Journal of Human Kinetics volume 104/2026, 279–291 DOI: 10.5114/jhk/210194
Section IV – Psychological and Sociological Aspects of Sport and Exercise

Effects of Listening to Preferred Music and Prior Knowledge of the Exercise Endpoint on Physical and Psychophysiological Responses during the Specific Intermittent Anaerobic Speed Test in Male Kickboxers

by
Nidhal Jebabli [1,2], Manar Boujabli [1,3], Safaa M. Elkholi [4,], Nejmeddine Ouerghi [1,5,6], Mouna Maraghni [7], Halil İbrahim Ceylan [8], Anissa Bouassida [1], Abderraouf Ben Abderrahman [9], Wissem Dhahbi [1,10]*

This study investigated the effects of listening to preferred music and whether prior knowledge of the exercise endpoint would improve physical and psychophysiological responses during a specific intermittent anaerobic speed test in male kickboxers. In a randomized repeated measures crossover design, twenty-four male kickboxers performed the intermittent kickboxing anaerobic speed test (IKAST) under six conditions: (1) with no knowledge of the exercise endpoint (UNK), (2) being misled about the number of repetitions to be performed (DEC), (3) with knowledge of the number of repetitions to be performed (CON), (4) listening to preferred music during the IKAST performance without the exercise endpoint knowledge (M-UNK), (5) listening to preferred music being deceived about the number of repetitions to be completed (M-DEC), and (6) listening to preferred music with the IKAST endpoint knowledge (M-CON). Performance measures included physical indices, the heart rate, the rating of perceived exertion (RPE), and the feeling scale (FS). The results showed significant improvement in physical performance by decreased physical indices and the RPE, under M-CON and M-UNK compared to CON and UNK conditions. Also, the FS score increased significantly under the M-UNK compared to M-DEC condition, as well as under the UNK compared to the CON condition. Listening to preferred music during kickboxing, considering prior knowledge of the exercise endpoint, can contribute to optimizing performance and psychological outcomes.

***Keywords**: fast tempo music; tele-anticipation; deception; physical performance; combat sport*

Introduction

Combat sports such as kickboxing require athletes to perform high-intensity intermittent efforts while maintaining technical proficiency throughout competitions (Barley et al., 2019). Optimizing performance in these sports involves both physiological and psychological factors that

[1] *Research Unit: Sport Sciences, Health and Movement, High Institute of Sport and Physical Education of Kef, University of Jendouba, Kef, Tunisia.*
[2] *European Institute for Talents, Education, Research & Development, Split, Croatia.*
[3] *Perf-Up Rehabilitation Center, Doha, Qatar.*
[4] *Department of Rehabilitation Sciences, College of Health and Rehabilitation Sciences, Princess Nourah bint Abdulrahman University, Saudi Arabia.*
[5] *Faculty of Medicine of Tunis, Rabta Hospital, University of Tunis El Manar, Tunis, Tunisia.*
[6] *High Institute of Sport and Physical Education of Gafsa, University of Gafsa, Gafsa, Tunisia.*
[7] *Mental Health Service, Hamad Medical Corporation, Doha, Qatar.*
[8] *Physical Education and Sports Teaching Department, Faculty of Sports Sciences, Ataturk University, Erzurum, Turkey.*
[9] *Higher Institute of Sport and Physical Education of Ksar-Said, University of Manouba, Manouba, Tunisia.*
[10] *Qatar Police Academy, Police College, Training Department, Doha, Qatar.*
* Correspondence: smelkholi@pnu.edu.sa

can influence an athlete's ability to execute techniques effectively under fatigue (Slimani et al., 2017). Music has emerged as a potentially valuable ergogenic aid in various sports, including combat sports (Boujabli et al., 2024; Jebabli et al., 2025; Ouergui et al., 2023), tennis (Jarraya and Jarraya, 2019), swimming (Karageorghis et al., 2013), and team sports (Bigliassi et al., 2018). Recent evidence demonstrates that listening to music can enhance both psychophysiological states and physical performance outcomes (Ballmann, 2021). Indeed, the ergogenic effect of listening to music includes increased neuronal activity (Bigliassi et al., 2017; Kania et al., 2024), muscular efficiency (Centala et al., 2020; Jebabli et al., 2022), delayed perception of neuronal fatigue (Diehl et al., 2023), improved motivation (Maidhof et al., 2023), reduced perceived effort (Terry et al., 2020), and improved affective responses (Terry et al., 2020) during exercise. These benefits appear to be mediated through various mechanisms, including altered attention (Patania et al., 2020) and modulation of the central nervous system response to exercise (Ballmann, 2021).

The theory of parallel processing/dissociation proposed by Rejeski (1985) provides a framework for understanding how music may influence exercise performance. This theory suggests that external factors such as music can compete with internal physiological feedback for attention processing, potentially altering how effort and fatigue are perceived (Chow and Etnier, 2017). Recent neurophysiological studies have documented that music can modify activation patterns in brain regions associated with movement control and emotional processing (Karageorghis and Priest, 2012; Zaatar et al., 2024).

Additionally, knowledge of the exercise endpoint has emerged as another important factor influencing pacing and performance. According to the theory of tele-anticipation (Ulmer, 1996), athletes regulate their effort based on the anticipated exercise duration (Tucker, 2009). When endpoint knowledge is manipulated, it can significantly impact both psychophysiological responses and physical performance (Highton et al., 2017). This has been demonstrated in various endurance activities, where deception regarding exercise duration altered pacing strategies and performance outcomes (Highton et al., 2017; Tucker, 2009).

Research examining the effects of music in combat sports remains limited, particularly regarding high-intensity intermittent efforts characteristic of kickboxing (Boujabli et al., 2024; Vasconcelos et al., 2020). Furthermore, while both music and endpoint knowledge have been studied separately, their potential interactive effects on performance have not been systematically investigated (Vasconcelos et al., 2020). Understanding how these factors might work independently and in combination could provide valuable insights for optimizing both training and competition performance (Boujabli et al., 2024; Vasconcelos et al., 2020).

Recent investigations suggest that preferred music may be particularly effective for enhancing performance compared to researcher-selected music, potentially due to increased emotional connection and motivational qualities (R. M. Maidhof et al., 2023). However, the efficacy of preferred music may vary depending on exercise intensity and duration. High-intensity intermittent exercise presents unique challenges, as the severe physiological strain may potentially override music's psychological benefits (Ballmann, 2021).

The role of endpoint knowledge in regulating effort during high-intensity exercise remains debated. While some studies suggest that misleading athletes about exercise duration can lead to improved performance, others indicate that accurate duration knowledge allows for optimal pacing (Wingfield et al., 2018). These divergent findings may relate to the exercise mode and intensity, warranting investigation in sport-specific contexts like kickboxing (Smits et al., 2014).

Therefore, the present study aimed to examine the independent and combined effects of preferred music and endpoint knowledge manipulation on performance and psychophysiological responses during an intermittent kickboxing anaerobic speed test (IKAST) in kickboxers (Jebabli et al., 2025). This investigation addresses important gaps in understanding how these psychological interventions interact to improve both performance and cognitive ability in kickboxers during high-intensity exercise. Based on previous findings (Billaut, 2011; Jebabli et al., 2023, 2025), we hypothesized that listening to preferred music and prior knowledge of the number of repetitions

could independently improve physical performance compared to the no-music condition or other types of prior endpoint knowledge.

Methods

Participants

A power analysis conducted using G*Power 3.1.9.7 software (University of Kiel, Kiel, Germany) was based on statistical power of 0.80, a significance level of 0.05, and an effect size of 0.25 according to a related study using a similar kickboxing test (Jebabli et al., 2025). The analysis indicated that 24 kickboxers were needed to achieve 80% power.

Twenty-four amateur male kickboxers (age: 19 ± 1.44 years; body mass: 64.15 ± 9.46 kg; body height = 1.74 ± 0.08 m; body mass index [BMI]: 21.46 ± 2.17 kg/m^2; training experience: 4.27 ± 0.92 years) voluntarily participated in this study via direct invitation. All participants were recruited from the same local training club.

Kickboxers were recruited by convenience sampling according to the following inclusion criteria: a) at least 4 years of kickboxing training experience; b) free from injury or medical restrictions in the six months prior to the study.

Prior to participation, all kickboxers completed a medical history questionnaire and provided written informed consent including information about the experimental protocol.

The study protocol was approved by the local institutional ethics committee of the Higher Institute of Sport and Physical Education of Kef, University of Jendouba, Kef, Tunisia (approval code: ISSEP-0027/2024; approval date: 29 December 2024) and was conducted following the Declaration of Helsinki on research on human participants. The kickboxers' flowchart is presented in Figure 1.

Measures

Music Characteristics

Each kickboxer was asked to select their preferred music to listen to during the warm-up before the IKAST. Using the "Edjing Mix" app (version 6.45.00, Android, MWM, Boulogne-Billancourt, France), the average tempo of the preferred songs chosen by participants was characterized by a fast rhythm (mean ± SD: 145 ± 15 bpm). All preferred tracks were played during 15 min of the warm-up using the same wireless earbuds (AirPods Pro, Apple Inc., USA) and the same volume (moderate volume, 80 dB) for all kickboxers.

During no music condition, the same wireless player was worn but no music was played. Additionally, during the experimental sessions, no verbal feedback or verbal encouragement was given to participants by investigators.

Intermittent Kickboxing Anaerobic Speed Test

The intermittent kickboxing anaerobic speed test (IKAST) consisted of five repetitions of a four-technique combination: (1) a right-left punch, (2) a right roundhouse kick, (3) a right-right punch, and (4) a left roundhouse kick (Figure 2). This sequence was performed in five sets with a 10-s rest interval between sets (Gençoğlu et al., 2023). Three physical indices were recorded: (1) total time (TT) of sequences performed, representing the sum of the duration of each repetition across all five sets; (2) best time (BT), i.e., fastest time of the sequence performed presented as the best repetition; (3) a fatigue index, calculated as the relative decrease in power using the following formula:

$$\text{Fatigue index (\%)} = [1 - (\text{peak time} \times 5 / \text{total stroke duration in all sets})] \times 100$$

All physical indices during the IKAST were analyzed from video recordings using Kinovea software (version 0.9.5) and a GoPro4 camera (NASDAQ: GPRO, US) with resolution of 1080 p (1920 × 1080, 16:9) and 48 frames per second (FPS).

The intraclass correlation coefficients (ICCs) and coefficients of variation (CV%) demonstrated high reliability for total time (ICC = 0.92; 95%CI = 0.88–0.95; CV = 2.3%), best time (ICC = 0.89; 95%CI = 0.85–0.93; CV = 3.1%), and the fatigue index (ICC = 0.87; 95%CI = 0.82–0.91; CV = 3.8%).

Heart Rate

Heart rate responses (peak heart rate [HR_{peak}] and mean heart rate [HR_{mean}]) were recorded continuously during the IKAST using a Polar Team 2 heart rate monitor (Polar Electro Oy, Finland).

Articles published in the Journal of Human Kinetics are licensed under an open access Creative Commons CC BY 4.0 license.

Rating of Perceived Exertion

Immediately following the test, kickboxers rated their overall physical exertion using the rating of perceived exertion (RPE) scale (CR-10) (Dhahbi et al., 2024). This is a scale from "0" to "10" with associated verbal expressions, which progressively increases with the intensity of the exercise (0 = nothing at all; 1 = very light; 2 = light; 3 = moderate; 4 = somewhat hard; 5–6 = hard; 7–9 = very hard; and 10 = maximal).

Feeling Scale

The 11-item Feeling Scale (FS) (Hardy & Rejeski, 1989) was administered to assess the current mood after the IKAST with scores ranging from −5 (very bad), 0 (neutral) to +5 (very good).

Design and Procedures

This study employed a randomized, crossover trial design to investigate the effects of preferred music and prior knowledge of the exercise endpoint on physical performance and psychophysiological responses in kickboxers.

First, kickboxers performed two familiarization sessions for the IKAST under standardized conditions similar to those of the experimental sessions over one week before the beginning of the study, to minimize learning effects. During these sessions, kickboxers were informed in detail about the IKAST procedure, the rating of perceived exertion (RPE) scale and the feeling scale (FS). In addition, anthropometric measurements were performed for the participants.

During experimental sessions, kickboxers performed the IKAST in random order, with standardized instructions specific to each session. During the session under no knowledge of the exercise endpoint (UNK) condition, the kickboxer was required to perform the IKAST without knowing the number of repetitions to be performed, but stopped after five repetitions were completed. During the session when athletes had knowledge of the number of repetitions to be performed (CON), the exact number of repetitions of the IKAST to be performed (five) was indicated before the test commenced. In sessions when athletes were misled about the number of repetitions to be performed (DEC), the kickboxer was informed before the test that they would perform three repetitions of the IKAST, but once these three repetitions were completed, they were unexpectedly instructed to complete two additional repetitions. All these sessions were repeated with listening to music during the warm-up (M-UNK: listening to preferred music during exercise without the IKAST endpoint knowledge; M-DEC: listening to preferred music being deceived about the number of repetitions to be completed; M-CON: listening to preferred music with the IKAST endpoint knowledge), with a total of six sessions. Each testing session was followed by 48-h recovery. A six-day washout period separated the first three sessions. All sessions were conducted at the same time of the day (afternoon, 3–4 PM) under controlled environmental conditions (temperature 20–22°C, relative humidity < 40%) in the same gym. Kickboxers were instructed to abstain from strenuous exercise and maintain a regular food diary devoid of ergogenic products (e.g., caffeine, vitamins) and alcohol for 48 h preceding each session. Randomization of experimental sessions was conducted using a free online tool by an independent investigator (https://www.randomizer.org). Prior to each testing session, kickboxers completed a 15-min general and specific warm-up consisting of running, stretching, low-intensity kicking, and punching. Both kickboxers and investigators remained blinded to the participants' data throughout the experimental protocol.

Statistical Analysis

All statistical analyses were performed using SPSS 28 statistical software (SPSS Inc., Chicago, IL). Data are presented as means ± standard deviations (SDs). Normality and homogeneity of variance were assessed using the Shapiro-Wilk test, and all variables were found to be normally distributed. The reliability of all tests was evaluated using the ICC with 95% confidence intervals (95% CI) and the CV (Čular et al., 2021). Repeated-measures one-way ANOVA was used to analyze the effects of the experimental conditions on IKAST indices, the area under the curve, HR_{mean}, HR_{peak}, RPE, and FS scores. The area under the curve (AUC) was calculated using the definite integral of the function f(x) over the interval [a,b], expressed mathematically as A = ∫abf(x). dx. When significant differences were detected, pairwise comparisons were conducted using the LSD post-hoc test. Effect sizes were calculated using partial eta-squared (η^2_p) and Cohen's *d*, with the following

interpretation: trivial (<0.2), small (0.2–0.5), moderate (0.5–0.8), and large (≥0.8) (Lakens, 2013). Additionally, 95% confidence intervals (95% CIs) were calculated for the differences between conditions. The level of statistical significance was set at $p < 0.05$.

Results

Physical Performance

A significant main effect of music was observed for TT and BT (TT: $p < 0.001$, $\eta_p^2 = 0.90$; BT: $p < 0.001$, $\eta_p^2 = 0.71$). Also, a significant main effect of the endpoint knowledge was observed for BT (BT: $p = 0.054$, $\eta_p^2 = 0.08$). In addition, a significant endpoint knowledge × music interaction was found for TT and BT (TT: $p < 0.001$, $\eta_p^2 = 0.73$; BT: $p < 0.001$, $\eta_p^2 = 0.50$). Post-hoc tests revealed a significant ($p < 0.001$) decrease in TT (M-CON vs. CON: $d = 0.62$; 95%CI = −1.74 to −1.22; M-UNK vs. UNK: $d = 0.24$, *95%CI* = −2.02 to −1.76) and BT (M-CON vs. CON: $d = 0.71$, 95%CI = −0.34 to −0.24; M-UNK vs. UNK: $d = 0.24$, 95%CI = −0.05 to −0.29) in all conditions including listening to preferred music compared to no music conditions. Post-hoc tests revealed also lower BT under the DEC ($p = 0.001$; $d = 0.36$; 95%CI = −0.92 to −0.23) compared to the UNK condition (Figure 3). For the AUC, a significant main effect of music ($p < 0.001$, $\eta_p^2 = 0.90$) and endpoint knowledge × music interaction ($p < 0.001$; $\eta_p^2 = 0.73$) were observed. However, no significant main effect of endpoint knowledge ($p = 0.573$, $\eta_p^2 = 0.02$) was found. Post-hoc tests revealed a significant ($p < 0.001$) decrease in the AUC under M-CON vs. CON conditions ($d = 0.50$, 95%CI = −1.39 to −0.97), as well as M-UNK vs. UNK conditions ($d = 0.72$, 95%CI = −1.56 to −1.42) (Figure 3). For the FI, no significant main effect of listening to preferred music and endpoint knowledge × music interaction were observed. However, a significant main effect of endpoint knowledge was found ($p < 0.001$; $\eta p^2 = 0.34$) (Figure 3).

For the HR_{mean} and the HR_{peak}, no significant endpoint × music interaction was observed (Figure 4).

Rating of Perceived Exertion and the Feeling Scale

For the RPE post-test, a significant main effect of listening to preferred music ($p = 0.002$, $\eta p^2 = 0.13$) and the main effect of endpoint knowledge ($p < 0.001$, $\eta p^2 = 0.22$) were observed. Also, a significant endpoint knowledge × music interaction was found ($p = 0.007$; $\eta p^2 = 0.09$). Post-hoc tests revealed a significant decrease in the RPE under the M-CON compared to M-DEC and M-UNK conditions (M-DEC: $p < 0.001$, $d = 1.15$, 95%CI = −1.36 to −0.47; M-UNK: $p = 0.001$, $d = 1.04$, 95CI% = −1.19 to −0.31) and no music condition (DEC: $p < 0.001$, $d = 1.14$, 95%CI = −0.95 to −0.30). For the FS post-test, a significant main effect of listening to preferred music ($p < 0.001$, $\eta p^2 = 0.51$) and the main effect of endpoint knowledge ($p = 0.054$, $\eta p^2 = 0.081$) were observed. Also, a significant endpoint knowledge × music interaction was found ($p = 0.047$; $\eta p^2 = 0.09$). Post-hoc tests revealed a significant increase in the FS score under the M-UNK compared to the M-DEC condition ($p = 0.007$; $d = 0.82$; 95%CI = 0.15 to 0.93). Furthermore, post-hoc tests revealed a significant increase in the FS score under the UNK compared to the CON condition ($p = 0.031$; $d = 0.66$; 95%CI = 0.05 to 0.95) (Figure 5).

Discussion

The primary purpose of this investigation was to examine the independent and combined effects of listening to preferred music and endpoint knowledge on performance and psychophysiological responses during a specific anaerobic speed test in kickboxers. The main findings revealed that listening to preferred music enhanced performance indices, particularly total time and best time, regardless the endpoint knowledge condition.

To our knowledge, the present study is one of the first to examine the unique and combined effects of listening to preferred music and endpoint knowledge during specific kickboxing exercises. To better understand this interaction, it is essential to analyze these two strategies separately. Our results demonstrated that listening to preferred music significantly improved performance measures across CON and UNK conditions. The most substantial improvements were observed under the M-CON compared to the CON condition for TT ($d = 0.62$), BT ($d = 0.71$), and the AUC ($d = 0.50$). These findings align with recent research by Jebabli et al. (2025) in which it was observed that listening to music with a high tempo (140 bpm), moderate volume (80 dB), standard frequency (440 Hz) and prior exercise endpoint knowledge improved physical performance of a specific anaerobic speed test for kickboxing when

Articles published in the Journal of Human Kinetics are licensed under an open access Creative Commons CC BY 4.0 license.

compared to a no-music condition. In this context, listening to music may promote systemic physiological changes during exercise by increasing brain activity in the left inferior frontal gyrus and insular cortex regions. This increase in activity may lead to attenuation of internal fatigue-related signals, resulting in improved physical performance (Ballmann, 2021). Also, the improvement in physical performance indices can be attributed to better synchronization between the tempo of the preferred music and the specificity of the motor tasks, which allows the activity to be more efficient (Bigliassi et al., 2019a; Jebabli et al., 2023, 2025).

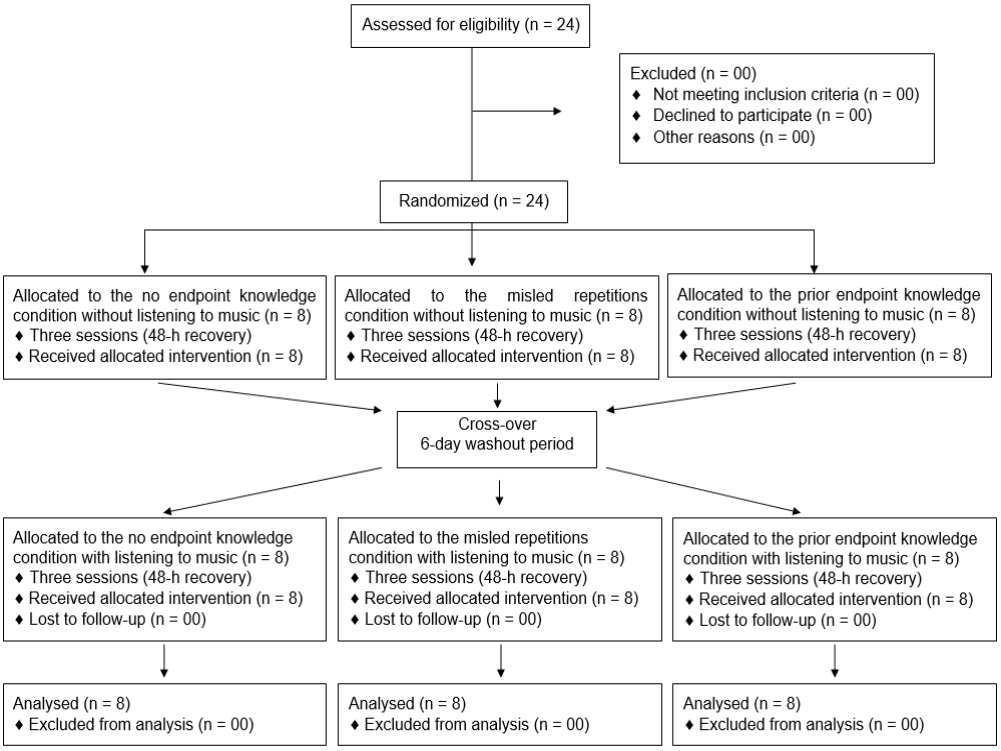

Figure 1. Consort flowchart.

Figure 2. Sequence of the kickboxing anaerobic speed test protocol.
(1) right-left punch, (2) right roundhouse kick, (3) right-right punch, (4) left roundhouse kick

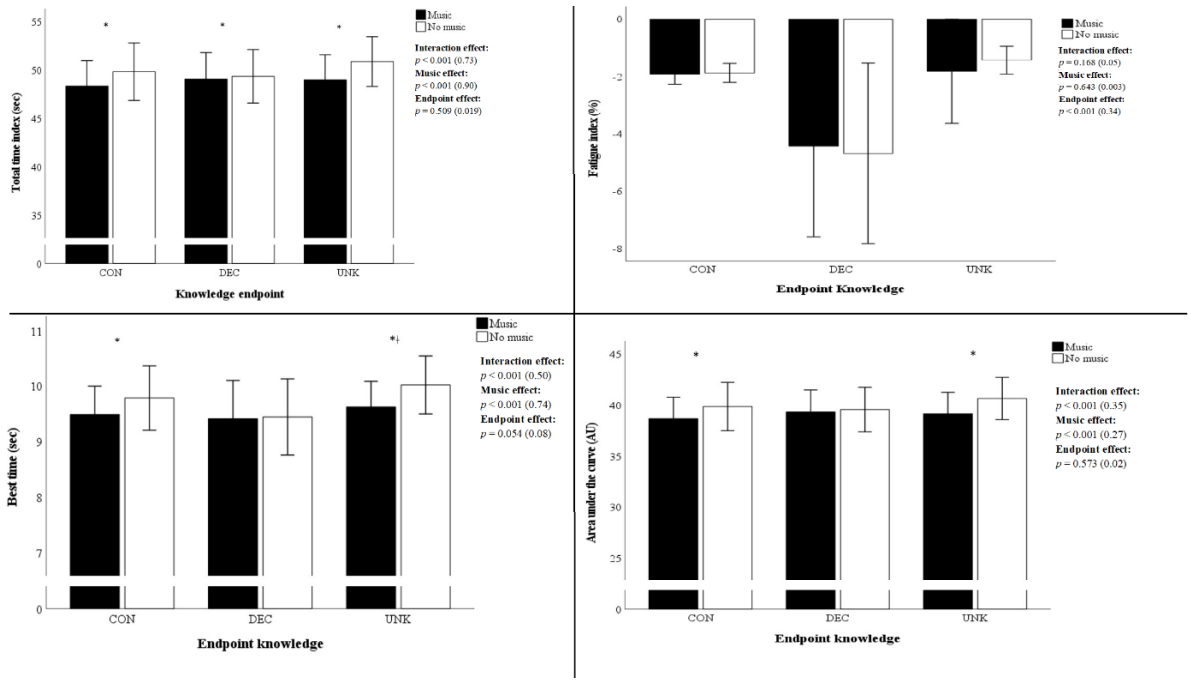

Figure 3. Single and combined effects of listening to preferred music and endpoint knowledge on physical indices during the IKAST.

*Mean ± SD; p-value (partial eta-squared); * indicates a significant effect of listening to music compared to no-music condition on each endpoint knowledge type; ǂ indicates a significant effect of the M-DEC compared to the M-UNK condition*

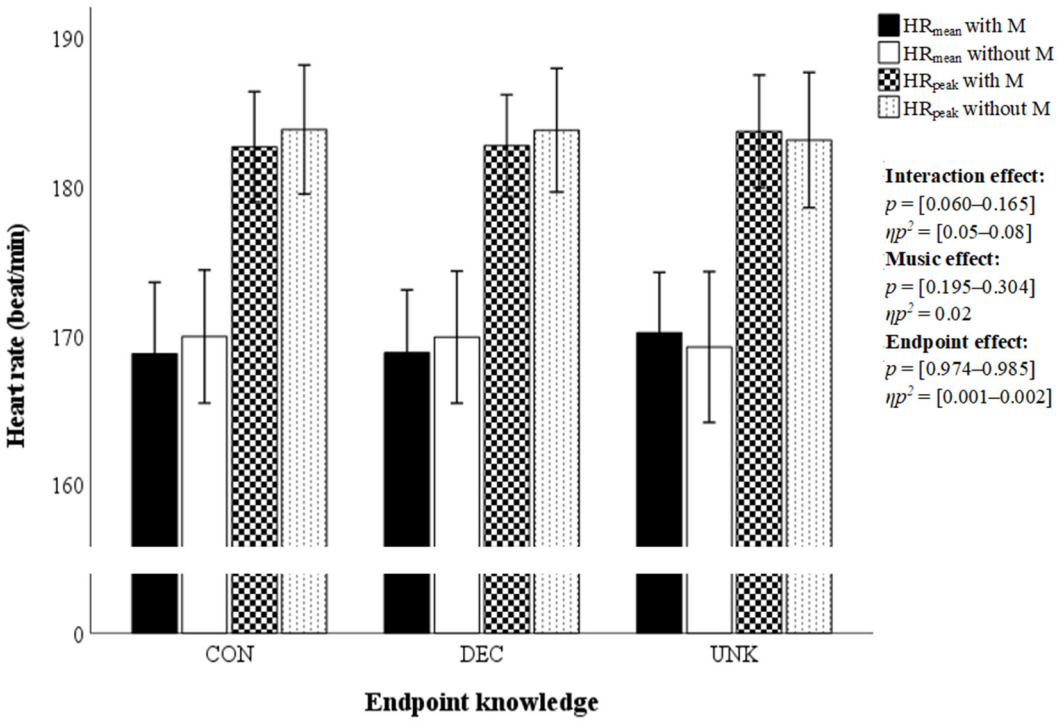

Figure 4. Single and combined effects of listening to preferred music and endpoint knowledge on physical indices during the IKAST.

Mean ± SD; ηp²: partial eta-squared

Articles published in the Journal of Human Kinetics are licensed under an open access Creative Commons CC BY 4.0 license.

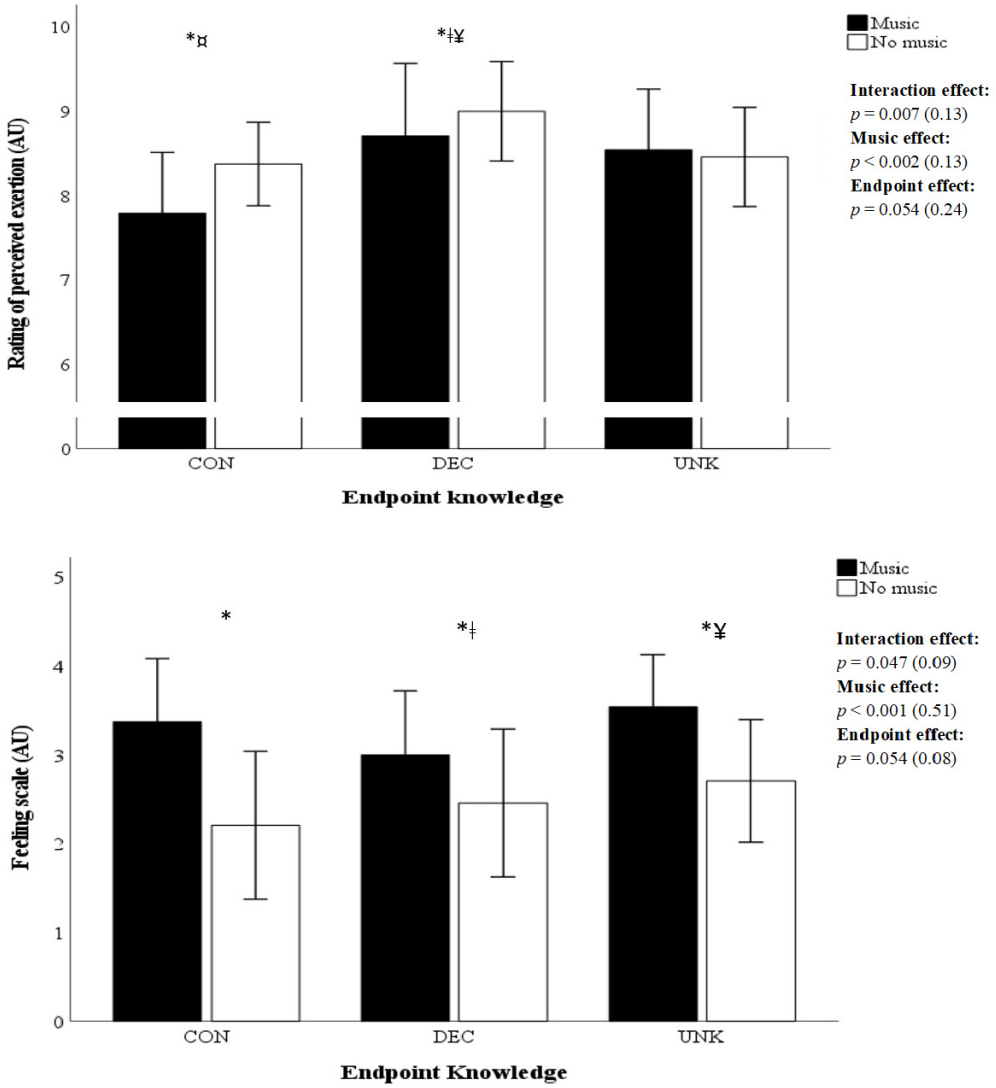

Figure 5. Single and combined effects of listening to preferred music and endpoint knowledge on the rating of perceived exertion and the feeling scale after the IKAST.
*Mean ± SD; p-value (partial eta-squared); * indicates a significant effect of listening to music compared to no-music condition on each endpoint knowledge type; ǂ indicates a significant effect of the M-DEC compared to the M-UNK condition; ¤ indicates a significant effect of the M-CON compared to the M-DEC condition; ¥ indicates a significant effect of the DEC compared to the UNK condition*

In our study, the endpoint knowledge manipulation revealed interesting patterns, with deception conditions showing a significant decrease in BT under the DEC compared to the UNK condition (d = 0.36), and this was similar to a study by Billaut et al. (2011) who reported a positive impact of deception on performance during high-intensity exercise. Billaut et al. (2011) reported that in high-intensity intermittent exercise, like repeated sprints, an unexpected disappointment about the number of sprints to be performed during the exercise led to an increase in power output during the first sprints, which is consistent with the present study (BT). As an

explanation, Billaut et al. (2011) observed that this initial power output decreased significantly in successive repetitions due to the onset of increased fatigue resulting from an unanticipated initial effort. In addition, Stone et al. (2017) reported that the deception condition promoted greater mobilization of anaerobic energy sources that resulted in increased power output and faster running times, which led to a more rapid depletion of energy reserves.

Given the differences in the experimental protocols of these studies, it may not be realistic to expect a common physiological explanation, given the differences in the participants' fitness levels (e.g., trained vs. untrained), testing procedures (e.g., the number of repetitions), and the sport they practiced (e.g., athletics, kickboxing). Fatigue index results revealed an interesting pattern, with no significant music effect but a substantial exercise endpoint knowledge effect ($p < 0.001$, $\eta_p^2 = 0.34$). This suggests that while music may enhance overall performance, the rate of fatigue development is more strongly influenced by knowledge of exercise duration. These findings support the tele-anticipation theory proposed by Ulmer (1996), indicating that athletes modulate effort based on anticipated exercise duration. Taken together, the interaction between music and endpoint knowledge provides valuable insights into pacing strategies during high-intensity intermittent exercise. However, this complex relationship also requires ongoing physiological assessment, including measurement of metabolic, hormonal, and neurological variables during exercise, to better understand this combined phenomenon.

The cardiovascular responses, measured through the HR_{mean} and the HR_{peak}, showed no significant differences across conditions, suggesting that performance improvements were not primarily mediated through altered cardiovascular function (Schittenhelm et al., 2024). This finding aligns with research by Jebabli et al. (2023) where similar heart rate responses despite enhanced performance when listening to preferred music during high-intensity exercise were reported.

A significant interaction effect was observed for the RPE, with lower values under the M-CON condition compared to both M-DEC (d = 1.15) and M-UNK conditions (d = 1.04). This aligns with research by Chow and Etnier (2017) demonstrating reduced perceived exertion when exercise duration is known and accompanied by motivational stimuli. Particularly, listening to music may offer improved distraction from fatigue-related symptoms by reducing the RPE and modulating beta frequency activity in the brain, which improves the positive mental state during intense physical activity (Bigliassi et al., 2019b; Jebabi et al., 2025).

In our study, we also observed that under CON conditions, RPE values were lower either with or without listening to music compared to DEC (music, d = 1.15; no music, d = 1.14) and UNK (music, d = 1.04) conditions. This finding is logical as the kickboxer's perception of effort would be higher in response to a sudden and unexpected increase in the number of repetitions to be performed (DEC condition) or to the absence of information about the exercise endpoint and a new required number of repetitions to be performed (UNK condition). These results are in agreement with previous results by Jebabli et al. (2023) who observed that repeated CMJs without a priori knowledge of the endpoint significantly increased the RPE compared to a priori knowledge of the duration of the exercise or the number of jumps to be performed.

Feeling scale responses showed notable improvements under listening to preferred music conditions compared to no-music conditions in all endpoint knowledge conditions, with greater improvement in the UNK (d = 1.19) compared to CON (d = 1.05) and DEC (d = 0.69) conditions. This is in agreement with recent findings by Greco et al. (2024) regarding music's positive impact on affective responses during combat sport-specific tasks. The enhanced psychological responses may be explained through the dissociative effects of music on attention focus during exercise (Delleli et al., 2023; Jebabli et al., 2025). Also, our findings could be partly explained by the intrinsic characteristics of the preferred music that presented higher rhythmic characteristics (> 140 beats/min). Indeed, it has been shown that the tempo of music must be higher than 120 bpm to be effective in improving the mood (Terry et al., 2020). Similarly, evidence supports that listening to preferred music is more effective for enhancing well-being (Karageorghis and Priest, 2008; Ouergui et al., 2023). These considerations could

Articles published in the Journal of Human Kinetics are licensed under an open access Creative Commons CC BY 4.0 license.

explain the positive FS scores in the different endpoint knowledge conditions. Despite this, we found more positive effects under the UNK condition. We hypothesize that this improvement could be related to the perception of kickboxers listening to music, according to which the number of repetitions of the IKAST can be unlimited until exhaustion (UNK). This could be associated with a tele-anticipatory regulation of the force of the blows (reduction of the force of the strikes), even if the speed remained maximal to maintain the all-out strategy. This could reduce psychophysiological stress and improve the mood. However, these results need to be verified, due to the lack of evaluation of the forces of the blows.

The consistent performance enhancement when listening to preferred music suggests its value as a training aid during high-intensity sport-specific drills (Karageorghis and Priest, 2008; Ouergui et al., 2023). Coaches should consider incorporating athlete-selected music during specific training sessions, particularly when targeting anaerobic performance enhancement. The lower RPE values observed under music conditions indicate potential benefits for training tolerance and recovery. Additionally, the interaction between listening to music and endpoint knowledge, particularly under CON and DEC conditions, suggests that providing accurate duration information alongside preferred music may optimize both performance and psychological responses during intense training sessions (Terry et al., 2020). This combination could be particularly valuable during preparation phases where maintaining training intensity is crucial.

Several limitations should be considered when interpreting these results. First, the study included only male amateur kickboxers, potentially limiting generalizability across gender and competitive levels. Second, while the IKAST simulates sport-specific movements, it may not fully replicate the complexity of actual combat situations. Future research should examine these effects in female athletes and across different competitive levels. Additionally, conducting such a study within actual sparring or competition scenarios could provide valuable ecological validity. The potential long-term effects of music and endpoint knowledge manipulation on training adaptations also warrant further investigation.

Based on our findings, we recommend that combat sports coaches and athletes consider implementing listening to preferred music during high-intensity training sessions, particularly when performing technical drills or conditioning work. When structuring training sessions, providing accurate information about exercise duration alongside preferred music may optimize both performance and psychological responses. However, coaches could vary the endpoint knowledge strategically during different training phases to develop athletes' ability to manage effort under CON and DEC conditions. The selection of music should be individualized, considering athletes' preferences and the specific demands of the training session.

Conclusions

This investigation demonstrated that listening to preferred music significantly enhanced performance during high-intensity kickboxing-specific exercise, with these effects being modulated by endpoint knowledge. The combined intervention showed particular benefits for psychological responses, suggesting potential value for training optimization, particularly under CON conditions. These findings extend our understanding of how psychological interventions can be effectively implemented in combat sports training while highlighting the complex interaction among music, endpoint knowledge, and performance regulation during high-intensity intermittent exercise. Future research should build upon these findings to further optimize training interventions in combat sports.

Author Contributions: Conceptualization: N.J. and M.B.; methodology: N.J.; software: N.J.; validation: N.J., M.B. and W.D.; formal analysis: N.J.; investigation: M.M. and N.O.; resources: N.J.; data curation: N.J.; writing—original draft preparation: N.J., M.B., H.I.C., W.D. and S.M.E.; writing—review & editing: N.J., W.D., A.B. and A.B.A.; visualization: A.B.A.; supervision: W.D.; project administration: S.M.E.; funding acquisition: S.M.E.; N.J. and M.B. contributed equally to this work. All authors have read and agreed to the published version of the manuscript.

ORCID iD:

Nidhal Jebabli: https://orcid.org/0000-0002-6328-4915

Manar Boujabli: https://orcid.org/0009-0002-7042-3407

Safaa M. Elkholi: https://orcid.org/0000-0002-1100-4301

Nejmeddine Ouerghi: https://orcid.org/0000-0002-8840-1735

Halil İbrahim Ceylan: https://orcid.org/0000-0003-1133-5511

Anissa Bouassida: https://orcid.org/0000-0003-0971-0183

Abderraouf Ben Abderrahman: https://orcid.org/0000-0003-1351-8717

Wissem Dhahbi: https://orcid.org/0000-0001-6221-546X

Funding Information: This study was funded by the Princess Nourah bint Abdulrahman University Researchers Supporting Project number (PNURSP2026R145), Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia.

Institutional Review Board Statement: The study protocol was approved by the local institutional ethics committee of the Higher Institute of Sport and Physical Education of Kef, University of Jendouba, Kef, Tunisia (approval code: ISSEP-0027/2024; approval date: 29 December 2024) and was conducted following the Declaration of Helsinki.

Informed Consent: Informed consent was obtained from all participants included in the study.

Conflicts of Interest: The authors declare no conflict of interest.

Acknowledgements: We thank the participants for taking part in this study.

Received: 29 April 2025

Accepted: 02 September 2025

References

Ballmann, C. G. (2021). The influence of music preference on exercise responses and performance: a review. *Journal of Functional Morphology and Kinesiology*, *6*(2), 33.

Barley, O. R., Chapman, D. W., Guppy, S. N., & Abbiss, C. R. (2019). Considerations when assessing endurance in combat sport athletes. *Frontiers in Physiology*, *10*, 205.

Bigliassi, M., Greca, J. P., Barreto-Silva, V., Chierotti, P., Oliveira, A. R. d., & Altimari, L. R. (2019a). Effects of audiovisual stimuli on psychological and psychophysiological responses during exercise in adults with obesity. *Journal of Sports Sciences*, *37*(5), 525–536.

Bigliassi, M., Karageorghis, C. I., Bishop, D. T., Nowicky, A. V., & Wright, M. J. (2018). Cerebral effects of music during isometric exercise: An fMRI study. *International Journal of Psychophysiology*, *133*, 131–139.

Bigliassi, M., Karageorghis, C. I., Hoy, G. K., & Layne, G. S. (2019b). The Way You Make Me Feel: Psychological and cerebral responses to music during real-life physical activity. *Psychology of Sport and Exercise*, *41*, 211–217.

Bigliassi, M., Karageorghis, C. I., Wright, M. J., Orgs, G., & Nowicky, A. V. (2017). Effects of auditory stimuli on electrical activity in the brain during cycle ergometry. *Physiology & Behavior*, *177*, 135–147.

Billaut, F. (2011). Influence of knowledge of sprint number on pacing. *Medicine & Science in Sports & Exercise*, *43*(4), 665–672.

Boujabli, M., Jebabli, N., Sahli, F., Sahli, H., Zghibi, M., & van den Tillaar, R. (2024). Combined Effects of Listening to Preferred Music and Video Feedback, during Warm-Up, on Physical Performance in Young Kickboxers. *Sports*, *12*(5), 131.

Articles published in the Journal of Human Kinetics are licensed under an open access Creative Commons CC BY 4.0 license.

Centala, J., Pogorel, C., Pummill, S. W., & Malek, M. H. (2020). Listening to fast-tempo music delays the onset of neuromuscular fatigue. *Journal of Strength & Conditioning Research*, *34*(3), 617–622.

Chow, E. C., & Etnier, J. L. (2017). Effects of music and video on perceived exertion during high-intensity exercise. *Journal of Sport and Health Science*, *6*(1), 81–88.

Čular, D., Dhahbi, W., Kolak, I., Iacono, A. D., Bešlija, T., Laffaye, G., & Padulo, J. (2021). Reliability, sensitivity, and minimal detectable change of a new specific climbing test for assessing asymmetry in reach technique. *Journal of Strength & Conditioning Research*, *35*(2), 527–534.

Delleli, S., Ouergui, I., Ballmann, C. G., Messaoudi, H., Trabelsi, K., Ardigò, L. P., & Chtourou, H. (2023). The effects of pre-task music on exercise performance and associated psycho-physiological responses: a systematic review with multilevel meta-analysis of controlled studies. *Frontiers in Psychology*, *14*, 1293783.

Dhahbi, W., Chaabene, H., Pyne, D. B., & Chamari, K. (2024). Standardizing the quantification of external load across different training modalities: a critical need in sport-science research. *International Journal of Sports Physiology and Performance*, *19*(11), 1173–1175.

Diehl, T. L., Jennifer, N. Y., Storer, F. M., & Malek, M. H. (2023). Listening to Music Pretask on Neuromuscular Fatigue During Exercise: Preferred vs. Nonpreferred Music. *Journal of Strength & Conditioning Research*, *37*(7), 1537–1542.

Gençoğlu, C., Ulupınar, S., Özbay, S., Ouergui, I., & Franchini, E. (2023). Reliability and validity of the kickboxing anaerobic speed test. *Research Quarterly for Exercise and Sport*, *94*(3), 715–724.

Greco, F., Quinzi, F., Chiodo, S., Cerulli, C., Tranchita, E., Bertollo, M., & Emerenziani, G. P. (2024). The effects of pre-task music on choice visual reaction time in elite taekwondo athletes. *Journal of Science and Medicine in Sport*, *27*(4), 276–280.

Hardy, C. J., & Rejeski, W. J. (1989). Not what, but how one feels: the measurement of affect during exercise. *Journal of Sport and Exercise Psychology*, *11*(3), 304–317.

Highton, J., Mullen, T., & Twist, C. (2017). Influence of knowledge of task endpoint on pacing and performance during simulated rugby league match play. *International Journal of Sports Physiology and Performance*, *12*(9), 1192–1198.

Jarraya, S., & Jarraya, M. (2019). The effects of music and the time-of-day on cognitive abilities of tennis player. *International Journal of Sport and Exercise Psychology*, *17*(3), 185–196.

Jebabli, N., Boujabli, M., Khlifi, M., Ouerghi, N., Bouassida, A., Abderrahman, A. B., & van den Tillaar, R. (2025). Effects of 440-Hz vs. 432-Hz preferred music frequencies, during warm-up, on intermittent anaerobic speed test performance in men and women kickboxers: a double-blind crossover study. *PeerJ*, *13*, e19084.

Jebabli, N., Khlifi, M., Ouerghi, N., Boujabli, M., Bouassida, A., Abderrahman, A. B., & van den Tillaar, R. (2023). Single and combined effects of preferred music and endpoint knowledge on jump performance in basketball players. *Sports*, *11*(5), 105.

Jebabli, N., Zouhal, H., Boullosa, D., Govindasamy, K., Tourny, C., Hackney, A. C. ... & Ben Abderrahman, A. (2022). The Effects of Preferred Music and Its Timing on Performance, Pacing, and Psychophysiological Responses During the 6-min Test. *Journal of Human Kinetics*, *82*, 123–133. https://doi.org/10.2478/hukin-2022-0038

Kania, D., Romaniszyn-Kania, P. M., Bugdol, M., Tuszy, A., Ledwoń, D., Pollak, A., & Mitas, A. W. (2024). Flow and Physiological Response Assessment during Exercise Using Metrorhythmic Stimuli. *Journal of Human Kinetics*, *94*, 243–254. https://doi.org/10.5114/jhk/187804

Karageorghis, C., & Priest, D.-L. (2008). Music in sport and exercise: an update on research and application. *Sport Journal*, *11*(3), 1.

Karageorghis, C. I., Hutchinson, J. C., Jones, L., Farmer, H. L., Ayhan, M. S., Wilson, R. C., … & Bailey, S. G. (2013). Psychological, psychophysical, and ergogenic effects of music in swimming. *Psychology of Sport and Exercise*, *14*(4), 560–568.

Karageorghis, C. I., & Priest, D. L. (2012). Music in the exercise domain: a review and synthesis (Part I). *International Review of Sport and Exercise Psychology*, *5*(1), 44–66.

Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. *Frontiers in Psychology*, *4*, 863.

Maidhof, C., Müller, V., Lartillot, O., Agres, K., Bloska, J., Asano, R., … & Fachner, J. (2023). Intra-and inter-brain coupling and activity dynamics during improvisational music therapy with a person with dementia: An explorative EEG-hyperscanning single case study. *Frontiers in Psychology*, *14*, 1155732.

Maidhof, R. M., Kappert, M. B., Wuttke, A., Schwerdtfeger, A. R., Kreutz, G., & Nater, U. M. (2023). Effects of participant-selected versus researcher-selected music on stress and mood–The role of gender. *Psychoneuroendocrinology*, *158*, 106381.

Ouergui, I., Jebabli, A., Messaoudi, H., Delleli, S., Chtourou, H., Bouassida, A., … & Ardigò, L. P. (2023). The effects of tempo and loudness variations during warm-up with music on perceived exertion, physical enjoyment and specific performances in male and female taekwondo athletes. *PLoS One*, *18*(4), e0284720.

Patania, V. M., Padulo, J., Iuliano, E., Ardigò, L. P., Čular, D., Miletić, A., & De Giorgio, A. (2020). The psychophysiological effects of different tempo music on endurance versus high-intensity performances. *Frontiers in Psychology*, *11*, 74.

Rejeski, W. J. (1985). Perceived exertion: an active or passive process? *Journal of sport and exercise psychology*, *7*(4), 371–378.

Schittenhelm, A., Brandt, T., Andres, D., Adler, P., Fairhurst, M. T., & Schmidt, A. (2024). Music influences performance without increasing perceived exertion during high-intensity rowing intervals: a cross-over design study. *Frontiers in Psychology*, *15*, 1427373.

Slimani, M., Chaabene, H., Miarka, B., Franchini, E., Chamari, K., & Cheour, F. (2017). Kickboxing review: anthropometric, psychophysiological and activity profiles and injury epidemiology. *Biology of Sport*, *34*(2), 185–196.

Smits, B. L., Pepping, G. J., & Hettinga, F. J. (2014). Pacing and decision making in sport and exercise: the roles of perception and action in the regulation of exercise intensity. *Sports Medicine*, *44*, 763–775.

Stone, M. R., Thomas, K., Wilkinson, M., Stevenson, E., St. Clair Gibson, A., Jones, A. M., & Thompson, K. G. (2017). Exploring the performance reserve: Effect of different magnitudes of power output deception on 4,000 m cycling time-trial performance. *Plos One*, *12*(3), e0173120.

Terry, P. C., Karageorghis, C. I., Curran, M. L., Martin, O. V., & Parsons-Smith, R. L. (2020). Effects of music in exercise and sport: A meta-analytic review. *Psychological Bulletin*, *146*(2), 91.

Tucker, R. (2009). The anticipatory regulation of performance: the physiological basis for pacing strategies and the development of a perception-based model for exercise performance. *British Journal of Sports Medicine*, *43*(6), 392–400.

Ulmer, H.-V. (1996). Concept of an extracellular regulation of muscular metabolic rate during heavy exercise in humans by psychophysiological feedback. *Experientia*, *52*, 416–420.

Vasconcelos, B. B., Protzen, G. V., Galliano, L. M., Kirk, C., & Del Vecchio, F. B. (2020). Effects of high-intensity interval training in combat sports: a systematic review with meta-analysis. *Journal of Strength & Conditioning Research*, *34*(3), 888–900.

Wingfield, G., Marino, F., & Skein, M. (2018). The influence of knowledge of performance endpoint on pacing strategies, perception of effort, and neural activity during 30-km cycling time trials. *Physiological Reports*, *6*(21), e13892.

Zaatar, M. T., Alhakim, K., Enayeh, M., & Tamer, R. (2024). The transformative power of music: Insights into neuroplasticity, health, and disease. *Brain, Behavior, & Immunity-Health*, *35*, 100716.

Articles published in the Journal of Human Kinetics are licensed under an open access Creative Commons CC BY 4.0 license.