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Original article

Effects of music and video on perceived exertion during high-intensity exercise

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Abstract

Background: Dissociative attentional stimuli (e.g., music, video) are effective in decreasing ratings of perceived exertion (RPE) during low-to-moderate intensity exercise, but have inconsistent results during exercise at higher intensity. The purpose of this study was to assess attentional focus and RPE during high-intensity exercise as a function of being exposed to music, video, both (music and video), or a no-treatment control condition.

Methods: During the first session, healthy men ($n = 15$) completed a maximal fitness test to determine the workload necessary for high-intensity exercise (operationalized as 125% ventilatory threshold) to be performed during subsequent sessions. On 4 subsequent days, they completed 20 min of high-intensity exercise in a no-treatment control condition or while listening to music, watching a video, or both. Attentional focus, RPE, heart rate, and distance covered were measured every 4 min during the exercise.

Results: Music and video in combination resulted in significantly lower RPE across time (partial $\eta^2 = 0.36$) and the size of the effect increased over time (partial $\eta^2 = 0.14$). Additionally, music and video in combination resulted in a significantly more dissociative focus than the other conditions (partial $\eta^2 = 0.29$).

Conclusion: Music and video in combination may result in lower perceived exertion during high-intensity exercise when compared to music or video in isolation. Future research will be necessary to test if reductions in perceived exertion in response to dissociative attentional stimuli have implications for exercise adherence.

Keywords: Acute exercise; Attentional focus; Effort; Perceived exertion

1. Introduction

There are many physical and mental health benefits associated with participation in physical activity (PA). However, physical inactivity is widespread and has contributed to the increase in rates of obesity and chronic diseases.[1] Identifying ways to limit sedentary behavior, motivate individuals to become physically active, or encourage exercisers to continue their PA behaviors has developed into a popular area of research. One direction that this research has taken is to test the potential of music and/or video to influence attention in a way that may ultimately result in a change in PA behavior.[2–8]

The term "attention" describes the focus of an individual.[9] The direction of attention or attentional focus during PA has been described as ranging on a continuum from associative to dissociative and as potentially changing throughout the course of the activity.[10] When an individual has an associative focus, he or she concentrates on bodily sensations important for task performance,[11] such as breathing patterns, rhythm in movement, feelings of fatigue in the muscles, and/or heart rate (HR). In contrast, when using a dissociative focus, an individual concentrates on cues that are not relevant for task performance[11] such as auditory/visual stimuli and the environment, and this dissociative focus may provide distraction from his or her internal sensations (fatigue, breathing, and exertion). Based on the parallel-processing model and relevant to PA and exercise, perception is considered an active process that can influence judgments of sensory cues.[12] According to this model, dissociative strategies can reduce ratings of perceived exertion (RPE) during exercise conducted at low-to-moderate intensities. This effect occurs because, while physiological input is important for judgments of exertion, dissociative strategies compete for the

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limited channel capacity necessary to bring perceptions of exertion to awareness. Given this model, identifying ways to increase the extent to which an individual uses a dissociative focus during low-to-moderate intensity exercise may result in a significant reduction in perceived exertion, which may ultimately result in an acute benefit to PA behavior (i.e., greater work output). One way to encourage a dissociative focus is through using music and/or video.[13] Research on music and video shows that each of these stimuli possesses dissociative attentional qualities that may result in an individual perceiving less exertion and increasing performance (work output) during PA.[2–4]

Research conducted on the effect of music during PA suggests that music can be used as an aid to reduce negative bodily sensations and perceived exertion.[14,15] However, consonant with the parallel-processing model, the benefits of music seem to be most consistently evident when an individual participates in low-to-moderate intensity PA.[3,8,14–16] When an individual engages in PA at higher intensity levels, music has been shown to lose its beneficial effect.[16,17] This is in accord with the parallel-processing model because this model suggests that there is a point at which exercise intensity is high enough that a person's focus necessarily becomes more associative and at this intensity, external cues are no longer useful for maintaining a dissociative focus.

A relevant question, of course, is what is meant by "high enough" with regard to the point at which internal bodily sensations dominate attentional capacity despite efforts to adopt a dissociative focus. The dual mode theory suggests that this critical point may be at ventilatory threshold (VT).[18,19] When an individual exercises below his or her VT, cognitive strategies (such as dissociating) are useful to maintain enjoyment of an activity and help an individual perceive that he or she is feeling better. However, when an individual exercises at an intensity level above VT, the dual-mode theory suggests that cognitive processes are more difficult to maintain, the focus shifts to an internal or associative focus due to bodily cues, and pleasure is reduced.

This is further explained by Hutchinson and Tenenbaum[10] who indicate that the relationship between exercise intensity and music's effect on exertion is due to a shift in attentional focus (dissociative to associative) when an individual progresses from low-to-moderate to high-intensity PA. They suggest that at low-to-moderate intensity, individuals can effectively utilize music as a dissociative strategy to distract their focus from their bodily and internal sensations (exertion, fatigue). However, if individuals begin to engage in high-intensity activity, an individual's focus shifts away from the distracter (music) to a more associative strategy (bodily sensations) and the combined effect of the increased physiological effort and the decreased ability to focus externally are reflected in the observed increases in RPE. The result of this increase in perceived exertion is that individuals may perceive PA as too difficult or uncomfortable and the implication is that they may fail to maintain a habit of regular PA. Thus, understanding specifically how music might be used to facilitate the use of a dissociative focus has implications for perceived exertion and performance.

Research examining the effect of video on PA is less prevalent than research on music effects.[6,7,9,13,20] However, from the studies exploring the effects of video in the absence of music, it has also been shown to reduce RPE during exercise.[7,9,20] A limited number of studies[2,5–7] have also compared the combined effects of music and video to the effects of music or video in isolation based on the premise that the 2 in combination may have a stronger effect on attentional focus and RPE.[2]

Barwood et al.[2] examined the effects of no-treatment, a non-motivational video, and a combination of a motivational video and music on performance of a 30 min run consisting of a 15 min warm-up and a 15 min run at maximal effort (average HR = 179.38 bpm) performed in a warm (~26°C) moist (~50% relative humidity) environment. Results showed that participants ran farther in the music and video condition than in either other condition despite reporting similar levels of RPE. Based on participants running farther without experiencing an increase in RPE, Barwood et al.[2] concluded that combined music and video did have a beneficial effect on perceived exertion during maximal exertion exercise, apparently countering findings of previous literature. However, even if one accepts Barwood et al.'s interpretation of their findings, their study design negates the ability to attribute their findings to the unique effects of music and video in combination. In particular, their independent variable was actually motivational quality (absent, non-motivational, and motivational) rather than comparing combined music and video effects to effects of either in isolation.

In another study designed to explore the combined effects of music and video, Lin and Lu[7] asked participants to exercise "as hard as possible" on a stationary bicycle for 12 min while in no-treatment, music, video, and combined music and video conditions. Results indicated that HR was equivalent across the 4 conditions (range of means = 174–178 bpm). However, RPE were significantly less in all treatment conditions as compared to the control condition, and the amount of work completed was significantly greater in the combined condition than in the control condition. Importantly, this is the first study to demonstrate that the effects of combined music and video differ from those of music or video in isolation when participants exercise at a high-intensity level (average HR = 88% age-predicted maximum HR, JH Lin, personal communication, February 27, 2015). However, there are 2 limitations of this study. First, the researchers did not assess the effects on attentional focus, hence limiting our ability to identify the role of attentional focus in this relationship. Second, because participants were asked to exercise at a particular level of perceived exertion (i.e., "as hard as possible"), the influence of the combined intervention on perceived exertion actually had the potential to influence the exercise intensity itself and this is clearly a threat to the internal validity of the study.

Two studies have tested the effects of music and video in combination on attentional focus and/or RPE at objectively-determined high intensity levels. Jones et al.[6] asked participants to exercise for 10 min at +10%VT (average HR = 150.44 bpm) and −5%VT (average HR = 131.87 bpm) under conditions