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MOTIVATIONAL MUSIC AND REPEATED SPRINT ABILITY IN JUNIOR BASKETBALL PLAYERS

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ABSTRACT

We examined the effect of motivational music on repeated sprint ability (RSA) in a full squad of junior top national level league basketball players. Participants performed two repeated sprint tests (RSTs), with and without motivational music, at random order, during the end of the basketball season. The RST included 12 X 20 m runs departing every 20 s. There were no significant differences in ideal sprint time, total sprint time and performance decrement between RST with or without music. However, when we compared each sprint during the RST, the last two sprints (sprints number 11 and 12) were significantly faster with, compared to without, music ($p<0.01$). We conclude that music led to improved sprint performance towards the end of RST, suggesting, probably, beneficial effect mainly on aerobic components of repeated sprint ability. Therefore, music can be used during basketball training, hoping that improved training ability will convert also to better game performance.

Keywords: *aerobic, anaerobic, fitness, motivational music, repeated sprint test*

INTRODUCTION

Music is used frequently by athletes to increase motivation and improve aerobic and anaerobic performance [21]. However, while athletes report favourable subjective effects of music during training or competition (e.g. general feeling, mood, etc.), research has not always supported this notion [31]. It was suggested that the timing and type of music, the type of exercise, and the fitness level of the athlete, may all affect performance response to music [2, 26].

In recent years, the question what is the optimal music for use in sports has gained scientific interest. The term "motivational music" was defined as music that stimulates or inspires physical activity [20]. It is suggested that four factors, in hierarchical order, contribute to the psycho-physical motivational qualities of music: the natural reaction to the rhythm and tempo, the musicality (melody and harmony), the suitability of music to the socio-cultural background of the athlete, and the extra-musical associations triggered by music [31].

The majority of previous studies examined the effects of music on submaximal aerobic performance [8, 10, 18, 24, 25, 28, 29], and most of them reported positive effects on motivation, mood state and rate of perceive exertion (RPE) [8, 18, 25, 28]. The very few studies that examined the effect of music on supra-maximal anaerobic exercise yielded conflicting results [9, 26]. In recent years, the use of repeated sprint tests (RST) has gained popularity among coaches and athletes as a method of evaluating repeated sprint ability (RSA), that is used frequently in multi-sprint sports like soccer, basketball, and hockey [e.g., 1, 3, 23].

Thus, the aim of the present study was to evaluate the effect of motivational music on RSA in a group of junior top national league basketball players. We hypothesized that listening to motivational music during the RST will improve repeated sprint performance.

MATERIALS AND METHODS

Subjects

Twelve male late adolescent basketball players participated in the study. Anthropometric and aerobic characteristics of the participants are summarized in Table 1. Pubertal status was assessed by Tanner stage for pubic hair, and all the players were late pubertal (Tanner stage 4–5). Players were a full squad of a basketball team from the first division Israeli youth league. The players trained five days every week and competed once a week. The study was performed about a month before the end of the basketball season, when the players were assumed to be in top physical shape. Most training sessions at this time of the year were devoted to specific tactic drills and game skills with the use of balls. No resistance or aerobic training sessions were given at that time of the season. The study was approved by the institutional ethical committee. The testing procedure, but not the hypothesis of the study, were explained to the players, and a written informed consent was obtained from the players and their parents.

Table 1. Anthropometric and fitness characteristics of the study participants

	Mean ± SD
Age (years)	16±0.5
Height (cm)	185.9±0.9
Weight (kg)	75.5±6.1
Body fat (%)	10.6±1.9
VO_2 max (ml/kg/min)	50.3±4.4

Measures

Overall, the participants performed two RST's (with and without music) separated from each other by 4–5 days, at random order. Both tests were performed in the afternoon, three hours after lunch. The participants were instructed to drink 500 cc of water 30 min before each testing session. None of the participants were taking any food supplements. Each test was performed on a basketball court, using standard basketball shoes, to replicate game conditions. In order to prevent unnecessary fatigue accumulation, players and coaches were instructed to avoid intense exercise the day before each testing.

Repeated sprint tests

The RST protocol included a 12×20 m maximal run starting every 20 s. This protocol was chosen since its sprint length and rest duration mimic the typical movement pattern of players during a basketball game. Each participant performed a 20 m maximal sprint the day before the RSTs. The time of this sprint was used as a criterion score for the upcoming RSTs. In the first sprint of each RST, participants were required to achieve at least 95% of their criterion score. If 95% of the criterion score was not achieved, the participant was required to restart the RST. Accordingly, the participants were instructed by the coaches and the investigators to produce maximal effort during each sprint and to avoid pacing themselves. All subjects met the required criterion (95% of maximal speed in the first sprint) and no one had to restart the test again.

During each RST, a photoelectric cell timing system (Alge-Timing Electronic, Vienna, Austria) with an accuracy of 0.001 s linked to a digital chronoscope was used to record each sprint and rest interval time. Two sets of timing gates were used, working in opposite directions, to allow subjects to start the next run from the end point of the preceding sprint, thus eliminating the need to hurry back to a common starting point. A standing start, with the front foot placed 30 cm behind the timing lights, was used for all sprints. Timing was initiated when the subject broke the light beam. An experimenter was placed at each end of the track to provide verbal encouragement to each subject at each sprint.

Measurements

The three measures for each RST were the 20 m fastest ("ideal") sprint time (IS), the total accumulated sprinting time (TS) of the 12 sprints, and the performance decrement (PD) during each test. TS was calculated by the summation of all sprints times of each test. PD was used as an indication of fatigue and was calculated as [(TS/IS) X 100] – 100 [15]. The ideal possible total score was calculated as the best 20 m sprint time multiplied by 12. The test-retest reliability of the RST is 0.94 for total running time and 0.75 for the PD [15].

Heart rate was measured using a Polar heart rate monitor (Polar Accurex Plus, Polar Electro, Woodbury, NY) just before the beginning and immediately upon the completion of each run in each RST. RPE was determined using the modified Borg scale [5] just before the beginning and immediately upon completion of each RST.

Music selection

The music selection for the present study was based on the hierarchical four factor conceptual model [11, 19, 20], indicating that strong rhythm and fast tempo (>120 BPM), followed by the musicality, the suitability of music to the athlete's socio-cultural background, and lastly, the extra-musical associations triggered by music, contribute to the music psycho-physical motivational qualities. We selected a Western CD collection of greatest hits of all times converted to dance style with a rhythm of 32 and tempo of 140 BPM. Four tracks (numbers 3, 5, 8 &13) with accumulated time of 15 min were selected ("Freed from Desire"– Gala, 1996, "Time after Time"– Cyndi Lauper, 1984, "California Dreaming" – The Mamas and the Papas, 1965, and "Heaven" – Bryan Adams, 1983). Music was played by a stereo CD player (Sony CFD-V7). The music volume was equal to 70 decibels. Since Western music is very popular in our country, this CD is used frequently in health clubs, schools and sports colleges for aerobic training, and thus also fulfills the criteria of the music's suitability to socio-cultural background and strong association to sport. We have previously demonstrated that listening to selected tracks from this CD (ranked by the participants as a device to increase activity) during warm-up improved peak anaerobic power in elite adolescent volleyball players [13].

Statistical analysis

Paired t-test was used to determine differences in ideal sprint time, total sprint time, performance decrement, heart rate and RPE, between RST with and without music. ANOVA for repeated measurements was used to determine differences in each sprint result between RST with and without music. Data are presented as mean±SD. Significance level was set at $p<0.05$.

RESULTS

There was no significant difference in end RST heart rate between RST with (179.9±8.5 beats/min) and without music (181.4±6.3 beats/min). However, mean heart rate during the RST with music (179.4±3.9 beats/min) was significantly greater than mean heart rate during the RST without music (176.7±5.7 beats/min, $p<0.01$). There were no significant differences in end RST RPE with (7.1±0.7) and without music (7.0±1.0).

The effect of music on RST performance indices is shown in Figure 1. There were no significant differences in ideal sprint time, total sprint time and performance decrement between RST with or without music. However, when we compared each sprint during the RST, the last two sprints (sprints number 11 and 12) were significantly faster during the RST with, compared to without, music ($p<0.01$, Figure 2).

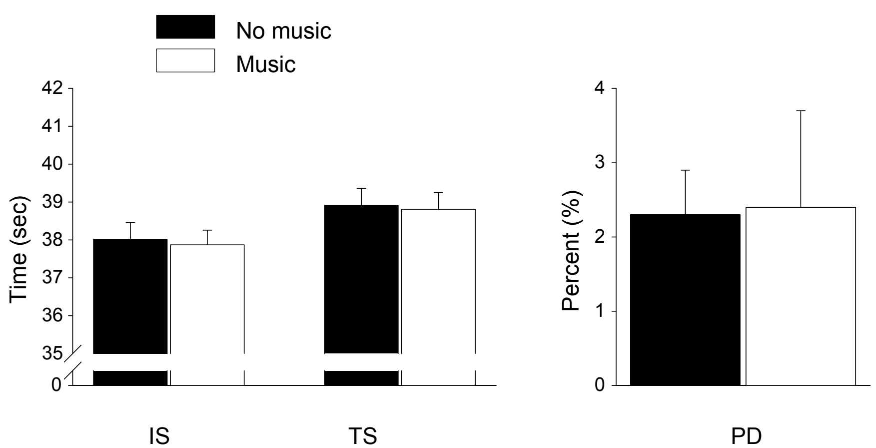

Figure 1. Effect of music on RST performance indices

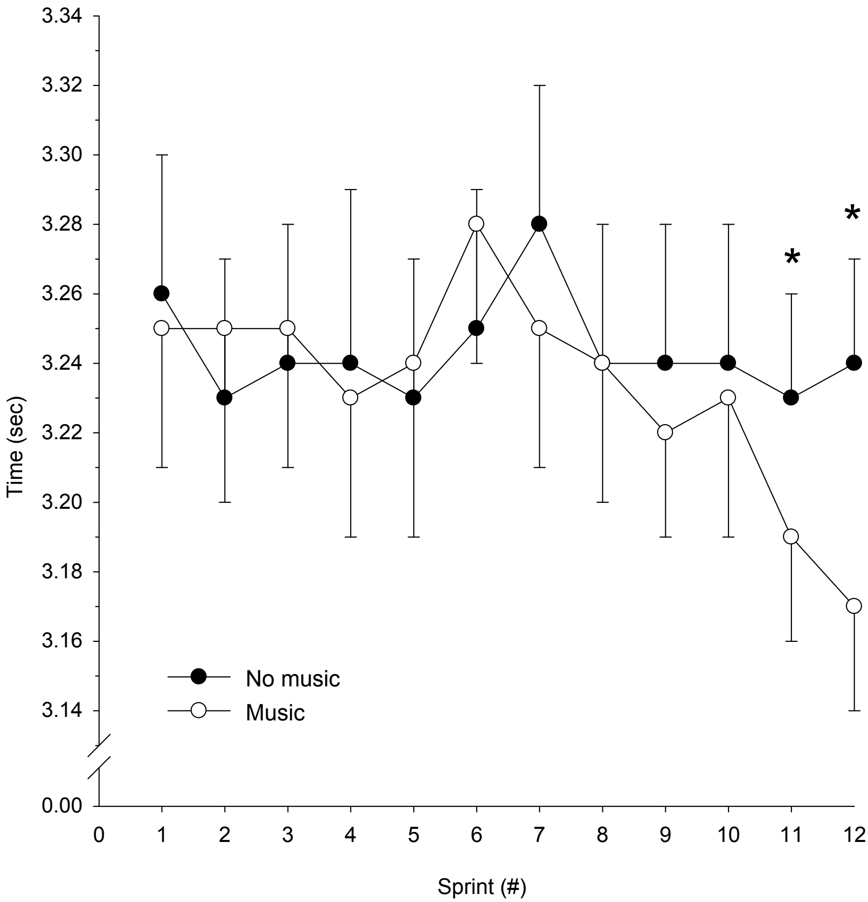

Figure 2. Effect of music on the results of each sprint during the repeated sprint test

DISCUSSION

We examined the effect of music on RSA in top national level junior basketball players. The main findings of the study were that while there was no effect of music on ideal sprint time, total sprint time and performance decrements, the last two of the 12 sprints in the RST were significantly faster during the RST with music, suggesting beneficial effect of music in high intensity intermittent exercise.

Selection of music type plays an important role in determining its effect on exercise capacity. It is generally accepted that music selection aims to optimize an individual's goal. When an athlete needs to be motivated or to remain aroused during intensive power and/or endurance exercise tasks, fast and motivational music should be selected. Usage of the same music can be detrimental for exercise that requires concentration and high level of coordination [14]. Since the aim of the present study was to test the effect of music on RSA, we selected motivational music (rhythmic with fast tempo). We hypothesized that the natural response to rhythm and tempo, and possible music-related dissociation from unpleasant feelings like pain and fatigue [31], would improve performance indices of the RST. However, in the present study music had beneficial effect only on the speed of the last two of the 12 sprints test.

As stated earlier, the majority of studies that demonstrated beneficial effects of music on exercise performance focused on sub-maximal aerobic exercise [e.g. 10, 26]. It was shown previously that the stores of phosphocreatine (PCr) are essential for the reconstitution of short-term power output during repeated exercise [4]. This is particularly relevant in RST protocols that include a high number of repetitions and a short recovery time. Indeed, PCr re-synthesis is controlled by the rate of oxidative metabolism within the muscle [30], and several previous studies have found moderate correlations between VO_2 max and performance indices of RSTs [12, 16, 22]. In the present study, music-related improvement in sprint performance was found only in the last two sprints, and not in the first sprints of the RST. Thus, one could argue that this finding emphasizes the beneficial effect of music on the more aerobic parts of the RST, and the lack of effect on the more anaerobic component of the test.

The significant beneficial effect of music on the speed in the last two sprints of the RST should not be underestimated. In competitive sports, even a small difference may distinguish between success and failure. For example, Cometti et al. [7] showed that French professional and amateur soccer players had similar 30-m sprint performance, but the professionals had significantly lower 10-m lap times. The reported 10-m sprinting times ranged from 1.79 to 1.90 s [27]. This means that faster players are on average about 1-m ahead of slower players after a sprint of only 10-m. This difference can influence the results of a game, especially at final stages when fatigue increases among the players and intensity tend to decrease. The same applies for a possible faster sprint performance of basketball players during time of fatigue in later parts of the game (e.g. fast break execution or prevention, ball stealing, etc.). However, since the present study examined effect of music *during* the exercise task on performance, the interpretation of the results is applicable only for basketball training and not to performance in a real game, when listening to music is not permitted. Hopefully, improved training performance will be converted to game performance as well.

Finally, previous reports have demonstrated that music effects are inversely related to the participant's fitness level, and that music had significantly greater enhancing effects in untrained participants, during initial stages of training programs [6, 17]. In the present study, the players were tested towards the end of the basketball season when they are assumed to be in top physical shape. It is possible that if the study was performed during earlier stages of the basketball season, when the players are less fit, music effects would have been more beneficial.

In summary, music led to improved sprint performance towards the end of RST, suggesting, probably, beneficial effect mainly on aerobic components of repeated sprint ability. Therefore, music can be used during basketball training, hoping that improved training level will translate also to better game performance. Additional studies are needed to examine the optimal selection and use of music and its role in enhancing athletic performance in young competitive athletes.

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