured every 3 min during the experimental sessions and every 5 min during recovery (PA5, PA10, PA15, PA20, PA25, PA30). This scale is composed of 6 points and evaluated the motivation of the participants from 1 (low activation) to 6 (high activation) (Sveback & Murgatroyd, 1985).

To use all the above-cited scales, an anchorage by memory was performed (Robertson et al., 2000). During this procedure, information regarding the scales was provided, and, individually, the participants were instructed about RPE, FS, and PA. The anchorage was always performed before the experimental sessions.

Procedures

Aerobic test and experimental sessions

The participants' anaerobic threshold were identified using the values from the Borg Scale of RPE. According to Scherr et al. (2013), values between 13 to 14 points in the scale are consistent with the anaerobic threshold. The incremental test was performed on a cyclergometer (Cefise Biotec, Model 2100). Before the test, a 2-min warm-up (without load) was performed at a speed of 50 rpm. After the beginning of the test, load was increased by 25-watt every minute, maintaining a speed of 50 rpm. The test was interrupted when the participant reached 16 points in the RPE scale or when he was not able to maintain the rotation of the cyclergometer at 50 rpm.

In the experimental sessions (CC, MC, VC), before beginning exercise on the cyclergometer, the participants remained in a seated position for 10 min, in silence, without making sudden movements. At the end of this period, heart rate (HR) was measured. Afterwards, the participants were placed on the cyclergometer and performed 2 min of warm-up (without load). Then, the participants began exercise with a load corresponding to 10% above anaerobic threshold until voluntary exhaustion or until they were not able to keep the rotation at 50 rpm. The duration of each session, in minutes, was recorded to analyze performance (time to exhaustion). In addition, during the sessions, HR, RPE, feeling scale (FS), and perceived activation (PA) were collected every 3 min. The perceptual scales were shown in a randomized order. Immediately after the exercise, the participants remained seated, in passive recovery for 30 min during which HR, RPE, FS, and PA were assessed every 5 min.

In the MC session, the participants performed exercise while listening to songs from a pre-established playlist. For VC, the participants performed exercise listening and watching video clips of songs from the same playlist. Finally, for CC, the participants performed exercise while wearing headphones but did not listen or watch anything.

Playlists and video clips

Two playlists were developed, one with fast and another with slow songs. The fast song playlist was composed of songs between 125 and 145 bpm, as proposed by Terry and Karageorghis (2011). These songs were used during the experimental sessions, while the slow songs were used post-exercise. The playlists were created by the researchers; however, the songs used during and after the experimental sessions and their order were chosen by the participants. The video clips consisted of the same songs in the playlist. Additionally, the same songs (and their respective video clips) in the same order were used for MC and VC.

To avoid gaps between songs, the playlists were edited using the software Free MP3 Cutter, version 2014 (for MC) and Windows Movie Maker version 2012 (for VC). All participants wore the same headphones (Sony model MDR-ZX110) plugged in a television set (55" Toshiba Regza). During the recovery period (post-exercise), the participants wore the same set of headphones; however, they listened to the songs and watched the video clips on a laptop (HP 14-ap000). The volume was set by the participant; nonetheless, it did not excess 85 dB.

Analysis

Data were collected and stored in a spreadsheet in Microsoft Excel 2010®. Afterwards, data were exported to SPSS 22.0 for Windows®. A descriptive analysis of the data was carried out and values were expressed as means and standard deviations. Normality was verified using Shapiro–Wilk's test. A two-way repeated measures ANOVA with Bonferroni's post-hoc was performed to compare sessions and moments. The hypothesis of sphericity was verified by Mauchly's test and, when violated, the degrees of freedom were corrected by Greenhouse–Geisser's estimates. The level of significance adopted was $p<0.05$.

Results

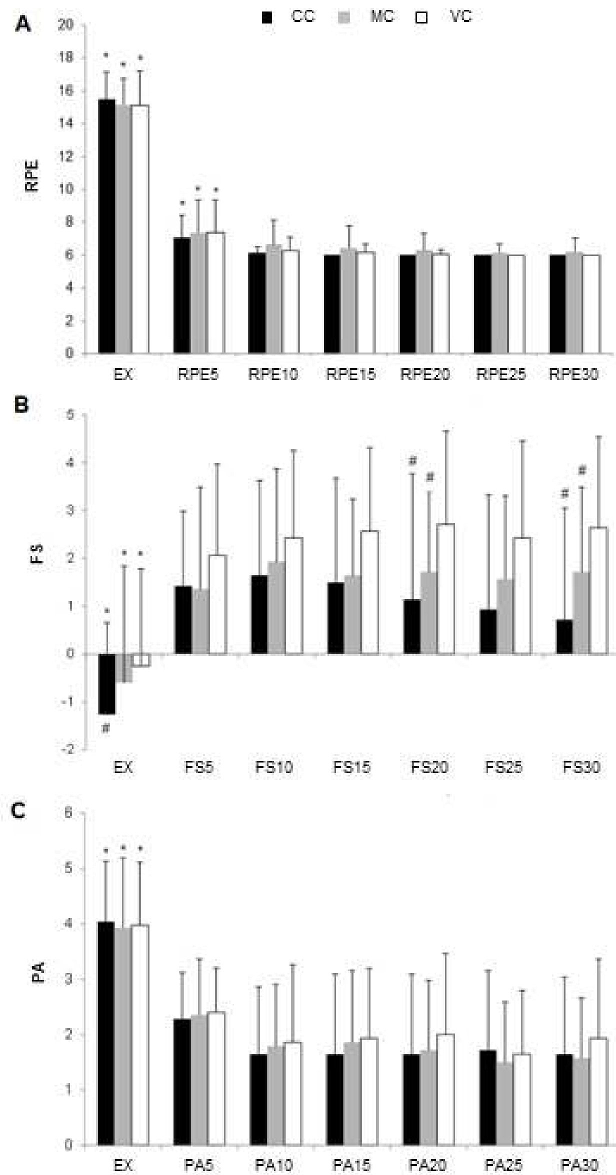
In total, 14 male volunteers participated in the study. The average main characteristics of the participants were an age of 23.4 ± 3.1 years, body mass of 78.3 ± 12.3 kg, height of 1.70 ± 0.06 m, and body mass index of 26.2 ± 3.4 kg/m².

Figure 1 presents RPE (A), FS (B) and PA (C) responses for CC, MC and VC during exercise and in the post-exercise recovery periods. Results showed that RPE and PA were higher during high intensity exercise for all three conditions when compared to all moments of recovery ($p<0.05$). FS was significantly lower during exercise compared to all recovery moments ($p<0.05$) in all experimental sessions. FS was also significantly lower during exercise in CC compared to that during VC and significantly higher in VC at FS20 and FS30 compared to the same moments in CC and MC.

Figure 2 presents HR values at different time periods (rest, exercise, and recovery) for all three experimental sessions. A statistically significant difference between CC and VC was verified for HR10 ($p=0.013$) and HR30 ($p=0.042$). No differences between conditions were found during exercise ($p>0.05$). HR was significantly higher during exercise compared to during rest and recovery moments for all three conditions ($p<0.05$). Moreover, HR at rest was significantly lower compared to exercise and post-exercise recovery time periods for all conditions ($p<0.05$).

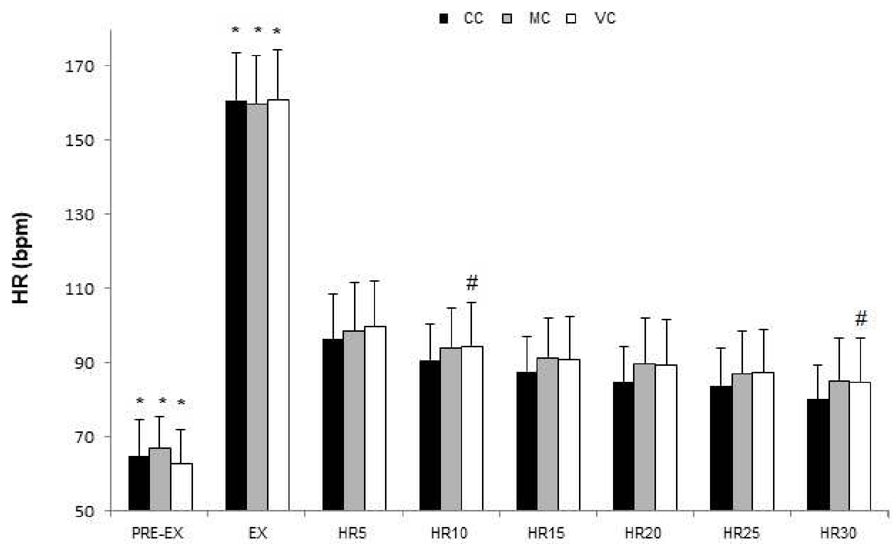
Figure 3 presents the values referring to time to exhaustion (in minutes) during the high intensity exercise sessions for all conditions (CC, MC and VC). No statistically significant differences were found between the groups (CC = 13.98 ± 6.1 min; MC = 12.45 ± 4.6 min; VC = 14.54 ± 6.6 min; $p>0.05$).

Figure 1. Means ± standard deviations of RPE (A), FS (B) and PA (C) in CC, MC and VC during exercise and post-exercise recovery (n=14)



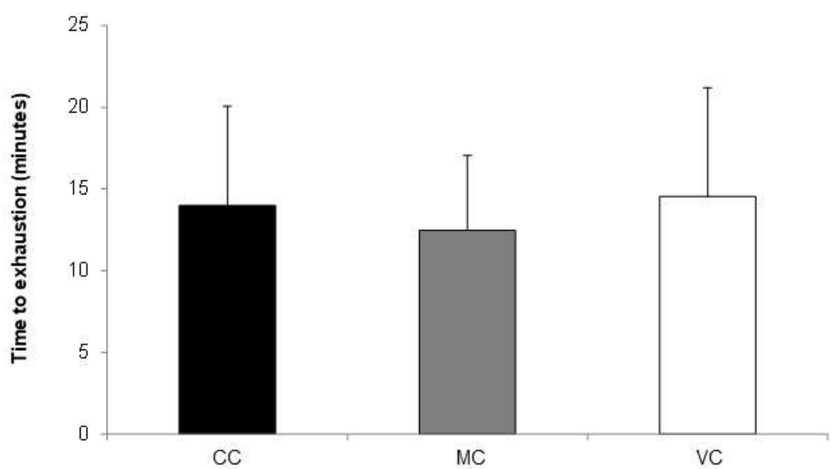
Note: CC = control condition. MC = music condition. VC = video clip condition. RPE = rate of perceived exertion. FS = feeling scale. PA = perceived activation. EX = during exercise. *$p<0.05$ for all time periods under the same condition. $^{\#}p<0.05$ for VC.

Figure 2. Means ± standard deviations of HR responses for CC, MC and VC at rest, during exercise, and for post-exercise recovery time periods (n=14)



Note: CC = control condition. MC = music condition. VC = video clip condition. HR = heart rate. EX = during exercise. *p<0.05 for all time periods under the same condition. #p<0.05 for CC.

Figure 3. Means ± standard deviations of time to exhaustion for CC, MC and VC (n=14)



Note: CC = control condition. MC = music condition. VC = video clip condition.

Discussion

The main finding of this study was that watching video clips attenuates displeasure during a high intensity exercise session and promotes a positive affect after exercise. However, no differences between the experimental conditions regarding RPE, PA, HR and performance during and after exercise were observed.

These findings could be explained by the distraction and visual/auditory stimulus provided by the musical video clips (Rider et al., 2016). Generally, the processing of environmental information is lower during high intensity activities (Carneiro et al., 2010) since internal stimuli (pain, fatigue, heavy breathing) are higher. Thus, exercise can be improved with external signals that are capable of distracting the individual through auditory and visual resources (Hutchinson et al., 2014). The dissociation, characterized by a decrease of focus on internal/physiological stimuli, seems to be the main factor that influences the responses caused by visual stimulus (Barwood et al., 2009; Bigliassi et al., 2016).

The results showed that listening to music did not differ from the control condition (without any kind of external stimulus). This could be explained by the fact that the participants chose songs from a pre-established playlist, and that listening to music alone may not have been enough to remove the focus from exercise (Nakamura et al., 2008). Moreover, during recovery, we showed that the audiovisual stimulus (musical video clips) was more pleasurable compared to the auditory stimulus alone or compared to the control. The boredom during the control session during recovery and the interaction between images and sound, which can be more pleasurable than only listening to music, could explain these results. Thus, VC could distract the attention from internal stimuli and promote feelings that are more positive.

Jones, Karageorghis, and Ekkekakis (2014) observed that affection scales can be positive for exercises 10% below and 5% above anaerobic threshold when listening to music or watching motivational videos with music. The authors observed that attention was higher when music and video were combined, proving that the dissociation of focus could be the main reason for finding positive affect responses above the anaerobic threshold. Such results corroborate with the findings of this study, which showed that even at higher intensities (10% above anaerobic threshold), watching video clips can alter auditory and visual stimuli during exercise, modifying pleasure responses.

Our results also showed that, despite the condition in which the high intensity exercise sessions were performed, no differences were found for RPE. Thus, even though feelings related to fatigue predominated, the use of video clips made theses interpretations more positive, showing that pleasure/displeasure are not necessarily reflected by high RPE responses (Figure 1). These results agree with the literature regarding the difficulty of decreasing RPE in high intensity exercise only by using music (Karagoerghis et al., 2009; Stork et al., 2014).

Moreover, PA was not different during and after exercise. In high intensity exercise, the degree of excitability was not different due to the increase in HR for all three conditions (Figure 2). Nonetheless, an immediate decrease in activation after exercise occurred in all sessions. Atan (2013) investigated the effects of listening to slow and fast music and not listening to music on the physiological responses and aerobic performance under maximum exercise and did not find differences between sessions regarding performance, HR, and blood lactate levels. This suggested that during high intensity exercise, PA scores do not seem to suffer any kind of alteration.

In this study, performance was analyzed using time to exhaustion, and no statistically significant differences were found between the different conditions (Figure 3). This does not corroborate with similar studies that used audiovisual resources (Annesi, 2001; Lin & Lu, 2013; Barwood et al., 2009). Other studies found a decrease in RPE and an increase in performance when using only music (Waterhouse, Hudson & Edwards, 2010; Silva et al., 2016), also differing from our study. However, these differences could be explained by the exercise type and intensity. In addition, cycling speed differed among the studies.

The present study contributes to the literature with interesting findings; however, some limitations need to be addressed. The participants were not able to choose their favorite songs due to the need for maintaining a similar bpm in all volunteers. Nonetheless, the participants had several options to choose from in the pre-established playlist. In addition, imposing a specific cycling speed (50 rpm) could be a limitation. Still, this was necessary to evaluate performance using time to exhaustion.

Finally, the use of motivational strategies can help with the adherence of individuals who exercise, allowing more pleasurable feelings and reducing mood factors that can disturb performing exercise, especially at high intensities. Vigorous exercise improves cardiometabolic health, physical fitness, and body composition at a higher degree than exercise at low and moderate intensities, increasing the time/efficiency ratio. In addition, we showed that using an audiovisual resource, such as musical video clips, can attenuate feelings of displeasure imposed by high intensity exercise.

Conclusions

Watching video clips may attenuate displeasure during an exercise session and increase the positive affect after high intensity aerobic exercise. In this scenario, sports and health professionals could use video clips as effective tools to increase exercise adhesion and to make post-exercise recovery periods more pleasant. In addition, gyms could offer audiovisual aids during customer workouts to increase the pleasure while performing an activity.

Our findings also showed RPE, PA, and performance were not different between the different experimental sessions. These results are still controversial in the literature and may be attributed to exercise type (cycling), exercise intensity (10% above AT), and audiovisual aid preference (choice of songs and/or video clips). Thus, it is important to understand the customer's and/or athlete's predilection regarding these factors to achieve better results during exercise sessions, especially in high intensity domains.

Conflicts of interest

The authors declare no conflicts of interests regarding this research, authorship, and/or publication of the present paper.

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