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Effects of slow tempo music on perceptions of time and exercise exertion

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Abstract. Exercise has many health benefits. Despite this, motivating people to start exercising is difficult. Maintaining a regular exercise regimen seems even more difficult as dropout-rates within the first 3–6 months commonly reaches 50%. Music during exercise has, however, been found to make it more enjoyable, significantly reducing perceived exertion and positively affecting mood and state motivation. Most research has focused on fast to medium tempo music. Slow tempo music has largely remained unexplored, which is why it is the focus in this study. *Material and Method*. Participants (n=24) were exposed on two occasions in randomized order to slow tempo music versus a silent control condition while performing exercise on a treadmill for 20 minutes at 70% of age predicted maximal heart rate. *Results*. A significant interaction was revealed between ratings of perceived exertion (RPE) and music preference (p<.05). Although there was a small difference between RPE for people who liked the music, people who disliked the music reported significantly higher RPE when listening to the music (M = 13.5, SD = 1.8) compared to when not (M = 11.7, SD = 1.6). No significant difference between estimated exercise-time was observed between the two conditions; competitiveness was also unrelated to the dependent variables. *Discussion*. Our results suggest that avoiding non-enjoyable music is important while exercising as both perceived exertion and exercise adherence otherwise can be negatively affected. It is noteworthy that choosing the "wrong music" may be more detrimental than selecting the "right music" is beneficial.
Key words: *perceived exertion, time perception, exercise, slow tempo music, music preference.*

Introduction

It is relatively easy to persuade people to start exercising; it is much more difficult to convince them to become regular exercisers (1). Making exercise more pleasurable can, however, positively affect exercise frequency and adherence (2-4). Music has been shown to produce positive affective responses, reduce perceived exertion, increase time to exhaustion, and enhance state motivation (5-7). This can at least partly be explained by dissociation, allowing an individual's attention to focus on external stimuli rather than unpleasant proprioceptive sensations (8-9).

Although listening to any music while exercising has the potential to alter a person's ratings of perceived exertion (RPE), the tempo of the music seems to play an important role as evidenced by previous research (e.g., 7, 10-12). Specifically, lowered RPEs were observed when using a music tempo range of 134-153 beats per minute (bpm; 10) and 80-97 bpm (7, 11). Further support for this claim can be observed from participants who exercised on a treadmill while listening to fast tempo music (200 bpm) and slow tempo music (70 bpm) versus no music: RPE was lower when the participants exercised while listening to the slow tempo music (13).

One problem with interpreting previous research is that the tempo of the music has not been consistently applied. For example, one study comparing slow, medium, and fast paced music included a track with a tempo of 106 bpm in the fast-paced music section (12). Music tempo at 106 bpm is defined by the New World Encyclopaedia (14) as being moderately paced (or *moderato*), and is therefore unsuitable to use in a fast tempo music selection. Research aiming to explore particular music and its impact while exercising should therefore take more care when assessing the tempo of the music and categorize it correctly. Furthermore, music preference should always be incorporated; in a study comparing music preferred by participants versus not preferred showed that the former lowered RPE whereas the latter increased it (15).

There is also evidence to suggest that music can alter time perception: participants listening to a self-selected playlist overestimated time, while listening to an unknown playlist resulted in underestimation (16). Similarly, research suggests that time may be judged longer while listening to fast tempo music, while slow tempo music may cause time to be judged as shorter (17). This has the potential to affect exercise adherence. Finally, a significant interaction between competitiveness and exercise effort was observed in older adults cycling on an ergometer with a competitive virtual reality opponent (18). Participants labelled as competitive

Had a significantly higher exercise effort compared to those labelled as non-competitive. Unfortunately, neither RPE nor time-estimations were included among the dependent variables.
Based on the above, we aim to assess participants' RPE and time perception during moderately intense exercise, either performed while listening to slow tempo music (60-67 bpm) or during a non-music control condition. We expect RPE to be lower and time perception underestimated when participants exercise to slow tempo music compared to the no music control. We further predict that people who like the music will underestimate time and report lower RPE, while people who dislike the music will overestimate time and report higher RPE. We also predict that people who are competitive will underestimate time and report lower RPE compared to people who are not competitive.

Material and Method

A total of 24 regular exercisers (16 male, 8 female) volunteered to participate. All completed a pre-exercise screening survey (Exercise Sports Science Australia, Fitness Australia & Sports Medicine Australia; 19) and were subsequently deemed healthy to exercise.
Apparatus and Measures. Music with a tempo between 60-67 bpm fit the criteria for this study. To assess the tempo (bpm) of each music track, Serato DJ, Version 1.9.6 was used. Songs were trimmed using Movie Edit Pro, Version 3.6.3 in a fashion so that a non-stop 20-minute playlist was produced. The music used for the playlist was: Faith No More – 'Easy'; Fat Freddy's Drop – 'Del Fuego'; Neil Young – 'Hey Hey, My My (Into the Black)'; Grinderman – 'Go Tell the Women'; and Frank Ocean –'Super Rich Kids'. A heart rate monitor (Forerunner 920XT, Garmin Ltd, Olathe, USA) was used to measure participants' heart rate during the experiment. A motorized treadmill (TMX428CP Trackmaster, by Full Vision Inc, Newton, USA) set at 0% grade was used for participants to complete exercise. A media link controller (MLC 55 RSVC, Extron Electronics, Anaheim, USA) was used to play music from a laptop computer through a set of speakers (SM 3, Extron Electronics, Anaheim, USA). A decibel metre (PM6708, Peakmeter Instrument Co., Ltd, Shenzhen, China) was used to standardise the music volume across participants to 86-89 decibels. Any clocks or screens displaying the time where removed from the lab or covered up in order for participants to be left blind as to how long the exercise lasted.
RPE was assessed using the 6-20 scale by Borg (20). The verbal anchors on Borg's RPE-scale ranges from 6 "No exertion at all", to 20 "Maximal exertion". This scale has demonstrated adequate intra-test (r=.93) and re-test (r=.83-.94) reliability (20). A laminated A4 copy of the scale was mounted on the wall in front of the treadmill where it could be easily referred to by participants.
Competitiveness was assessed using the Competitive Index scale (CI; 21). The CI is a 20-item scale containing true or false responses. Scores equal or above 14 and 15, respectively, are considered high in competitiveness for women and men. Scores equal or below 6 and 7, respectively, are considered low in competitiveness for women and men. The CI has been found to have high reliability with a coefficient alpha of .90 (21). The CI was completed when both exercise sessions had been completed.
How much participants enjoyed the music was assessed with a single item scale ranging from one to five with "1" indicating that they did not like the music at all and "5" that they very much liked the music. This was completed by the participants after they had finished the music session. Participants who rated the music as a "4" or "5" were considered to have liked the music whereas those who rated the music as "1" or "2" were considered to have disliked the music. Those rating their enjoyment of the music as a "3" were considered to neither like nor dislike the music and were discarded from the music preference between-subject analysis.
Procedure. Participants completed a total of two separate laboratory treadmill running sessions at 70% of age-predicted maximal heart rate (HR-max) in randomized order: one with slow tempo music, one without. Upon being recruited, participants were asked to refrain from consuming caffeine prior to both sessions. After filling out a consent form, they completed a pre-exercise screening assessment and their height and weight were recorded. The formula $(220\text{-Age}) \div 100 \times 70$ was used to determine 70% of HR-max. Before the first session, participants were fitted with a heart rate monitor and familiarized with the RPE-scale and the treadmill. They were reminded that they would be running for a random amount of time, not exceeding 30 minutes. All began running at a speed of 8 km per hour.
During the first five minutes of each session, the researcher adjusted the treadmill speed to achieve 70% of the participants predicted HR-max. RPEs were obtained at the 8-, 12-, 16-, and 20-minute marks. Upon completion of each session, participants were asked to estimate how long they thought they had been

exercising. After completing the music trial, they were asked to rate how much they enjoyed the music using the single item music preference scale. After the second session, participants were asked to complete the CI to assess their competitiveness.

Results

Means and standard deviations for RPE and time perception for both sessions are shown in Table 1. Two one-way repeated measures ANOVA were used to determine whether slow tempo music differed from no music in its effect on RPE and time-perception, respectively. Q-Q plots showed that data from both dependent variables were approximately normally distributed. The first one-way repeated measures ANOVA revealed no significant difference between RPEs while exercising to slow tempo music versus exercising to no music, $F(1,23)=.711$, $p = .408$, $n^2 = .030$. Likewise, the second one-way repeated measures ANOVA failed to detect any significant difference in time perception between the two conditions, $F(1,23) = .004$, $p = .948$, $n^2 = .00$.

Table 1. RPE and estimated time for the music and control condition, respectively (n=24)

	Slow Tempo Music		Control	
	M	*SD*	*M*	*SD*
RPE 8-min	11.8	(1.2)	12.1	(1.6)
RPE 12-min	13.0	(1.8)	13.2	(2.3)
RPE 16-min	13.7	(2.2)	13.8	(2.7)
RPE 20-min	14.4	(2.8)	14.6	(2.9)
Estimated time (min)	*15.9*	*(3.3)*	*15.8*	*(4.7)*

Next, 2 x 2 mixed-model ANOVAs were used to explore any impact of slow tempo music on RPE and time perception while exercising. All assumptions for a 2 x 2 mixed-model ANOVA were met. Both dependent variables met the assumption of homogeneity of variance as assessed by Levine's test ($p > .05$). Box's test of equality of covariance confirmed that homogeneity of covariance existed within the RPE and time perception data ($p > .05$).

No significant interaction between RPE and competitiveness was observed F (1,22) = .005, p=.946, $n^2 = .000$. The means showed that only small differences in RPE existed between those high or low on competitiveness. While exercising to slow tempo music, the ratings of the competitive participants RPE (M = 14.2, SD = 2) were only slightly lower compared to the non-competitive participants (M = 14.5, SD = 2.7). These means stayed about the same while exercising without slow tempo music. Competitive participants RPE (M = 14.5, SD = 2.8) was only slightly lower compared to non- competitive participants (M = 14.8, SD = 2).

Competitive participants did report lower estimates of time. However, no significant interaction between estimated exercise-time and competitiveness was detected $F(1,22)= 1.4$, $p = .25$, $n^2 = .060$. Competitive participants reported lower estimates of exercise-time when exercising to slow tempo music (M = 15.3, SD = 3.3) compared to non-competitive participants (M = 16.4, SD = 3.4). When exercising to no music, competitive participants reported lower estimates of exercise-time (M = 14.0, SD = 3) compared to non-competitive participants (M = 17.4, SD = 5.4).

No interaction between exercise-time estimations and music preference was observed $F(1,17) = 2.103$, $p = .17$, $n^2 = .110$. When participants exercised to no music, those who did not like the music reported lower estimates of exercise-time (M = 14.3, SD = 1.5) compared to those who did like the music (M = 16, SD = 5.3). However, when exercising to music, participants who did not like the music reported higher estimates of exercise-time (M = 17.3, SD = 3.2) compared to participants who did like the music (M = 15, SD = 2.8).

A significant interaction between RPE and music preference was detected, $F(1, 15) = 8.72$, $p = .010$ partial $n^2 = .37$. This interaction was followed up by separate tests for simple main effects. No significances for simple main effects were observed. Further examination of the means indicated that listening to slow tempo music did decrease RPE, but only for participants who liked the music. Participants who disliked the music instead experienced an increase in RPE when exercising to music (M = 13.5, SD = 1.83) compared to when

Exercising without it (M = 11.7, SD = 1.64). Only a small difference between RPE existed for participants who liked the music, although their RPE was slightly lower when exercising to the music (M = 14.4, SD = 0.87) compared to exercising without music (M = 15, SD = 0.78).

Discussion

The aim of this study was to compare slow tempo music with a silent control condition during moderately intense exercise performed on a treadmill. The primary dependent variables were rating of perceived exertion and estimation of exercise-time. We also included music preference and participants' level of competitiveness in the analyses. The results did not, however, support our hypotheses that slow tempo music during exercise would affect RPE and time perception more than a silent control condition. Further, the expected interaction between competitiveness and these variables did not eventuate.

However, as hypothesized, there was a significant interaction between RPE and music preference. Participants who disliked the music reported higher RPE when exercising with the slow tempo music compared to when exercising without it, while participants who liked the music reported lower RPE when exercising to the music compared to when exercising without it. These differences were greater in the dislike-group compared to the like-group. This may suggest that when exercising to music, if the music is not liked it can increase RPE rather than decrease it.

It must be noted though, that mean RPE was slightly lower for all participants in the music condition. A finding similar to Edworthy and Waring (13), who observed that slow tempo music lowered RPE compared to a fast music and control condition while exercising on a treadmill. However, maybe 70% of HR-max was too intense for our group of non-elite exercisers? This suggestion aligns with Karageorghis and Priest's (3) review showing that music seems to have an effect on RPE, but only during low-to-moderate intensity exercise. In fact, RPE was in one study only lower during low intensity cycle ergometer work, and not during moderate intensity work (22). Our use of 70% of HR-max may have triggered physiological cues that took precedence over any moderating effect played by the music; the nearly identical RPEs obtained during the music versus control condition supports such a conclusion—further supported by Rejeski's (23) parallel processing hypothesis highlighting that as intensity increases, so does physiological cues that even at moderate intensities tend to dominate perceived exertion (24).

We predicted that participants scoring high on competitiveness would underestimate time in the music condition and overestimate time in the silent control condition, while those scoring low on competitiveness would overestimate time in the music condition and underestimate time in the control. Although we did not detect any significant interactions, an interesting result emerged. While exercising in the music condition, non-competitive participants reported a lower time-estimate compared to when exercising in the control condition. Competitive participants reported lower time-estimates in both conditions compared to non-competitive participants (18). However, these two groups were affected differently by the slow tempo music. Slow tempo music actually increased estimated exercise-time for competitive participants while it decreased it for non-competitive participants. This is the opposite of our prediction: we believed that slow tempo music would decrease time estimations for competitive participants while increasing it for non-competitive participants.

The observation that slow tempo music resulted in increased time perception may have more to do with music preference than competitiveness, which is consistent with previous research by Nakamura et al. (15) and supports the conclusion that RPE is higher when exercising to music that is not liked. It also shows that this effect crosses over from ergometer cycling to running on a treadmill. This suggests that rather than being a distraction, music that is not liked actually makes people more aware of their perception of exertion, or even emphasizes this perception. Considering that average heart rate responses were similar for each participant between both conditions, it seems reasonable to suggest that music that is not preferred makes exercise less enjoyable.

This negative impact on RPE for people who did not like the music carries over to time perception. When exercising in the control condition, those who disliked the music underestimated time compared to those who liked it. However, those who disliked the music overestimated time compared to those who liked it. This finding is opposite to the results presented by Cassidy and MacDonald (16) and suggests that music that is known or preferred will result in underestimations of time. These results, along with the significant interaction between preference and RPE, illustrate the negative impact of exercising to music that is disliked.

If people exercise to music that they do not like, they can expect to feel more tired and also feel like time is dragging on — this would not be conducive to exercise adherence.

There are several limitations that may have influenced these findings; for example, estimated exercise-time yielded no difference between the two conditions. This could be due to the way in which the playlist was constructed. Five songs were played almost in their entirety with a clear beginning and ending. Because of this, the participants may have been able to estimate how long they exercised for by simply considering how long a song goes for and multiplying this by five. Several participants did comment after the experiment that this was in fact the process they used. To overcome this limitation, future research that is interested in music, exercise, and time perception may consider constructing a playlist that is not made up of entire songs but instead compiled of excerpts varying in lengths and presented in a randomized order.

Conclusively then, people disliking the music that is played during exercise can perceive their exertion to be higher than when listening to music they like. This finding supports previous research by Nakamura et al. (15). Choosing the "right" music for each individual, whether this being a seasoned athlete or beginner can help people to get the most out of their training regime. Gym staff should consider playing music that will meet the general consensus of their client base, or even consider letting the clients choose their own music to exercise to in order to maximize the positive effects provided by regular physical exercise.

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