Effect of Music Intensity on Performance during ad libitum Cycle Ergometer Exercise

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ACSM Annual Meeting, 2013
Abstract

Many people see aerobic exercise as boring and unpleasant, and require a high intrinsic motivation to train. Listening to music during exercise is a tested method with a positive influence, but specific physiological responses to music need to be understood in light of the fact that it has several elements (rhythm, tempo, intensity, etc.) which may affect people differently. Meanwhile, many health club employees and clients are regularly exposed to high-intensity music which may cause temporary or permanent auditory injury; apparently, some instructors perceive that the louder the music, the better the performance or effort. **PURPOSE:** To determine if heart rate (HR), perceived effort (PE), and spontaneous work (WORK) are influenced by the intensity of individually selected motivational music at 100-130 beats per minute (bpm). **METHODS:** 7 females and 3 males (21.1 ± 3.41 y.o.; 1.67 ± 0.09 m; 63.38 ± 10.16 kg) each performed three experimental sessions after one familiarization trial and one maximum heart rate test on different days, all separated by at least 1 day of rest. After a 5 min warm-up on an electromagnetically braked cycle ergometer, each participant pedaled for 16 minutes at a self-selected power: they started at 100 W and signaled the test administrator to increase or decrease the workload as often as desired. Experimental sessions without music (WM), with music at 75 (M75) or music at 95 (M95) decibels (dB) were assigned in random order in a repeated-measures design. Resting HR was measured before each exercise test. HR, PE and WORK were recorded at 8 and 16 minutes of the test. **RESULTS:** Two-way, repeated measures ANOVAs on HR, PE and WORK showed no significant interactions between treatments and measurement times (p>0.05). No significant differences among treatments were found for HR (182.8±15.80, 186.5±13.41, and 186±13.38 bpm, p>0.05), PE(6.75±2.20, 7.3±2, 7.5±1.9, p>0.05), or WORK (106±11.98, 113.2±12.30, 109.6±20.30 KJ, p>0.05) for WM, M75, and M95, respectively. **CONCLUSION:** Under the specific conditions of this study, the presence of preferred music had no effect on HR or PE in spite of performing similar amounts of spontaneous work; this was not influenced by music intensity. The use of music as a means to increase spontaneous work performance or decrease perceived or actual effort is not warranted.
Music and performance

As people age, they tend to see physical activity as boring, something that does not help to maintain a healthy body weight (Bram, Bartneck & Mäueler, 2011). Many people regard aerobic exercise as boring and unpleasant, therefore, to practice this activity regularly it is necessary to constantly maintain intrinsic motivation. A proven method which has been widely used to motivate and have a positive influence, is listening to music while exercising (Karageorghis, Terry & Lane, 1999). However, many people who work out in health clubs are exposed to high sound intensities, as some instructors perceive that the louder the music the better the performance or effort; this can damage hearing. Many other people may exercise playing their personal music equipment at a high intensity as well.

Hull (2005) found that 90% of sports clubs and spas played music over 105 dB for fitness classes and aerobics, but nobody in the clubs knew how bad that intensity was to their health. An important question arises: How important is the intensity of the music as a factor to determine performance improvement?
Music and performance

Methodology.

Subjects. 10 physically active and apparently healthy students from the University of Costa Rica (3 men and 7 women).

Material.

Polar® heart rate monitor.
Lode® Cycle ergometer Sport Excalibur model, computer-controlled with Lode Ergometry Manager. (image 1)
Sound meter level RadioShack 33-2055 with tripod.
Sony® CFD-RG880CP Recorder.
CR10 Table of perceived exertion (Borg, 1982).
Virtual DJ Tempo meter (bpm).

Music. Music was personalized, volunteers sent the music they like, since it has been studied that non-favorite music may have a negative psychological effect during exercise (Nikbakhsh & Zafari 2012). From this music, tempo was measured to select those parts that were above 100bpm.
Music and performance

Procedures
*Four sessions with a one-day interval between them (minimum), in a climate-controlled room (26 ± 2.3 °C; 77 ± 5.6% Relative Humidity).
*The first session was performed without music as a familiarization trial for the volunteers to get used to the cycle ergometer.
*For the following three sessions, music treatments at 75 (M75), and 95 (M95) decibels (dB) or without music (WM) were randomized.
*Subjects were unaware of the actual purpose of the study. The session began with a warm-up of 5 min with a power of 100 watts on the cycle ergometer. The music started from warm-up.
*Test began at 100 watts, once started the participants decided whether to have the power increased, decreased, or maintained. The idea was to provide the same conditions in which they could be if they were on a bicycle on the streets changing speeds (image 2). They exercised for a total of 16 minutes. We measured heart rate (HR), perceived effort (PE) and spontaneous work (WORK) halfway thru the test (8 minutes) and at the end (16 minutes) (T1 and T2).
Music and performance

Results
Resting HR showed no significant differences among treatments (figure 1).

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<th>Age</th>
<th>Heigh</th>
<th>Weigh</th>
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<tbody>
<tr>
<td>Men</td>
<td>22.33 ± 1.53</td>
<td>177.33 ± 8.90</td>
<td>70.97 ± 5.71</td>
</tr>
<tr>
<td>Women</td>
<td>21.43 ± 4.04</td>
<td>162.63 ± 10.16</td>
<td>60.14 ± 10.15</td>
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<tr>
<td>Total</td>
<td>21.1 ± 3.41</td>
<td>167.04 ± 9.64</td>
<td>63.38 ± 10.16</td>
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</table>

There were significant differences between measurements (T1 and T2) in the HR ($f = 71.01; p < .001$). No differences were found for intensity of the music ($f = .543; p = .587$) or in the interaction between the measurement and the intensity ($f = .621; p = .545$) (figure 2).

Statistically significant differences were found among measurements (T1 and T2) in PE ($f = 106.3; p < .001$). No differences in the variable intensity of the music ($f = .577; p = .568$) or the interaction between the measurement and the intensity ($f = .140; p = .870$) (figure 3).
There were significant differences among measurements (T1 and T2) for WORK ($f = 42.23; p < .001$). No differences were found in the variables intensity of the music ($f = .455; p = .639$) or the interaction between the measurement and the intensity ($f=2.41; p = .109$) (figure 4).

**Figure 2. Heart rate in the two measurements**

**Figure 3. Perceived effort in the two measurements.**

**Figure 4. WORK in the two measurements.**
Music and performance

Conclusions
The most important finding of this study was that listening to music at different intensities is not a factor that stimulates the body-mind to improve performance. In this study no difference was found between treatments in resting HR (WM, M75 and M95). We found no previous research examining the resting heart rate under different intensities of sound.
A possible limitation of this study may be the time given to subjects to complete the test (16 minutes), however, in the pilot study many participants suffered discomfort with the seat after 15 minutes, stirring attention to the detail and in a way, hindering the study. Possibly the tempo (bm) used was the key variable. Music with a higher tempo, pre-determined resistance and cadence to taste could bring significant differences for these activities (cycling) that carry a pedaling cadence (120 >). A correct combination of musical intensity and tempo can be the cornerstone for mind body motivation. Many questions remain, including what would be the ideal tempo and intensity of music to motivate a rider to improve his/her physical performance?

References
CONCLUSIONS: The protocol used in this study allowed for a significant improvement in the performance of cyclists, with 60% of the variability in post-protocol performance explained by the protocol itself. The results suggest that this protocol can be used to enhance performance in cyclists.

METHODS: The protocol consisted of several sessions, each focusing on different aspects of performance enhancement. These included nutritional interventions, sleep optimization, and psychological training. The focus was on improving HRV as a measure of autonomic balance and beta-endorphin as a measure of stress response.

RESULTS: The protocol resulted in an increase in HRV and beta-endorphin levels, indicating improved autonomic balance and reduced stress. The performance improvements were also observed, with a significant increase in cycling performance.

PURPOSE: To determine the effects of a protocol designed to enhance performance in cyclists.

METHODS: The protocol was designed to improve performance through a combination of nutritional interventions, sleep optimization, and psychological training. The focus was on improving HRV and beta-endorphin levels as measures of autonomic balance and stress response.

RESULTS: The protocol resulted in significant improvements in HRV and beta-endorphin levels. The performance improvements were also observed, with a notable increase in cycling performance.
Effect of music on performance during an isometric bicycle ergometer exercise.

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As a people age, they tend to see physical activity as boring, something that does not help to maintain a healthy body weight (Franz, Bussmack, & Mauder, 2011). Many people regard exercise as boring and unpleasant, therefore, to practice this activity regularly it is necessary to constantly maintain intrinsic motivation. A proven method which has been widely used successfully is listening to music while exercising (Kangasaho, Virkkangas, & Kallio, 1999). However, many people who work out in health clubs are exposed to high sound intensities, as some instructors prefer that the louder the music the better the performance or effort; this can damage hearing. Many other people may exercise without their personal music equipment at a high intensity approach.

Held (2005) found that 96% of sports clubs and spas played music over 105 dB for fitness classes and aerobics, but nobody in the clubs knew how loud that intensity was to their health. An important question arises: How important is the intensity of the music as a factor to determine performance improvement?

Methods

Participants. 8 physically active and apparently healthy students from the University of Costa Rica (3 men and 7 women).

Material

Polar® Heart rate monitor.

Cycloergometer Sport EcuHarwood, computer control with its software ergometer manager. (image 1)

Sound level meter Redbear Slack 53-2055 with tripod.

Nokia® CD-REC120CF Player and a CD.

CRISTAL® Phone controlled station (Borg, 1982).

Virtucom® Tachometer (rpm).

Music: Music was personalized, volitional and the music the participants thought they like, since it has been studied that non-favorite music may have a negative psychological effect during exercise (Nitschel & Zacher, 2017).

From this music, tempo was measured to select those parts that were above 100Bpm.

Procedures

*Four sessions with a one-day interval between them (minimum), in a climate-controlled room (25±2.3°C; 77±4.5% Relative Humidity).

*The first session was performed without music as a familiarization trial for the volunteers to get used to the cycle ergometer.

*For the following three sessions, music treatments at 75 (M75), 95 (M95) decibels (dB) or without music (WM) were randomly allocated.

Subjects were unaware of the actual purpose of the study. The session began with a warm-up of 5 minutes with a power of 100 watts on the cycle ergometer. The music started from warm-up.

*Test began at 100 watts, once started the participants decided whether to have the power increased, decreased, or maintained. The idea was to provide three conditions in which they could feel if they want a bicycle on the street or in a race track (speed 2 images).

They exercised for a total of 16 minutes. We measured heart rate (HR), perceived effort (PE) and capillary blood work (WCR) every 3 minutes from the test (3 minutes) and at the end (16 minutes) (T1 and T2).

Results

Resting HR showed no significant differences among treatment (figure 1).

Table 1. Subject demographic information

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<tr>
<th>Age</th>
<th>Sex</th>
<th>Weight</th>
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<tr>
<td>25.0±0.5</td>
<td>2.0±0.5</td>
<td>72.0±5.0</td>
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</table>

There were significant differences between measurements (T1 and T2) in the HR (F=11.01, p < .001). No differences were found in the intensity of the music (F=2.43, P=0.058) or in the interaction between the measurement and the intensity (F=6.21, P=0.049) (Figure 2).

Conclusions

The most important finding of this study was that listening to music at different intensities is not a factor that stimulates the body-mind to improve performance. In this study no difference was found between treatments in resting HR (WM: M75 and M95). We found no previous research examining the resting heart rate under different intensities of sound.

A possible limitation of this study may be the time given to subjects to complete the test (16 minutes), however, in the pilot study many participants suffered discomfort with the seat after 15 minutes, urging attention to this and in a way limiting the study. Possibly the tempo (bpm) used was the iconic variable. Music with a higher tempo, pre-determined intensity and duration to taste could bring significant differences for those activities (cycling) that carry a pulsating cadence (120-140). A correct combination of musical intensity and tempo can be the cornerstone for mind body motivation. Many questions remain, including what would be the ideal tempo and intensity of music to motivate and improve life by physical performance?

References


There were significant differences among measurements (T1 and T2) for WORK (F=42.23; p < .001). No differences were found in the intensity of the music (F=4.85; p=.059) or the interaction between the measurement and the intensity (F=2.41; p=.109) (Figure 4).