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

Lic. Jorge Alberto Aburto Corona
Luis Fernando Aragón V., Ph.D., FACSM

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 highintensity music which may cause temporary or permanent auditory injury; apparently, some instructors perceive that the louder the music, the better theperformance 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 ± 0.09m; 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 intrinsec 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-RG88oCP Recorder.

CR10 Table of perceived exertion (Borg, 1982).

Virtual DJ Tempo meter (bpm).

Image 1. Cycle ergometer

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 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).

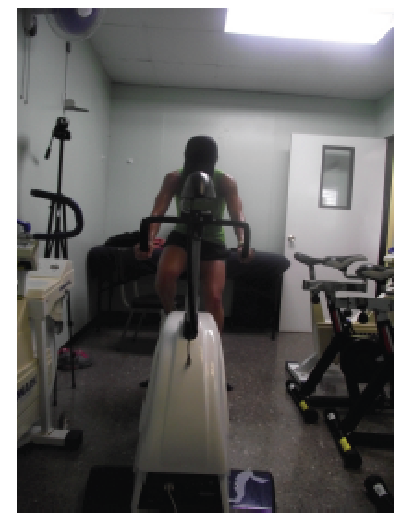

Image 2. Subject in the test condition

Music and performance

Results

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

Table 1. Subjects characteristics

	Age	Heigh	Weigth
Men	22.33 ± 1.53	177.33 ± 8.90	70.97 ± 5.71
Women	21.43 ± 4.04	162.63 ± 10.16	60.14 ± 10.15
Total	21.1 ± 3.41	167.04 ± 9.64	63.38 ± 10.16

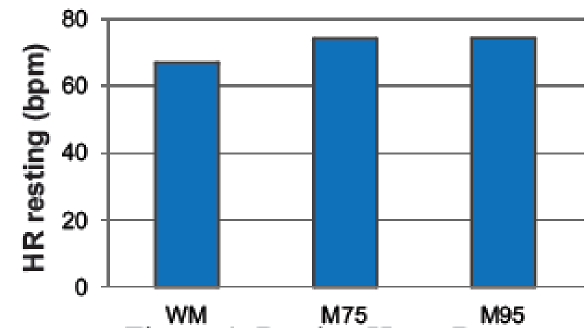

Figure 1. Resting Heart Rate (f=.538; p= .437)

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).

Statically significant differences were found among measurements (T1 and T2) in PE (f = 106.3; p < .001). No differencies 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).

Music and performance

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).

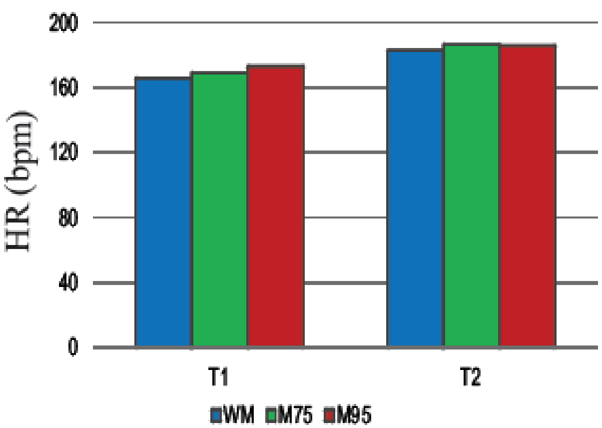

Figure 2. Heart rate in the two measurements

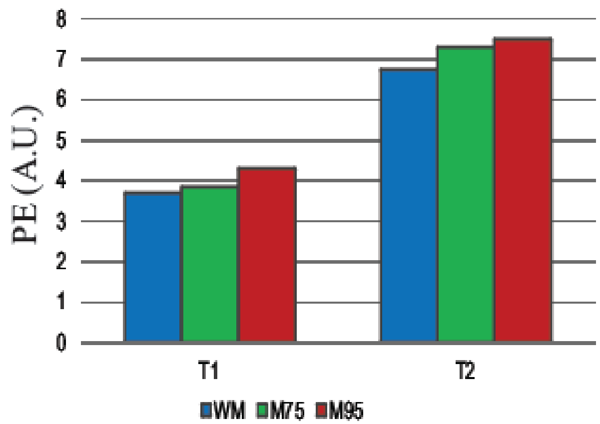

Figure 3. Perceived effort in the two measurements.

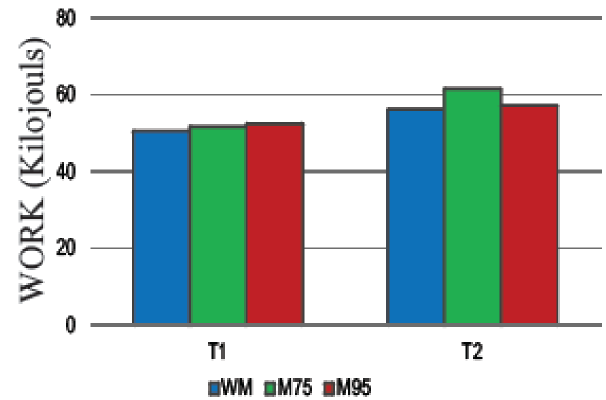

Figure 4. WORK in the two measurements.

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

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CONCLUSION: T-C and P-C variables associated with standing ergometer sprinting can be established reliably using IL and when expressed relative to body mass explain 38-59% of the variance in sprint start performance. These results highlight that while TMAX and PMAX are important physical characteristics for sprint cyclists other factors must be considered when evaluating sprint performance, for example, coordination of muscular power.

Supported by VU/ASC Grant

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593 Board #68 May 29, 3:30 PM - 5:00 PM

Constant Anaerobically Attributable Work in Relation To Cycle Time Trail Length

Katherine R. Malterer[1], Roy Mulder[2], Dionne A. Noordhof[3], Jos J. de Koning, FACSM[3], Carl Foster, FACSM[1]. *[1]University of Wisconsin-La Crosse, La Crosse, WI. [2]VU -Amsterdam, Amsterdam, Netherlands. [3]VU-Amsterdam, Amsterdam, Netherlands.*

(No relationships reported)

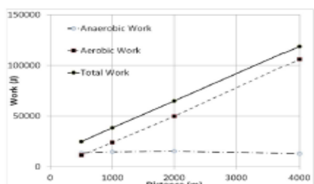
The proportion of work during athletic events attributable to aerobic (AER) and anaerobic (ANAER) sources has been of interest for many years. Previous studies have failed to account for gross efficiency (GE) which almost certainly varies during the course of a time trial (TT).

PURPOSE: This study measured AER and ANAER during cycle TT of 500, 1000, 2000, & 4000 m by accounting for total work accomplished and subtracting AER. GE was calculated based on a back extrapolation method that allows for estimation of GE changes during a TT.

METHODS: Well-trained, task habituated cyclists (N=17) performed all 4 TT in random order. ANAER was calculated by subtracting AER from total work (TOTAL) accomplished, with GE measured immediately before and after TT to account for changes in GE.

RESULTS: The TT required 41.3+1.4, 80.8+4.2, 163.6+7.9, & 332.4+15.1 s for 500, 1000, 2000, & 4000 m, respectively. TOTAL and AER grew progressively with TT distance, but ANAER was not different (p=0.21) with increased TT distance (13435+2131, 14593+2922, 15185+4628 & 12788+7471 J, respectively).

CONCLUSION: The data suggest that ANAER is a fixed value that is fully expended even during short (<60s) TT.



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594 Board #69 May 29, 3:30 PM - 5:00 PM

Effect Of Music Intensity On Performance During Ad Libitum Cycle Ergometer Exercise

Jorge A. Aburto-Corona, Luis F. Aragón-Vargas, FACSM. *Universidad de Costa Rica, San José, Costa Rica.*

(No relationships reported)

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.

CONCLUSIONS: 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.

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595 Board #70 May 29, 3:30 PM - 5:00 PM

Physiological and Performance Changes of an Elite Female Team Pursuiter

Esme L. Taylor[1], Chris J. White[1], Jonathan D.C. Leeder[1], Steve A. Ingham[2]. *[1]English Institute of Sport, Manchester, United Kingdom. [2]English Institute of Sport, Loughborough, United Kingdom.*

(No relationships reported)

PURPOSE: This case study examined the physiological and performance changes observed over a 7 month period for an elite female 3000 m track pursuit cyclist in the lead into the 2012 Olympic Games.

METHOD: Training performances were recorded for a World and Olympic female team pursuit champion (height 1.79 m, body mass 65 kg) over a 7 month period prior to the London 2012 Olympic Games. Power data was collected using a power meter, which was fixed to a track bicycle (Shoberer Resistance Mechanism, SRM, Germany). Timing data was collected for training performances using a wireless timing system (Brower timing systems, Utah, USA) and video analysis (Dartfish, Fribourg, Switzerland). Mean power output (PO) in the lead position and total team time was analysed for team pursuit sessions during distances of 3000, 2500, and 1500 m, and during individual efforts over 125 m. All data are expressed as a percentage change from best performances during the preparatory phase (-7 months) compared to the competition phase (-1 month).

RESULTS: Performance time in a 3000 m team pursuit improved by 0.8% with a 1.4% increase in PO in the lead position. Performance time over 2500 m improved by 2.8% with a 5.0% increase in PO. Performance time over 1500 m improved by 1.1% with a 0.6% increase in PO. Individual training times over 125 m improved by 0.6% with a 7.1% increase in PO.

CONCLUSIONS: This high performing athlete demonstrated small but notable improvement in 3000 m performance time over a 7 month period for the Olympic Gold medal winning team. However, improvements in performance time do not reflect the changes in average power output, which suggests further complexities to the event including technical ability and pacing strategy that may have contributed to changes in performance.

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596 Board #71 May 29, 3:30 PM - 5:00 PM

Physiological and Psychological Comparison of Indoor and Outdoor Cycling

William Goodenkauf, Molly Mieras, Matthew Heesch, Dustin Slivka. *University of Nebraska at Omaha, Omaha, NE.*

(Sponsor: Charles Dumke, FACSM)

(No relationships reported)

Cyclists often feel they work harder when training indoors than they do outdoors. It is difficult to tell whether this feeling is due to an actual change in intensity or work rate, or due to the occurrence of different physiological and psychological responses indoors versus outdoors.

PURPOSE: To determine whether an indoor versus outdoor cycling session stimulates different physiological and psychological responses.

METHODS: Recreationally trained male cyclists (n = 12, age 36.8 ± 7.1 y, mass 82.1 ± 16.6 kg, 15.1 ± 6.2 % body fat, VO2 peak 4.28 ± 0.4 L · min-1) completed 2 experimental trials. Each experimental trial consisted of a 40 kilometer set course. Participants were told to "exert as much effort as you normally would in a 40 km training ride. Try to keep your effort consistent throughout the ride. For example, don't do intervals. This effort should be perceived as the same for both your indoor and outdoor trial". One experimental trial was completed outdoors while the other trial was completed indoors on a computrainer with a GPS loaded profile of the outdoor course. Power output, heart rate, core temperature, RPE, attentional focus, as well as environmental conditions were measured during each trial.

RESULTS: There were no differences in temperature, heat index and barometric pressure between outdoor and indoor trials (22.0 ± 0.4 and 22.0 ± 0.1° C, 70.8 ± 0.8 and 69.7 ± 0.3° C, 973.2 ± 1.7 and 973.0 ± 2.2 mb, respectively). There was a difference in wind speed (2.4 ± 0.6 outdoor and 0.0 m · s-1 indoor). RPE and attentional focus were not different between trials (13.7 ± 0.4 indoors, 13.7 ± 0.6 outdoors, and 6.2 ± 0.6 indoors, 5.5 ± 0.6 outdoors, respectively). Skin temperature

Effect of music intensity on performance during ad libitum cycle ergometer exercise.

UNIVERSIDAD DE COSTA RICA

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LACIMOV
Laboratorio de Ciencias del Movimiento Humano

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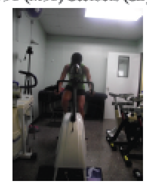

Image 2. Subject in the test condition

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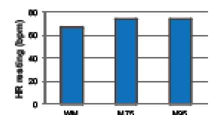

Figure 1. Resting Heart Rate (f=.538; p= .487)

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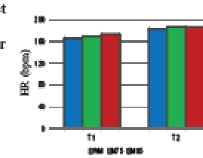

Figure 2. Heart rate in the two measurements

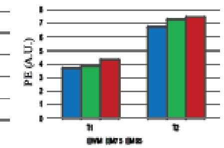

Figure 3. Perceived effort in the two measurements.

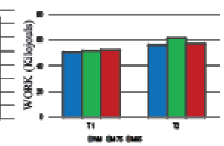

Figure 4. WORK in the two measurements.

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?

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