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An Evaluation of Distraction Control in Experienced Cyclists During a 20 Minute Time-Trial Performance

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Abstract

This study examined mental toughness skills in 23 experienced road cyclists with music being introduced as a distraction. Exercisers who listen to favourable music while training have been found to experience positive physical and psychological effects, such as a decrease in heart rate and the ability to train for longer periods with lower levels of perceived effort [1]. Training with preferred music (PM) is a positive distraction [2,3]; however, training with non-preferred music [NMP] can be a negative distraction, inhibiting maximal performance outcomes [4]. Loehr [4] describes mental toughness as the ability to perform consistently at peak levels. The purposes of this study were to 1) determine the effect of music as a distraction in experienced cyclists' performance during a 20 min cycling effort, and 2) determine whether participants' mental toughness (high vs. low) minimizes or negates the distractor's effect on performance. Randomized interventions included PM, NPM, and no music (NM), with nine performance metrics measured. Participants completed a Physiological Performance Inventory (PPI) and Brunel's Music Rating Inventory (BMRI) to determine levels of mental toughness and confirm music preferences. The large majority of participants revealed low mental toughness scores, performing similarly under all music conditions, with marginal increases in performance outcomes under the PM.

Keywords: Sports Psychology; Cycling; Music; Distraction Control; Mental Toughness

Abbreviations

PM: Preferred Music; NPM: Non-Preferred Music; NM: No Music; PPI: Physiological Performance Inventory; BMRI: Brunel's Music Rating Inventory; HR: Heart Rate; RPE: Rating of Perceived Exertion: SPC: Sport Psychology Consultant.

Introduction

Cyclists who ride while listening to their preferred music (PM) may alter the physiological component of their training session by suppressing fatigue, lowering their heart rate, and reducing the perceived level of exertion [5]. Preferred music may provide performance benefits, thus serving as a positive distraction [4]. Karageorghis C, et al. [5] reported that when listening to PM, ergogenic and psychological benefits are experienced during high-intensity exercise. Distractions can be interpreted positively or negatively, and if the athlete can manage the negative distractions, higher results are likely to be achieved [6], demonstrating that a stimulus can be controlled. Negative distractions can also be brought on by the athlete making a mistake, having a negative mindset, or difficulties staying in the moment [7].

Cyclists with less experience in mental toughness tend to rely more on music as motivation [8]; furthermore, are more likely to allow non-preferred music (NPM) to interfere with achieving optimal performance [8].

Mental toughness is defined by Loehr [9] as the athlete's ability to repeatedly perform near the upper range of their skill and talent despite the competitive circumstances. Additionally, it is one's ability to overcome the physical and mental demands that come along with high levels of competition [9]. A distraction can be defined as a stimulus that is interpreted negatively, interrupting the intended task, thus resulting in a decline in performance [9]. Orlick [10] stated that distraction control can be defined as the athlete's ability to regain or maintain positive attention when faced with adversity, whether its origin is internal or external. Being a mentally tough athlete is not about having "a killer instinct" [9]; instead, the mentally tough athlete can manage and overcome adversity, pressure, or stress and generally cope better than their competitors [10-12]. Developing mental toughness enables athletes to manage internal or external distractions to optimize performance consistently [13].

Training with PM, a positive external distracter, is a method commonly employed by many athletes, as music can alter perceptions of time, effort, and motivation [14]. Preferred music is described as any genre, song, or melody that the individual most enjoys when given an array of other music options [15]. Synchronizing activity with music at a faster tempo allows a mentally tough athlete to trick the body into working at exerting greater effort for longer periods [15].

Conversely, when slower music is administered to those who are less mentally tough, they tend to succumb to the external stimuli by reducing their cadence [16], accompanied by an increase in heart rate (HR), an elevated rate of perceived exertion (RPE), and report higher displeasure in the activity [8]. Additionally, those less skilled perceive the slower cadence as an unpleasant stimulus, which requires an increase in mental effort to achieve their desired ride goal; the outcome is an augmented perception response [13]. Additionally, the exerciser who is less skilled in mental toughness strategies disengages early (psychologically and physiologically), which increases RPE, even though HR remains unchanged [13]. One-way athletes may mitigate the effect of distraction on performance is through the use of mental toughness skills.

Literature has shown that negative distractors during training or competition can be detrimental to the performance of an inexperienced athlete whose mental toughness skills are evaluated as low [12,13]. When using music as the control distracter, performance, HR, and RPE can be increased or decreased, depending on the type of music [17]. The research also states that for individuals to maximize performance, they must be exposed to a similar stressor-purposeful practice [18]. The skilled athlete develops specific and automated routines that require a low level of active awareness [12].

The purposes of this study were to 1) determine the effect of a distractor (i.e., NPM and No Music) on experienced road cyclists' performance (i.e., power, HR, RPE) during a 20 min continuous cycling session, and 2) determine whether participants' mental toughness (low vs. high) minimizes or negates the distractor's effect on performance.

Two hypotheses were given for this research study. First, in cycling athletes, music perceived to be motivating (PM) will have a positive effect on performance in comparison to the NPM and no music (NM) treatments. Second, those with higher mental toughness are anticipated to demonstrate similar performance outcomes (power, HR, RPE) for the PM, NPM, and NM treatments.

Cyclists who successfully achieve personal goals in their sport may be relying on more than just fitness; these athletes practice mental skills [9]. Experienced cyclists who are unable to achieve their cycling goals through physical training alone should consider implementing mental skills into their training regimen; psychological skills training is not just for elite performers [9].

Methods

Due to the specific experience required of these participants, purposeful sampling was used for participation. Inclusion for participation were that the cyclist successfully passed the Physical Activity Readiness and You Questionnaire health survey, are actively training and competing, cycles with music using at least one headphone during training, cycles a minimum of 100 miles a week, and has completed a minimum of one-time trial (requiring at least a continuous 20 min effort) within the past year.

General Demographics

Twenty-three competitive adult road cyclists (males = 13, females = 10) participated in the study. Their categorical age in years ranged from 18-21 (n = 1, 4.3%), 31-35 (n = 7, 30.4%), 36-45 (n = 6, 26.0%), and 46 and older (n = 9, 39.1%). Participants were predominantly Caucasian (n = 16, 69.6%), with four identifying as Hispanic/Latino (1.7%) and three as Asian/Pacific Islander (1.3%). Participants' categorical number of years at competitive road cycling ranged from less than one year to eight years or more. Five participants (21.7%) had three or fewer years of competitive road cycling experience. The remaining participants (n = 18, 78.3%) had four or more years of experience, with nine participants having competed for eight years or more. Nearly half the participants (n = 11, 47.8%) ride four or more days per week, and the remaining participants (n = 12, 52.2%) ride two to three days per week. Additionally, 82% of participants (n = 19) reported riding six to 15 hours per week, 13% (n = 3) ride 16-25 hours per week, and one participant rode less than five hours per week.

As an indicator of competitive, experienced road cycling status, participants had to have completed at least one individual time trial race within the past 12 months prior to participating in this study. A time trial is defined as a race against the clock, where cyclists race for a specified distance, ranging from 10 to 100 miles, and drafting is not permissible – this is an individual event [19]. Eleven (47.8%) cyclists participated in 1-2 events, five (21.75%) have participated in 3-4 events, five (21.75%) of the cyclists have participated in 5-6 events, and two (8.7%) of the cyclists have participated in 7-8 events in the past year. Of the 23 participants' highest placings, nine (39%) placed first, six (26%) placed in the "Top 3" position, three (13%) placed in the "Top 10", while the remaining (22%) participants did not place.

Measures

Institutional Review Board approval for the use of human subjects in research was secured, and participants completed an informed consent form prior to testing. The rights of human participants in research and the University's guidelines for ethics in research were always adhered to. The 7-item Physical Activity Readiness Questionnaire (PAR-Q) assessed the participants' physical health, determining their ability to participate in physical activity [20]. A 22-item demographic survey was created to collect personal and sport-specific information about the participants. Brunel's Music Rating Inventory (BMRI), a 13-question survey, was administered to determine music preferences. The BMRI has a strong, consistent psychometric tool for measuring music during exercise [21]. Brunel's Music Rating Inventory survey asks participants to rate the motivational properties of the PM and NPM treatments on a 10-point Likert scale. Additionally, the BMRI was used to assess the motivational qualities of the PM and NPM playlist treatments, ranging from 1 (Not at all Motivating) to 10 (Extremely Motivating). The Physiological Performance Inventory (PPI) is a reliable 42-question, 5-point Likert scale survey that measures seven psychological and mental toughness factors: self-confidence, negative energy, attention control, visual and imagery control, motivation level, positive energy, and attitude control [4]. The Borg Rating of Perceived Exertion (RPE) is a valid and commonly used criterion-based, 10-point Likert scale survey. Participants self-assessed effort levels with responses from 0 (No Exertion) to 10 (Extremely Strong-Maximal) [22]. The nine cycle performance variables (dependent variables) measured were power, distance, average speed/pace, maximum speed/best pace, average heart rate, maximum heart rate, calories, total pedal strokes (cadence), and RPE.

Each participant completed three trials with PM, NPM, or NM treatments, where they were randomly assigned to one of the interventions. Between trials, cyclists were asked to maintain normal levels of activity, with >72 hours of rest between testing and >5 days between each trial. The trials used each participant's bicycle; the researcher provided a Wahoo stationary trainer. Participants wore a Wahoo heart rate chest strap, warmed up at a self-regulated pace, and then cycled for 20 mins with the music intervention. The participant adjusted the earbuds and volume of music to ensure comfort. Each participant was asked to cycle at a challenging pace (self-determined) for 20 mins to simulate a time-trial effort, then cool down at a self-regulated pace. The BMRI was completed after the PM and NPM testing trial. The Wahoo trainer measured power, distance, cadence, average speed, and speed. The Wahoo heart rate chest strap collected HR data. The RPE assessed participants' effort level after each trial.

Familiarity & Use of Sport Psychology

Twenty-two (95.7%) participants reported that they had not sought counsel with a sport psychology consultant (SPC) before volunteering for this study. One participant reported having had one to two visits with an SPC. However, all 23 participants indicated they believe sport psychology and mental skills would be useful to cyclists. Participants also indicated that they use mental skills before (yes = 14, no = 9), during (yes = 21, no = 2), and after (yes = 5, no = 18) training rides. The majority (n = 17, 73.9%) reported using mental skills during competition.

Mental Toughness Skills Intensity

The PPI survey recorded the participants' mental toughness subscale and composite scores, which were interpreted using the skill level categories developed by Loehr [4] - needs special attention, room for improvement, and excellent (Table 1). Descriptive statistics and frequency of participants' PPI scores per skill level category are given in Table 2.

Subscales	Skill Level	Total/Composite Score
26 – 30	Excellent	181 – 220
20 – 25	Room for Improvement	136 – 180
6 – 19	Needs Special Attention	42 – 135

Table 1: Psychological Performance Inventory Score Interpretation.

			PPI Category					
			Needs Your Special Attention		Room for Improvement		Excellent Skills	
PPI Subscale	M	SD	f	%	f	%	f	%
Self-Confidence	15.24	1.81	22	95.65	1	4.35	0	0
Negative Energy	18.77	2.72	13	56.5	10	43.5	0	0
Attention Control	20.68	3.08	8	34.78	15	65.22	0	0
Visual & Imagery Control	14.82	4.67	19	82.61	3	13.04	1	4.35
Motivational Level	13.32	2.95	22	95.65	1	4.35	0	0
Positive Energy	12.95	2.44	23	100	0	0	0	0
Attitude Control	14.45	1.99	23	100	0	0	0	0
Composite/Total Score	110.76	10.48	23	100	0	0	0	0

Table 2: Participants' PPI Descriptive Statistics and Frequency of Scores Per Skill Level Category.

Results

Demographic Variable Main Effects

Prior to hypothesis testing, the main effect of potentially influential demographic variables underwent separate ANOVA analyses as the independent variable on the nine cycle performance variables (dependent variable). The demographic variables explored for their main effect were age, sex, years cycling, number of days ridden per week, and number of hours ridden per week. Demographic variables found to have a significant main effect on performance variables were entered as covariates in the repeated measure ANOVA hypothesis tests and are described in the description of each specific hypothesis test analysis in this report.

BMRI – Confirmation of Music as Preferred (PM) and Non-Preferred (NPM)

Separate sum scores of the 13-item BMRI for the two types of music playlists, PM and NPM, were categorized using Karageorghis C, et al. [16] interpretation as not at all motivating (10-39), somewhat motivating (40-59), motivating (60-79), or extremely motivating (80-130). As expected, participants indicated the PM playlist was extremely motivating (M = 87.26, SD = 23.22), and the NPM playlist was not at all motivating (M = 27.91, SD = 13.42). Therefore, repeated-measure analysis of variance (R-ANOVA) of performance measures across the three music conditions (PM, NPM, NM) is appropriate.

Hypotheses Analyses

It was hypothesized that, for competitive road cyclists, PM perceived to be motivating would have a positive effect on the nine cycle performance variables (e.g., increased power, distance, and total pedal strokes/cadence) in comparison to their performance under the NPM and NM treatment conditions. Separate R-ANOVA of the nine performance variables (dependent variable) by music treatment condition (PM, NPM, NM) as the independent variable was conducted. Demographic variables (e.g., age, sex, years cycling) that showed a main effect were entered as a covariate in the R-ANOVA for the performance variable and its association was significant. See Table 3 for demographic statistics of cycling performance by music treatment condition, multivariate test results (i.e., Wilks' Λ, p, partial h2), and covariate(s) entered per analysis. The hypothesis was not supported. Instead, with each performance variable's covariate(s) entered in its R-ANOVA analysis, these cyclists performed similarly on all performance metrics between music conditions.

Performance Variable	Music Treatment Condition						Multivariate Tests Results			
	PM		NPM		NM		Wilks' L		Partial	Covariate(s)
	M	SD	M	SD	M	SD	F	p	h2	Entered
Power	214.91	6.73	206.87	63.2	207.04	63.98	0.81		0.75	Sex
Distance	7.28	2.22	6.9	2.33	7.02	2.21	2.45	0.11	0.2	sex
Avg. Speed	21.9	6.68	21.39	5.88	21.49	6.83	2.63	0.1	0.21	sex
Max Speed	32.06	27.09	25.67	9.02	31.98	30.75	3.49	0.05	0.27	sex & # hours riding weekly
Avg. HR	158.91	12.39	153.74	15.18	157.57	13.69	2.17	0.14	0.17	none
Max HR	172.7	10.39	168	14.15	169.87	11.57	0.62	0.55	0.06	age & sex
Calories	286.91	84.32	268.78	94.57	271.09	84.04	0.05	0.96	0.01	age, sex & # years cycling
Tot. Strokes (Cadence)	1881.04	191.82	1773.7	390.63	1821.13	201.81	2.04	0.16	0.16	none
RPE	7.3	1.79	7.37	1.41	7.78	1.42	1.93	0.17	0.16	# years cycling
*Sig p < .05										

Table 3: Demographic Statistics of Cycle Performance Variables by Music Treatment Condition and R-ANOVA Multivariate Test Results with Covariate(s) Entered Per Analysis.

For repeated measures designs, it is customary to compute the amount of improvement from one treatment condition to another by assessing the percent of change. The magnitude of the effect size is expressed as a percentage gained. Table 4 shows the percent of cycle performance gains under the PM treatment condition (M2) compared to the NPM and NM conditions (M1).

Performance Variable	Music Treatment Condition (M)			Percent Improvement	
	PM	NPM	NM	PM (M2) v. NPM (M1)	PM (M2) v. NM (M1)
Power	214.91	206.87	207.04	3.89	3.8
Distance	7.28	6.9	7.02	5.5	3.7
Avg. Speed	21.9	21.39	21.49	2.38	1.91
Max Speed	32.06	25.67	31.98	24.89	0.03
Avg. HR	158.91	153.74	157.57	3.36	0.09
Max HR	172.7	168	169.87	2.78	1.67
Calories	286.91	268.78	271.09	6.75	5.84
Tot. Strokes (Cadence)	1881.04	1773.7	1821.13	6.05	3.29
RPE	7.3	7.37	7.78	0.95	6.17
Percent Improvement = (M2 – M1 / M1) x 100					

Table 4: Percent of Performance Improvement PM-NPM and PM-NM.

It was also hypothesized that competitive road cyclists with high mental toughness (i.e., PPI scores in the excellent skills category) are anticipated to experience similar performance outcomes (e.g., power, distance, etc.) for the music treatment conditions (PM, NPM, NM). Unexpectedly, participants did not achieve a frequency distribution of PPI subscale and composite scores in each mental toughness skills level category (see Table 5). The majority of participants had low mental toughness skills scores that needs [their] special attention, except for Negative Energy and Attention Control subscales where 45.5% and 68.2% of cyclists' scores were within the room for improvement (i.e., moderate level of skill) category, respectively. One cyclist reported excellent skill at visual and imagery control. However, no other cyclists' scores populated in the excellent skill (i.e., high level of skill) category. Therefore, without a group of cyclists with high mental toughness skills, this hypothesis could not be tested. Instead, an exploratory analysis of the relationship of participants' mental toughness skills with their road cycling performances for each treatment condition was conducted (Table 5 for all Pearson Correlations results). The experienced cyclists' self-confidence was significantly correlated with several performance variables under the three music treatment conditions. That is, self-confidence had a moderate correlation with Average HR under the PM condition (r = -.53, p = .01) and RPE under the NPM condition (r = -.49, p = .03), and a moderately high negative correlation with both Average HR (r = -.65, p < .01) and Max HR (r = -.54, p = .01) under the NM condition. Negative energy had a moderate negative relationship with Max Speed (Best Pace) under the NM condition (r = -.43, p =.05). Lastly, also under the PM condition, Total Stroke (Cadence) had a moderately negative relationship with motivational level (r = -.45, p = .04) and positive energy (r = -.47, p = .03).

Treatment Condition & Cycling Performance Variables	**Psychological Performance Inventory (PPI) Subscales**							
Preferred Music (PM)	**SC**	**NE**	**AT**	**VIC**	**ML**	**PE**	**AtC**	**CS**
Power	-0.2	0.35	0.32	0.24	0.09	-0.02	0.13	0.26
Distance	-0.32	0.19	0.29	0.29	-0.05	-0.23	0.07	0.12
Avg Speed (Avg Pace)	-0.29	0.2	0.31	0.28	-0.05	-0.22	0.09	0.14
Max Speed (Best Pace)	-0.25	0.01	0.21	0.11	-0.28	0.09	-0.03	-0.02
Avg HR	-.53*	-0.2	-0.08	-0.07	-0.03	0.08	-0.03	-0.14
Max HR	-0.24	0.02	0.12	0.09	-0.06	-0.11	0.02	0.04
Calories	-0.21	-0.02	0.01	0.1	0.14	0.11	0.4	0.08
Total Strokes (Cadence)	-0.17	0.06	0.04	-0.12	-.45*	-.47*	-0.09	-0.29
RPE	0.06	0.37	0.13	0.16	-0.37	0.16	-0.24	0.13
Non-Preferred Music (NPM)								
Power	-0.2	0.29	0.37	0.34	0.06	-0.2	0.03	0.23
Distance	-0.15	0.06	0.26	0.26	0.04	-0.22	-0.04	0.11
Avg Speed (Avg Pace)	-0.17	0.13	0.32	0.35	0.15	-0.11	0.12	0.26
Max Speed (Best Pace)	-0.16	0.12	0.3	0.28	0.11	-0.16	0.14	0.2
Avg HR	-0.35	-0.09	-0.01	0.16	-0.19	-0.17	-0.27	-0.13
Max HR	-0.32	0.12	0.16	0.1	-0.23	-0.29	-0.21	-0.07
Calories	-0.09	-0.06	0.08	0.05	-0.03	-0.2	0.11	-0.09
Total Strokes (Cadence)	0.03	-0.06	0.09	-0.12	-0.28	-0.34	-0.25	-0.22
RPE	-.49*	0.01	-0.01	0.41	0.04	0.2	-0.07	0.07
No Music (NM)								
Power	-0.26	0.28	0.39	0.3	0.11	-0.13	0.03	0.24
Distance	-0.34	0.25	0.35	0.36	0.03	-0.09	0.19	0.27
Avg Speed (Avg Pace)	-0.34	0.26	0.36	0.37	0.06	-0.04	0.24	0.31
Max Speed (Best Pace)	-0.35	-.43*	-0.42	-0.1	0.1	-0.19	-0.09	-0.41
Avg HR	-.65**	-0.17	0	0.06	-0.17	-0.08	-0.18	-0.18
Max HR	-.54*	-0.04	0.13	-0.01	-0.18	-0.16	-0.05	-0.13
Calories	-0.26	-0.06	0.06	0.1	0.1	-0.06	0.28	0.01
Total Strokes (Cadence)	-0.31	0.3	0.3	0.12	-0.31	-0.23	-0.18	0.01
RPE	-0.27	-0.01	0.06	-0.06	-0.02	0.02	-0.38	-0.13

Table 5: Pearson Correlations (r) of Cyclist Performance Variables with PPI Subscale and Composite Scores per Music Treatment Condition.

*Sig. (2-tailed) p ≤ .05; ** p < .01

Legend: SC - Self-Confidence, NE - Negative Energy, AC - Attention Control, VIC - Visual & Imagery Control, ML - Motivational Level, PE - Positive Energy, AtC - Attitude Control, CS - Composite (Total) Score.

Discussion

It was hypothesized that music perceived to be motivating (PM) would have a positive effect on performance in comparison to the NPM and NM treatments. Analyzing the covariates (e.g. age, sex, years cycling) found that this hypothesis was not supported. It was also hypothesized that cyclists with higher mental toughness (i.e., PPI scores) would exhibit similar performance outcomes in both the PM and NPM conditions, as well as in the NM treatments. However, this group of cyclists performed similarly on all performance measures; the null hypothesis was not rejected, with no significant differences between treatments were found.

Participant PPI scores revealed low mental toughness, with scores ranging from 6 to 25 in all areas. Analyzing the PPI scores revealed no differences in mental toughness and performance; cyclists relied on physical training for their performance, and lacked the psychological component required to achieve competitive peak performance. Participants showed high performance metrics in all areas except when measuring their BMRI; they worked harder under the PM conditions than under NPM and NM variables. Participants are able to maintain focus during training and achieve strong performance outcomes; however, in competition, these metrics may not translate, such as in attitude control and attention. While in training, athletes can pause a negative situation and reset, whereas in competition, this is not an option. The literature has shown that athletes who are stronger in mental skills experience positive, consistent, and improved performance outcomes [12]; however, the participants in this study do not demonstrate consistency within treatments, specifically with the NPM and NM variables.

Furthermore, it was found that the music did not have a significant impact on the psychological or physiological variables, as some literature suggests [23]. This group of cyclists achieved nearly consistent levels of physical performance for each music condition. However, although not statistically robust, real-world implications include an increase in power and distance, as well as a decrease in RPE, under the PM performance (Table 4). When riding longer distances or climbing hills +/- 8 watts of power, along with a lower perceived exertion level, offers a substantial performance benefit [24].

Future directions for continued research include exploring mental toughness skills in other cycling disciplines, such as gravel, cyclo-cross, and mountain biking, as there is limited data available on mental toughness and performance outcomes in these athletes. Finally, and leading to further research, limitations include that the current study relied on the RPE scale to seek the cyclists' perspectives on their effort levels with each intervention. Measuring oxygen consumption, in addition to RPE, would provide valuable insight into the cyclist's physiological experience.

Implications

Ninety-six percent of the participants reported no prior experience with an SPC, instead seeking mental skills advice from books, friends, blogs, or their coach; most of which do not address the specific and comprehensive needs of the individual athlete. Notably, 100% of the participants believed that mental skills are beneficial and implemented skills to the best of their knowledge and ability pre, during, and post training and in competition. However, the participants stated they did not know how to find a sports psychologist, nor did they believe they could afford the consultation fees.

Cycling athletes who compete at the highest professional level have access to mental skills experts. Conversely, cyclists who compete at high levels of amateur status and desire mental skills support lack the resources. Speaking with anonymity to protect the affiliated practicing organization (APA Ethics Code Standard 4.07), an expert in the field of sports psychology as a Certified Mental Performance Consultant (CMPC), the consultant offered the following regarding the availability of services and fees:

I am not aware of a single comprehensive list of sports psychologists, as each consultant has different pricing, style of support, and location. However, the United States Olympic & Paralympic Committee provides a list of well-vetted and highly qualified CMPCs that can be found by the state or the type of training they offer. Oftentimes, the athlete will come in seeking support in one area, and frequently it will blend into other areas and deepen; insurance will cover the costs of consultation services when there is a mental health diagnosis.

For future exploration, it would be to increase the ease of accessibility of SPC resources to non-professional athletes. The participants in this study would benefit from working with an SPC to increase their use of mental skills, rather than relying on fitness, for optimal and consistent performance. The crucial piece to achieving competitive peak performance in this group of cyclists is to increase mental toughness.

The results of this study have the potential to serve as an educational tool for athletes and coaches, as well as a basis for further research into the physical and psychological effects on exercisers who train while listening to PM.

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