The Official Journal of the International Society for Comparative Physical Education and Sport

ORIGINAL RESEARCH

# Melodic Movements: The Role of Music in Shaping Sport Performance and Psychological Responses

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## Abstract

*The application of music in sport can enhance training and competition performance. This study explored the effects of different music genres on students' emotional, psychological, and athletic performance. Motivational music (e.g., blues, jazz, classical) has reflective and complex qualities, with a tempo of 60-80 beats per minute; high-tempo music (e.g., rock, heavy metal, alternative) has intense and rebellious characteristics, with a tempo of 120-140 beats per minute; upbeat music (e.g., pop music, New German Wave), film music, and popular German music have cheerful and traditional qualities, with a tempo of 100-130 beats per minute; rhythmic music (e.g., soul/R&B, rap/hip-hop, and electronic music), have strong rhythmic features, with a tempo of 80-100 beats per minute; and self-selected music is chosen by the participants based on preference. Using a structured questionnaire, data were collected from 400 students at Shandong Sport University (50.8% male, 49.3% female, ages 18-21) to assess demographics, music preferences (Short Test of Music Preferences), psychological responses (Sport Emotions Questionnaire (SEQ) and Attention Questionnaire (AQ-RARC), sport motivation (adapted from Gill et al., 1983), and physical performance (International Fitness Inventory). Results from the PLS-SEM analysis indicated a composite reliability (CR ≥0.7) and an average variance extracted (AVE ≥0.5), meeting the Fornell-Larcker criteria for the model's reliability and validity. Model fit indices (SRMR, RMSEA < 0.08; CFI > 0.90) and path coefficient (t-value > 1.96), confirmed significance, with an $R^2$ value > 0.3 and a $Q^2$ value > 0, demonstrating the model's explanatory and predictive power. Findings suggest that different music genres significantly enhance students' athletic performance and psychological well-being.*

**Keywords:**
good health, motivation, music, physical activity, physical education, psychological responses, sport performance, well-being

**Recommended Citation:** Song, R., Motevalli, S., & Zhou, Y. (2024). Melodic Movements: The Role of Music in Shaping Sport Performance and Psychological Responses, *International Sports Studies, 46*(2), 96-124, https://doi.org/ 10.69665/iss.v46i2.24

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## Introduction

### *The Effects of Different Music Genres on Sport Psychological Factors*

Sport psychology examines the impact of psychological elements on athletic performance, encompassing constructs such as motivation, self-assurance, anxiety, concentration, objective establishment, mental imagery, and

collaboration (Eysenck & Brysbaert, 2018). Sport psychologists collaborate with athletes, coaches, and teams to facilitate the attainment of peak performance, the effective management of stress, and the successful surmounting of obstacles. Sport psychology utilizes research findings from psychology, sociology, physiology, and kinesiology to examine human behaviour in sport and apply this understanding to practical applications (Weinberg & Gould, 2023). The field of sport psychology has gained recognition since the 1960s and 1970s. It is currently experiencing rapid growth as researchers and practitioners strive for a more comprehensive and nuanced understanding of the psychological factors that impact athletic performance to better inform the design of interventions to assist athletes achieve their best performance (Khodi et al., 2022)., relaxation training, and biofeedback (James, 2007; Jones et al., 2017).

Psychological elements such as motivation, attention, and emotion play crucial roles in motor performance. Motivation is the inherent impetus that instigates and guides conduct toward a specific objective (Ryan & Deci, 2000). It is a multifaceted term shaped by various aspects such as personality, prior experiences, and environmental influences. In the realm of sport, motivation may be categorized into two types: intrinsic and extrinsic. Motivation that comes from inside, such as the drive to improve one's abilities and the desire to take pleasure in one's own activities, is known as intrinsic motivation. On the other hand, awards and recognition are examples of extrinsic motivation, which is impacted by factors that are external to the individual.

Attentional concentration is a vital psychological factor that greatly influences sport performance. Attentional control denotes the ability to focus attention on specific tasks or stimuli (Anghelcev, 2013). Attention is crucial for athletes, facilitating sustained concentration on performance and enabling responsive adaptation to changing external conditions. Previous research has examined the influence of attentional concentration on athletic performance (Jones et al., 2017; Kinanti et al., 2023). Several studies have established a connection between an individual's emotions and behavioural responses in physical activity and sport. Emotions represent complex and varied experiences that encompass a range of physiological and psychological responses (Folkman, 2020; Lazarus, 1991). Emotions in sport influence an athlete's performance by affecting arousal levels, attention concentration, and decision-making capabilities (Khodi et al., 2024). Research indicates that athletes who effectively regulate their emotions are more likely to perform better in high-pressure situations (Lane & Terry, 2000). Additionally, athletes who experience positive emotions, such as enthusiasm and joy, tend to exhibit higher motivation and improved performance compared to those who encounter negative emotions like anxiety and dread (Milona et al., 2024).

A substantial body of research has investigated the influence of music on PA levels and the associated enjoyment experienced by individuals. Tran Minh (2022) discovered that popular music increased speed, agility, and aerobic speed in female students, but Ouergui et al. (2023) discovered that favoured and loud music boosted physical performance and satisfaction in taekwondo jins. Kumar and Sivachandiran (2022) and Karageorghis et al. (2021) both found that music improved interest and satisfaction in

physical exercises, with Karageorghis emphasising the advantages of medium-tempo music during high-intensity interval training. Kinanti et al. (2023) and Röglin et al. (2023) provided additional support for these findings, with Kinanti demonstrating that fast-paced music boosted attention and Röglin discovering that a high-intensity exergame entertained youngsters. Mohamed et al. (2022) found that popular music has no long-term influence on the fitness of female pupils in physical education classes.

Moderate physical activity (PA) has a significant influence on the central nervous system by stimulating the endorphin production, which supports brain health (Consorti et al., 2021) and fosters a sense of ease and pleasantness, lowering both alcohol cravings and stress levels (Gawor et al., 2021; Shirehjini et al., 2023). When combined with rhythmic music, especially during high-intensity interval training, PA may increase endorphin production and generate sensations of relaxation and pleasure (Karageorghis et al., 2021). Exercise and music can also contribute to regulating autonomic and neuro-endocrine responses to psychological stress (Jawwad et al., 2022). However, the subjective enjoyment of PA also plays an essential role in strengthening the positive association between exercise and mental health (Kagawa et al., 2022). Mind-body activities such as Qi Gong can promote mental well-being by inducing eutonic relaxation (Goldbeck et al., 2021). Furthermore, musical movement patterns have been shown to boost divergent thinking in adults and improve cognitive functioning, particularly executive functioning, although further research is needed to clarify these effects.

### *The Impact of Various Genres of Music on Motivation, Attention, And Emotion*

Music has long been used to boost motivation during PA, and there is a growing corpus of studies investigating the influence of different genres on motivational levels. Various research has looked into the effects of other music genres on motivation, attention, and emotions. Jakupčević et al. (2021) revealed a positive correlation between music absorption and emotion control, whereas a negative correlation was identified for mindfulness (Khodi, 2021). Rock music has been demonstrated to improve emotion, elicit emotions, and inspire listeners (Tripathy & Chaudhari, 2021). Different music genres may be effectively categorised based on their impact on cerebral hemodynamic responses, with deep learning models performing well (Abadi, Khairah, et al., 2022; Rahman et al., 2022). Musical regulation of emotions can potentially impact attentional performance, notably the arousal component (Fernandez et al., 2021). Background music can interact with cognitive regulation, and judgements of musical arrangements are essential (Motevalli et al., 2022; Yoo et al., 2022). Musicians modulate their emotions throughout practice to support their goal orientation, with others preferring a mixed emotional state (Breaden Madden & Jabusch, 2021).

Furthermore, numerous studies have shown that emotions significantly influence physical performance during PA. Banu et al. (2022) found that engaging in physical activities can minimise fatigue and improve academic achievement. Both Liu et al. (2023) and Homagain and Ehgoetz Martens (2023) proved that emotional states had an impact on physical performance, with emotions influencing emotion responses and gait metrics. Zhang et al. (2023) investigated the function of self-

compassion and stress in physical exercise, finding that self-compassion reduces psychological discomfort and increases barrier self-efficacy, whereas stress has a detrimental impact on sport performance. Finally, Meetei (2023) and Abadi, Tiis, et al. (2022) emphasised the benefits of sport and physical activities for academic success and general human growth.

Upbeat music, known for its fast speed and pleasant sentiments, has been demonstrated to improve alertness and emotion, enhancing desire during exercise (Pang, 2022). For example, (Terry et al., 2020) discovered that listening to upbeat music while cycling increased enthusiasm and decreased perceived effort. Motivational music, with lyrics and messages that encourage and promote positivity, also increases motivation (Ransom, 2015); Borges et al. (2021) reported increased motivation levels during sprinting exercises, while (Piatkowski et al., 2024) observed increased motivation and improved performance in weightlifting activities. Rhythmic music, recognised for its continuous beat and pace, enhances coordination and motivation in various physical exercises; Wang and Zheng (2022) found benefits in basketball tasks, while Ballmann (2021) saw increased motivation while running. Individually chosen music improves motivation and performance, as Clark et al. (2021) discovered in their studies on sprinting and treadmill activities. In another study, participants completed 400-meter time trials 5.07% quicker than control group participants (Karageorghis et al., 2019). (Hove et al., 2022) indicated that upbeat music significantly affects attention during exercise by enhancing arousal levels, improving emotional states, and promoting greater engagement and enjoyment. Additionally, rhythmic music facilitates a consistent tempo and pace during exercise, enhancing athletic performance and intensifying the subjective experience of flow (Thakare et al., 2017). Hutchinson et al. (2018) asserted that self-selected music enhances motivation and engagement by enabling individuals to select personally engaging music, thereby diminishing the perceived effort. Finally, Koelsch et al. (2019) demonstrated that self-selected music stimulates the brain's reward system, leading to increased motivation and positive emotions during physical activity.

### *The Impact of Psychological Factors on Physical Performance*

Several studies have demonstrated the significant influence of psychological elements on physical performance, emphasising their diverse and critical function. Behm and Carter (2021) emphasise the relevance of empathy, self-efficacy, and self-confidence, demonstrating how these psychological attributes improve athletic performance by instilling optimism and drive. Rakhmatullayevna (2023) and Méndez-Alonso et al. (2021) emphasise the importance of psychological health, mental toughness, and resilience, stating that these characteristics are required for athletes to overcome obstacles and sustain high performance. Besides, Reyes-Bossio et al. (2022) and Yang (2022) indicated significant effects of psychological treatments, such as mindfulness practices and cognitive-behavioral methods, as well as the monitoring of psychological indicators, on athletic performance. These therapeutic methods include the monitoring of psychological factors. Both research by Di Corrado et al. (2021) and Zhang et al. (2023) suggested a more comprehensive perspective by investigating the association between physical and mental well-being. More

specifically, they highlighted the role of self-compassion in promoting extended physical activity and boosting the healing of injuries. When taken as a whole, these studies demonstrate that psychological factors are not only necessary for sport achievement but also for the enhancement of overall physical health and performance.

### *Proposed Theoretical Model*

This study proposes a theoretical model, illustrated in Figure 1, as derived from the concepts of Attentional Focus Theory (AFT), Self-Determination Theory (SDT), and Affective Response Theory (ART). According to the Attentional Focus Theory (AFT), an individual's attention and arousal level during physical activities are impacted by music, which serves as an external stimulus. The Self-Determination Theory (SDT) underscores the significance of motivation, particularly highlighting the satisfaction of demands associated with autonomy, competence, and relatedness. When these criteria are met, individuals reveal improved intrinsic desire and engagement in the task, which is vital for enhancing physical performance in educational settings. The Affective Response Theory (ART) explains the emotional and hedonic emotions individuals experience during physical activity. Music can provoke noble emotional states, enhancing the enjoyment of physical activity, fostering engagement, and causing heightened intensity. This study's theoretical model suggests that various music genres serve as independent variables influencing the intermediate aspects of motivation, attention, and emotion, which in turn influence physical performance. By synthesizing several theoretical viewpoints, the proposed model offers an extensive comprehension of the effects of various music on psychological and physiological reactions during physical activities.

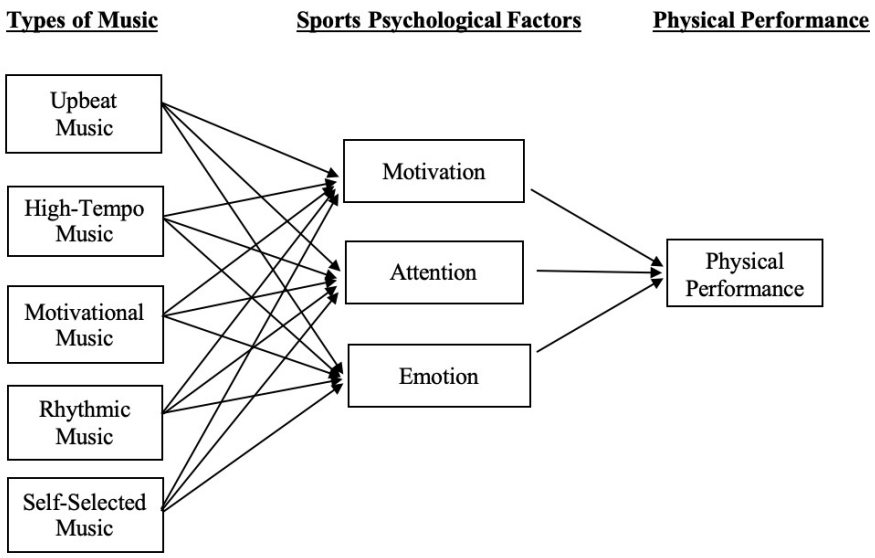


*Figure 1.* Proposed Theoretical Model

## Method

### *Participants*

The research recruited volunteers from Shandong Sport University, located in Shandong Province, China. Shandong Sport University was founded in 1958.

In 2000, it was established by a combination of the Provincial Institute of Physical Education and Technology and the Provincial Centre for Physical Education and Sports Research, receiving formal permission from the Government of Shandong Province. The sample size of 368 participants was established using the Krejcie and Morgan (1970) table, which is well-known in educational and social sciences research to determine the appropriate sample size depending on population size. Table 1 reveals that, for a population of roughly 8,380 students at Shandong Sport University, a sample size of 368 participants is adequate to get a 95% confidence level with a 5% margin of error. This approach yields a statistically valid estimate, guaranteeing that the sample size is sufficient to generate accurate findings. Besides, a G-Power analysis was performed to confirm the adequacy of the sample size. The G-Power study, a statistical power analysis tool, verified that a sample size of 368 participants is adequate to identify significant effects with a power level of 0.80, a standard threshold in research to reduce Type II errors. By integrating Krejcie and Morgan's table with G-Power analysis, we confirmed that the selected sample size is both statistically and practically sufficient for this investigation.

*Table 1.* Descriptive Statistics of Demographics, Listen to Music, and Music Preferences

| | | Frequency | Percentage | Valid Percentage | Cumulative Percentage |
|---|---|---|---|---|---|
| Gender | Male | 203 | 50.8 | 50.8 | 50.8 |
| | Female | 197 | 49.3 | 49.3 | 100.0 |
| | Total | 400 | 100.0 | 100.0 | |
| Current year of study | 1 | 82 | 20.5 | 20.5 | 20.5 |
| | 2 | 130 | 32.5 | 32.5 | 53.0 |
| | 3 | 117 | 29.3 | 29.3 | 82.3 |
| | 4 | 71 | 17.8 | 17.8 | 100.0 |
| | Total | 400 | 100.0 | 100.0 | |
| Listen to music while exercising | Male | 186 | 46.5 | 46.5 | 46.5 |
| | Female | 214 | 53.5 | 53.5 | 100.0 |
| | Total | 400 | 100.0 | 100.0 | |
| Music preferences during sport | High-Tempo Music | 71 | 17.8 | 17.8 | 17.8 |
| | Motivational Music | 71 | 17.8 | 17.8 | 35.5 |
| | Rhythmic Music | 81 | 20.3 | 20.3 | 55.8 |
| | Self-Selected Music | 98 | 24.5 | 24.5 | 80.3 |
| | Upbeat Music | 79 | 19.8 | 19.8 | 100.0 |
| | Total | 400 | 100.0 | 100.0 | |

Table 5 shows that the actual sample had a relatively equal proportion of male participants, with 50.8% males and 49.3% females. In relation to the practice of listening to music during exercise, 214 ladies (constituting 53.5% of the female participants) and 186 males (representing 46.5% of the male participants) stated that they engaged in this activity. The results indicate that females were more inclined to use music to improve their PA experience. The largest enrolment was observed in Year 2, with a total of 130 students, accounting for 32.5% of the entire sample. The number of students in year three was 117, which accounted for 29.3% of the total. In the initial year, 82 students accounted for 20.5% of the sample. In the fourth year, they consisted of 71 students, which accounted for 17.8% of the total. This section accurately depicts the distribution of current academic levels among participants. It also offers insights into participants' music preferences, indicating the influence of different types of music on their PA experiences.

### *Validity and Reliability of the Questionnaires*

The survey questionnaire used in this research was derived from previous surveys, particularly the STOMP (Short Test of Music Preferences) developed by Rentfrow and Gosling (2003), and later modified by Langmeyer et al. (2012). It was designed to assess four dimensions of music preference: motivational music, high-tempo music, upbeat music, and rhythmic music. Responses were assessed using Likert scales, which categorize data on an ordinal scale. The researchers employed five-point Likert scales to assess music preferences and emotions, and seven-point Likert scales to evaluate attention and self-reported physical performance, in accordance with the recommendations of Rentfrow and Gosling (2003) and Langmeyer et al. (2012).

This study explicitly differentiates between observable independent variables and latent variables. Music that individuals choose for themselves, as well as lively, fast-paced, motivating, and rhythmic music, are considered independent factors that directly affect motivation, attention, and emotion (which are hidden factors), and then influence physical performance (the final result). These genres of music are used as exogenous variables in our structural equation model (PLS-SEM) to examine their direct impact on reflecting latent variables.

In order to guarantee the accuracy and dependability of the measuring tools, we utilized the PLS-SEM methodology. The reliability of the model was evaluated using Composite Reliability (CR), which is particularly suitable for PLS-SEM. Additionally, Cronbach's Alpha was used. A CR score above 0.7 indicates satisfactory reliability. The validity of the data was evaluated by calculating the Average Variance Extracted (AVE), where values greater than 0.5 indicate satisfactory convergent validity. The Fornell-Larcker criterion was utilized to establish discriminant validity among the constructs.

### *Designing the Questionnaire*

In this study, a methodical questionnaire, modified from prior survey items, was employed to assess individuals' inclination towards listening to music while engaging in physical exercise. The questionnaire items were derived from Rentfrow and Gosling (2003) concise music preference test, with slight modifications. The questionnaire consists of 13 items that cover four dimensions of music preference:

motivational music (e.g., blues, jazz, and classical music), fast-paced music (e.g., rock, heavy metal, and alternative music), upbeat music (e.g., pop music, New German Wave, movie music, and German pop), and rhythmic music (e.g., soul/R&B, rap/hip-hop, and electronica) (Brown, 2012; Langmeyer et al., 2012).

This study classifies self-selected, upbeat, high-tempo, motivational, and rhythmic music as independent variables. These variables are used to explore their impact on the three latent variables of motivation, attention, and emotion, ultimately affecting physical performance. These music-type variables are treated as exogenous variables in our PLS-SEM analysis.

The participants' motivation in sport was assessed using a questionnaire created by Gill et al. (1983), which encompassed eight categories: achievement/status, teamwork, fitness, energy release, situational considerations, skill development, friendship, and fun. The researchers employed the Sport Emotions Questionnaire (SEQ) to assess the primary emotions experienced by participants during physical activity, including enthusiasm, happiness, anger, annoyance, and anxiety (Jones et al., 2005). The SEQ consisting 22 items of emotions. The study utilized the Attention Questionnaire (AQ-RARC), developed and validated by Christakou et al. (2012), consisting of 10 questions to evaluate participants' attention levels during exercise. The researchers employed the International Fitness Inventory (IFIS) questionnaire to assess participants' self-reported physical performance and fitness levels while listening to music. This questionnaire addressed multiple dimensions, encompassing general physical fitness, cardiorespiratory fitness, muscular strength, speed and agility, and flexibility.

The structured survey questionnaire for this research was adapted from previous surveys, specifically the STOMP (Short Test of Music Preferences) by Rentfrow and Gosling (2003), later modified by Langmeyer et al. (2012) to cover four music preference dimensions: motivational music (blues, jazz, and classical), high-tempo music (rock, heavy metal, and alternative), upbeat music (pop, New German Wave, film music, and popular German music), and rhythmic music (soul/R&B, rap/Hip Hop, and electronica) (Rudan & Tarnai, 2012). The measurement of responses followed the Likert scale, placing data on an ordinal scale. Five-point Likert scales were used for music preferences and emotions, while seven-point Likert scales measured attention and self-reported physical performance, as recommended by the original sources. The PLS-SEM methodology assessed the reliability and validity of latent variables and associated indicators. Reliability measured consistency, while validity evaluated the accuracy of depicting fundamental concepts. The model's reliability and validity were confirmed by the Fornell-Larcker criterion, requiring a composite reliability (CR) of at least 0.7 and an average variance extracted (AVE) of at least 0.5.

### *Analysis of Data*

The PLS-SEM methodology assesses measurement models by examining the reliability and validity of latent variables and associated indicators. The latent variables in this study include motivation, attention, and emotion. These variables are not directly observed but are inferred from multiple observed indicators. For example, motivation is measured using indicators such as self-reported enthusiasm,

willingness to engage in physical activities, and persistence. Attention is measured through indicators like focus duration, distraction frequency, and task completion rates. Emotion is assessed using indicators such as self-reported feelings of happiness, stress, and relaxation. We clearly distinguished between independent and latent variables in the data analysis. Self-selected music, along with upbeat music, high-tempo music, motivational music, and rhythmic music, are treated as independent variables. These directly impact changes in motivation, attention, and emotion (considered as latent variables) and, through these latent variables, further influence physical performance (the dependent variable).

These music type variables are analyzed as exogenous variables to assess their direct effects on the latent variables. For example, motivation is measured using a questionnaire with items such as 'I want to improve my skills,' 'I like to compete,' and 'I want to stay in shape,' which are rated on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree). Attention is measured through items like 'My thoughts were concentrated on my goal,' 'My attention was distracted by irrelevant thoughts,' and 'I was concentrated on my performance,' rated on a scale from 1 (Not at all) to 7 (Very Much). Emotion is assessed using a list of feelings such as 'Joyful,' 'Nervous,' and 'Tense,' rated on a scale from 0 (Not at all) to 4 (Extremely). Reliability evaluates the consistency and dependability of measurements, while validity concerns the degree to which these measurements accurately represent the underlying concepts. The model's validity and reliability are confirmed through adherence to the Fornell-Larcker criterion, necessitating composite reliability (CR) of no less than 0.7 and average variance extracted (AVE) of no less than 0.5. This study selected SmartPLS-SEM for its capacity to manage complex models involving multiple latent variables and its robustness in addressing small sample sizes. This method facilitates the simultaneous analysis of multiple relationships and is capable of handling non-normal data distributions.

Additionally, SmartPLS-SEM offers reliable estimates for both formative and reflective measurement models, rendering it proper for the comprehensive analysis necessary in this study. The assessment of the structural model included analysing the model fit adequacy, the statistical significance and importance of the path coefficients, and the model's predictive capability. The model's fit measures, specifically the Standardized Root Mean Square Residual (SRMR) and Root Mean Square Error of Approximation (RMSEA) being below 0.08, along with the Comparative Fit Index (CFI) exceeding 0.90, met the acceptance criteria. Furthermore, the t-value of the path coefficient exceeds 1.96, signifying its statistical significance. A model exhibiting a $R^2$ value exceeding 0.3 and a $Q^2$ value greater than 0 demonstrates robust explanatory and predictive capabilities. These data unequivocally validate that various music genres have a substantial impact on improving athletic performance and psychological well-being.

### *Reliability Analysis*

We evaluated the dependability and accuracy of this study as seen in Table 2.1 and 2.2. Dependability pertains to the degree of consistency in a study, and the Cronbach's alpha coefficient is a widely employed analytical approach. Coefficients ranging from 0.8 to 0.9 typically indicate a high level of

dependability. Validity analysis, also known as reliability, pertains to the measurement instrument's capacity to accurately assess the intended variable. High validity refers to the extent to which measurements accurately capture the true characteristics of the subject and establish a shared understanding of a variable among many researchers. A CR score exceeding 0.7 signifies a consistent explanation of the variable by the measurements inside each latent variable. The convergent validity of the dimensions was evaluated using variance extraction (AVE), where AVE values greater than 0.5 indicate strong convergent validity. The attention dimension, as measured by Cronbach's alpha (0.905), CR (0.921), and AVE (0.54), demonstrated strong consistency and reliability.

*Table 2.1.* Reliability and Validity Analysis of Constructs

| Latent variable | Observed variables | factor loadings | Cronbach alpha | CR | AVE |
|---|---|---|---|---|---|
| Attention | c1 | 0.743 | 0.905 | 0.921 | 0.54 |
| | c2 | 0.734 | | | |
| | c3 | 0.707 | | | |
| | c4 | 0.705 | | | |
| | c5 | 0.755 | | | |
| | c6 | 0.734 | | | |
| | c7 | 0.721 | | | |
| | c8 | 0.751 | | | |
| | c9 | 0.736 | | | |
| | c10 | 0.755 | | | |
| Emotion | e1 | 0.716 | 0.956 | 0.960 | 0.522 |
| | e2 | 0.713 | | | |
| | e3 | 0.721 | | | |
| | e4 | 0.711 | | | |
| | e5 | 0.771 | | | |
| | e6 | 0.709 | | | |
| | e7 | 0.713 | | | |
| | e8 | 0.738 | | | |
| | e9 | 0.717 | | | |
| | e10 | 0.735 | | | |
| | e11 | 0.717 | | | |
| | e12 | 0.722 | | | |
| | e13 | 0.735 | | | |
| | e14 | 0.709 | | | |
| | e15 | 0.718 | | | |
| | e16 | 0.718 | | | |
| | e17 | 0.711 | | | |
| | e18 | 0.713 | | | |
| | e19 | 0.717 | | | |
| | e20 | 0.704 | | | |
| | e21 | 0.721 | | | |
| | e22 | 0.758 | | | |
| High-tempo Music | x4 | 0.853 | 0.846 | 0.906 | 0.764 |
| | x5 | 0.894 | | | |
| | x6 | 0.874 | | | |

*Table 2.2.* Reliability and Validity Analysis of Constructs

| Latent variable | Observed variables | factor loadings | Cronbach alpha | CR | AVE |
|---|---|---|---|---|---|
| Motivation | m1 | 0.717 | 0.968 | 0.970 | 0.519 |
| | m2 | 0.728 | | | |
| | m3 | 0.707 | | | |
| | m4 | 0.716 | | | |
| | m5 | 0.709 | | | |
| | m6 | 0.710 | | | |
| | m7 | 0.707 | | | |
| | m8 | 0.715 | | | |
| | m9 | 0.713 | | | |
| | m10 | 0.723 | | | |
| | m11 | 0.732 | | | |
| | m12 | 0.725 | | | |
| | m13 | 0.721 | | | |
| | m14 | 0.717 | | | |
| | m15 | 0.729 | | | |
| | m16 | 0.728 | | | |
| | m17 | 0.724 | | | |
| | m18 | 0.708 | | | |
| | m19 | 0.702 | | | |
| | m20 | 0.718 | | | |
| | m21 | 0.721 | | | |
| | m22 | 0.730 | | | |
| | m23 | 0.741 | | | |
| | m24 | 0.735 | | | |
| | m25 | 0.725 | | | |
| | m26 | 0.725 | | | |
| | m27 | 0.731 | | | |
| | m28 | 0.736 | | | |
| | m29 | 0.708 | | | |
| | m30 | 0.717 | | | |
| Motivation Music | x1 | 0.859 | 0.807 | 0.886 | 0.721 |
| | x2 | 0.835 | | | |
| | x3 | 0.852 | | | |
| Physical Performance | p1 | 0.765 | 0.806 | 0.866 | 0.563 |
| | p2 | 0.753 | | | |
| | p3 | 0.743 | | | |
| | p4 | 0.759 | | | |
| | p5 | 0.731 | | | |
| Rhythmic Music | x11 | 0.874 | 0.858 | 0.913 | 0.779 |
| | x12 | 0.897 | | | |
| | x13 | 0.876 | | | |
| Upbeat Music | x7 | 0.840 | 0.860 | 0.905 | 0.705 |
| | x8 | 0.837 | | | |
| | x9 | 0.839 | | | |
| | x10 | 0.842 | | | |

Similarly, the emotion dimension, as measured by Cronbach's alpha (0.956), CR (0.960), and AVE (0.522), also exhibited strong consistency and reliability. The fast-paced music, with a Cronbach's alpha of 0.846, CR of 0.906, and AVE of 0.764, demonstrated strong performance in eliciting associated

psychological responses. The dependent variable, "self-selected music", was measured with a single item, so its confirmatory factor analysis results were not considered. The questionnaire, which incorporated motivational music, displayed reliability and convergent validity, as indicated by its Cronbach's alpha values of 0.807 and 0.806, CR values of 0.886 and 0.866, and AVE values of 0.721 and 0.563, respectively. The statistics not only establish the reliability and validity of the questionnaire measures, but also offer a quantitative foundation for comprehending the impact of music on physical performance.

*Discriminant Validity*

The Heterotrait-Monotrait Ratio (HTMT) approach was employed in this study to evaluate the discriminant validity among latent variables. A ratio below 0.85 was considered indicative of strong validity. Table 3 demonstrates that the HTMT ratios for the five music kinds (High-tempo, Motivational, Rhythmic, Upbeat, and Self-Selected) and the three psychological aspects (Attention, Emotion, Motivation) were all lower than the specified threshold, suggesting a satisfactory level of distinction. The ratios ranged from 0.300 to 0.471, demonstrating the distinct impact of various forms of music on psychological traits. The independent variable of Physical Performance exhibited HTMT ratios below 0.5 with all other variables, thus confirming the model's validity. To summarise, the HTMT results indicate strong discriminant validity, thereby supporting the overall validity and precision of the model's measurements. Further analysis employing the Fornell-Larcker criterion can yield additional verification.

*Table 3.* Discriminant Validity Using Fornell-Larcker Criterion

| | C | E | H | M | MM | P | RM | SM | UM |
|---|---|---|---|---|---|---|---|---|---|
| Attention | **0.735** | | | | | | | | |
| Emotion | 0.313 | **0.722** | | | | | | | |
| High-tempo Music | 0.369 | 0.300 | **0.874** | | | | | | |
| Motivation | 0.368 | 0.371 | 0.384 | **0.721** | | | | | |
| Motivation Music | 0.360 | 0.329 | 0.260 | 0.357 | **0.849** | | | | |
| Physical Performance | 0.374 | 0.428 | 0.352 | 0.375 | 0.307 | **0.750** | | | |
| Rhythmic Music | 0.308 | 0.363 | 0.380 | 0.394 | 0.243 | 0.347 | **0.882** | | |
| Self-Selected Music | 0.386 | 0.361 | 0.344 | 0.388 | 0.358 | 0.398 | 0.340 | **1.000** | |
| Upbeat Music | 0.400 | 0.396 | 0.454 | 0.433 | 0.347 | 0.403 | 0.423 | 0.373 | **0.840** |

This study utilised the Fornell-Larcker criterion to assess the discriminant validity. Table 4 shows that the square roots of the Average Variance Extracted (AVE) for each latent variable significantly exceed their correlations with other variables, thereby verifying their independence within the model. As an illustration, the square root of the average of the squared values for High-tempo Music is 0.874, exceeding its correlations with Motivation (0.384) and Attention (0.370). Moreover, the AVE values for all five music styles and the three psychological components (Attention, Emotion, Motivation) and Physical Performance exceed their correlations, indicating strong discriminant validity. This supports the previous HTMT Ratio analysis, further

confirming the model's capacity to differentiate between various constructs. The dual validation strategy, comprising the HTMT Ratio and Fornell-Larcker criterion, verifies that the latent variables in the research model are distinct. This enhances the validity and credibility of the findings.

*Table 4*. Path coefficient

| Path | Coefficient | Standard Deviation | T-statistic | p-value |
|---|---|---|---|---|
| Attention-> Physical Performance | 0.214 | 0.054 | 3.955 | 0.000 |
| Emotion -> Physical Performance | 0.291 | 0.052 | 5.606 | 0.000 |
| High-tempo Music -> Attention | 0.157 | 0.054 | 2.909 | 0.004 |
| High-tempo Music -> Emotion | 0.057 | 0.056 | 1.021 | **0.308** |
| High-tempo Music -> Motivation | 0.140 | 0.052 | 2.700 | 0.007 |
| Motivation -> Physical Performance | 0.188 | 0.061 | 3.096 | 0.002 |
| Motivation Music -> Attention | 0.179 | 0.051 | 3.492 | 0.000 |
| Motivation Music -> Emotion | 0.151 | 0.054 | 2.820 | 0.005 |
| Motivation Music -> Motivation | 0.159 | 0.050 | 3.190 | 0.001 |
| Rhythmic Music -> Attention | 0.072 | 0.049 | 1.479 | **0.139** |
| Rhythmic Music -> Emotion | 0.172 | 0.055 | 3.097 | 0.002 |
| Rhythmic Music -> Motivation | 0.172 | 0.052 | 3.280 | 0.001 |
| Self-Selected Music -> Attention | 0.180 | 0.052 | 3.455 | 0.001 |
| Self-Selected Music -> Emotion | 0.160 | 0.055 | 2.893 | 0.004 |
| Self-Selected Music -> Motivation | 0.156 | 0.051 | 3.079 | 0.002 |
| Upbeat Music -> Attention | 0.169 | 0.058 | 2.925 | 0.003 |
| Upbeat Music -> Emotion | 0.186 | 0.055 | 3.363 | 0.001 |
| Upbeat Music -> Motivation | 0.183 | 0.057 | 3.181 | 0.001 |

Figure 2 depicts a Structural Equation Model (SEM) employing Partial Least Squares Path Modelling (PLS-PM) approaches to evaluate the impact of various music genres on psychological attributes (such as motivation, emotion, and attention) and physical performance. The approach encompasses five distinct genres of music: motivational, fast-paced, uplifting, rhythmic, and self-selected. The relationship between these music categories and psychological qualities and physical performance was analysed predictively. The figure reveals latent variables, denoted by blue circles, and encompasses psychological qualities and physical performance. Observable variables are depicted as yellow rectangles, symbolising different music genres as observable indicators. The numbers on the connecting lines indicate route coefficients, which measure the level of correlation between the predictors and the outcome variables.

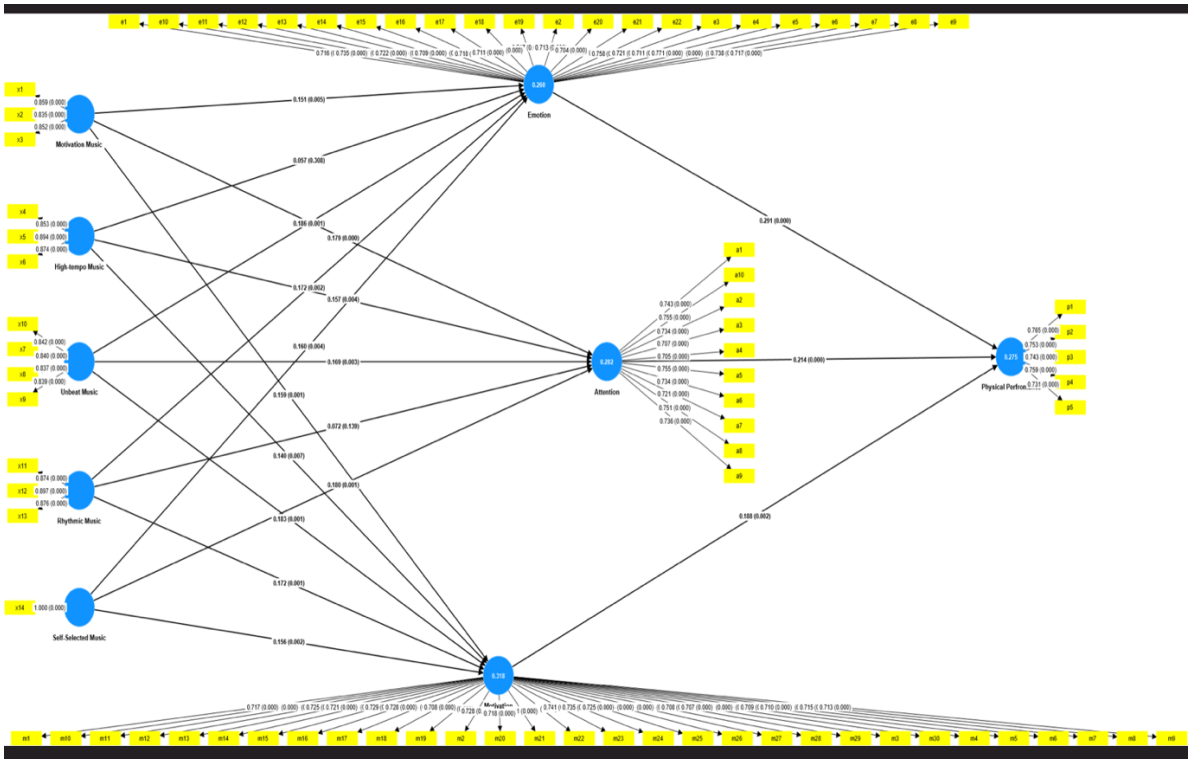


*Figure 2.* Partial Least Square Structural Equation Modelling Results

The structural model analysis, as shown in Table 5, revealed that attention and physical performance had a strong positive correlation (t-value = 3.955, p-value = 0.000). Additionally, emotion had a significant impact on physical performance (t-value = 5.606, p-value = 0.000), and motivation also had a statistically significant effect on physical performance (p-value = 0.002, t-value = 3.096). The presence of fast-paced music had a notable impact on both attention and motivation (p-value = 0.004 and 0.0007, respectively, with t-values of 2.909 and 2.700, respectively). However, it did not have a significant influence on emotion (p-value = 0.308, t-value = 1.021). The impact of motivational music on attention, emotion, and motivation was statistically significant (p-value=0.000, 0.005, and 0.001, t-value=3.429, 2.820, 3.190, respectively). Similarly, the effect of rhythmic music on these psychological aspects was also statistically significant (p-value=0.003, 0.001, and 0.001, t-value=2.925, 3.363, and 3.181, respectively). The participants' selection of music had a notable and beneficial impact on their focus, emotional state, and drive (p-values varied from 0.001 to 0.004). In general, the majority of music genres showed notable beneficial impacts on many psychological aspects, which subsequently affected physical performance.

*Table 5.* Physical performance

| | $R^2$ | post-adjustmentR2 |
|---|---|---|
| Attention | 0.282 | 0.272 |
| Emotion | 0.260 | 0.251 |
| Motivation | 0.318 | 0.309 |
| Physical Performance | 0.275 | 0.270 |

The structural model assessment showed that the path coefficient t-value > 1.96, indicating significance, and the model fit metrics (SRMR, RMSEA < 0.08; CFI > 0.90) satisfied the acceptance criteria. Good explanatory and predictive ability was demonstrated by the model's $R^2$ value > 0.3 and $Q^2$ value > 0. These data unequivocally validate that various music genres substantially impact athletic performance and psychological well-being.

## Findings

### *Various genres of music have a substantial impact on enhancing participants' enthusiasm for physical activity*

The study demonstrates that music can regulate emotions, subsequently influencing individuals' motivation and conduct. Upbeat music enhances an individual's innate motivation by amplifying good emotions. The study's findings demonstrated that upbeat, high-tempo, motivational, rhythmic, and self-selected music notably enhanced participants' motivation to engage in physical activities. Karageorghis and Priest (2008) discovered that music can enhance the emotion and motivation of athletes, particularly music with lively rhythms and joyful tones, which can elevate positive emotion and motivation during physical exercises. According to the theories mentioned above and prior research, it is anticipated that upbeat, high-tempo, motivational, rhythmic, and self-selected music will significantly enhance participants' motivation in PA, leading to a notable positive effect. Table 6 shows that hypotheses H3a-H3e propose that upbeat, high-tempo, motivational, rhythmic, and self-selected music have a significant positive correlation with enhancing participants' motivation levels during physical exercise. Results confirm that they are strongly linked.

### *Various genres of music have notable impacts on enhancing participants' concentration during physical exertion*

Studies indicate that music can improve concentration by modifying a person's emotional condition and heightening cognitive stimulation. Music can elicit happy emotions, which are thought to enhance cognitive functions, including attention and concentration. Furthermore, based on the psychological theory of music, music can impact an individual's mental arousal by employing its rhythmic and melodic characteristics, indirectly influencing their ability to concentrate and sustain attention. Rapid-paced and rhythmic characteristics of music may enhance athletic performance by improving positive emotions and reducing feelings of fatigue and exertion (Liu et al., 2021). Patania et al. (2020) found that rapid-paced music had a positive influence on exercisers' physiological responses. Their findings indicated that music with

rapid tempo significantly increased physiological arousal and performance levels during physical activity. This study highlights the significance of music tempo in enhancing the exercise experience by increasing emotion and motivation, which permits improved performance and endurance among participants. This includes enhanced attention, elevated arousal, and raised faster reaction speed. Thakare et al. (2017) found that motivational music can enhance an individual's mental state and facilitate better concentration and determination, especially during long periods of physical exertion. The music an individual selects for themselves has a substantial and advantageous impact on enhancing attention, regardless of the options available. Researchers found that allowing participants to choose their music improved their attention and performance more than the music provided for them (Clark et al., 2021; Jebabli et al., 2020). This is because it closely aligns with an individual's preferences and emotional condition. According to the theories mentioned above and prior research, it is anticipated that Upbeat, Motivational, Rhythmic, and Self-Selected Music will have a noteworthy and favourable influence on individuals engaging in physical activities, particularly enhancing their attention.

While High-Tempo Music may have particular benefits for specific individuals or situations, its impact on improving attention is often limited. Multiple studies support the claim that music may impact emotional states and perceived effort. For instance, Clark et al. (2021) and Terry et al. (2020) demonstrated that the speed and motivational aspects of music significantly influence athletes' performance by modifying their emotional states and perceived exertion levels. According to Terry et al. (2020) music featuring quality lyrics and an energising tempo can boost motivation and emotional states and reduce the perceived exertion when exercising. Williams et al. (2023) demonstrated that self-selected music enhances emotional states and motivation during exercise, resulting in improved performance and overall satisfaction with the exercise experience. These findings highlight the significant impact that music may play in regulating emotional reactions and enhancing the physical performance of those who engage in physical activities. A recent study Meng et al. (2020) has shown the impact of music on various elements of physical and cognitive function. Ouergui et al. (2023) demonstrated that fast-paced music enhances physiological responses during exercise, thereby improving motivation and performance. Furthermore, the impact of music on attention varies depending on the song and the listener's emotional condition. McFerran et al. (2022) investigated this by looking at how music impacts focus during daily work, indicating that rhythmic music may not constantly improve attention under some circumstances. The study demonstrated that specific genres of music can be disruptive, mainly when performing jobs that demand a significant amount of focus.

It has been proposed that the impact of music on attention is contingent upon the attributes of the music itself and the individual's current state of attention. Thus, hypotheses H4a, H4c, H4d, and H4e state that during PA, upbeat, high-tempo, motivational, and self-selected music have a substantial association with boosting participants' attention levels. As presented in Table 6, the presence of rhythmic music, as stated in H4d, did not significantly

improve participants' attention levels. This outcome may be attributed to the repetitive nature of rhythmic music, which might not sufficiently stimulate or sustain attention compared to other music genres. Additionally, individual differences in music preferences and task demands could influence the varying effects of music on attention. Research by Karageorghis et al. (2019) suggests that while rhythmic music enhances coordination and flow, its repetitive structure may limit its ability to engage cognitive processes like attention.

### *Various genres of music have a notable impact on enhancing the emotions of individuals when engaging in physical exercise*

Various genres of music have a notable impact on enhancing the emotions of individuals when engaging in physical exercise. Studies indicate that music can positively influence individuals' emotional well-being by helping them manage and control their emotions (Karageorghis & Priest, 2012; Lane & Terry, 2000). It elicits diverse emotional responses through melodic, rhythmic, and harmonic elements, which affect an individual's emotional condition (Tong, 2024). It elicits diverse emotional responses by including various melodic, rhythmic, and harmonic elements, influencing an individual's emotional condition. According to the According to Attentional Focusing Theory (Eysenck et al., 2007) and Affective Response Theory (Mehrabian & Russell, 1974), music enables individuals to regulate their emotions by adapting or altering their present emotional state. Music exerts a favorable influence on emotional states by stimulating the brain's emotional centers and modulating an individual's emotional reactions. humans utilize music to regulate their emotions, intending to adapt or alter their present emotional state. Music has a favourable impact on emotional states by influencing the brain's emotional centres and modulating an individual's emotional reactions.

Furthermore, music can serve as a psychological intervention. According to the idea of psychological arousal, suitable music can manage an individual's level of psychological arousal and aid in attaining a desired emotional state. Dynamic music, motivating music, and music with a pronounced rhythm can significantly amplify the emotional condition of those involved in physical exercise. Lane and Terry (2000) discovered that including vibrant music can greatly enhance the emotional well-being of athletes and amplify the pleasure they derive from participating in PA. Biagini et al. (2012) shown that the utilization of motivational music improves an individual's emotional state and stimulates them to actively engage and get enjoyment from physical exercises. Karageorghis and Priest (2008) discovered that rhythmic music can enhance the emotional well-being of athletes by promoting positive emotions and diminishing negative emotions. The selection of music by individuals has a substantial influence on improving emotion during PA. A study conducted by Terry et al. (2020) demonstrated that an individual's selection of music can have a substantial impact on emotion enhancement, the promotion of happiness, and the facilitation of engagement when exercising. The result of the current investigation aligns with these prior studies.

Nevertheless, several studies (e.g., Karageorghis et al., 2010; Smith & Brown, 2015) has indicated that high-tempo music may not increase emotion

to the degree anticipated. As summarised in Table 6, the impact of high-speed music on emotion improvement was not statistically significant, possibly because the emotional response is highly sensitive to the music's tempo. Karageorghis et al. (2010) noted that while high-tempo music can enhance arousal, its effects on emotion may vary depending on individual preferences and task demands. Furthermore, listening to music while exercising may improve psychological factors (e.g., emotion, motivation) and psychophysiological (e.g., rate of perceived effort, arousal) alterations, allowing for more positive reactions throughout an exercise challenge. However, there is conflicting data about music's efficacy, which might be mediated by differences in music selection and preference (Ballmann, 2021). Karageorghis et al. (1999) discovered that fast-paced music boosted facial muscle activation and skin conductance, indicating a beneficial effect on general well-being. However, they found that high-tempo music did not significantly improve emotion more than melancholy music. According to the aforementioned theories and studies, hypotheses H5a, H5c, H5d, and H5e propose that Upbeat Music, Motivational Music, Rhythmic Music, and Self-Selected Music have a strong correlation with enhancing the participants' Attention level during physical activities. According to the aforementioned theories and studies, hypotheses H5a, H5c, H5d, and H5e propose that Upbeat Music, Motivational Music, Rhythmic Music, and Self-Selected Music have a strong correlation with enhancing participants' emotion levels during physical activities. However, H5b, concerning High-Tempo Music, lacks substantial evidence to support its impact on improving emotion levels. This outcome may be attributed to the complexity of emotional responses, which are often influenced by individual differences, such as personal preferences for tempo and the psychological state of participants prior to engaging with the music, as presented in Table 6.

### *Participant motivation has a substantial impact on the performance or results of physical activity*

Music has the ability to impact athletes' performance by affecting their sense of rhythm, increasing their drive, and enhancing their psychological emotions. This is achieved through music's rhythmic, melodic, and harmonic parts. Psychophysiological theories suggest that music can impact both the physiological and psychological condition of an individual, hence influencing their athletic performance. According to research, different genres impact motivation, attention, and emotions. Jakupčević et al. (2021) discovered a favourable link between music absorption and emotion regulation, but a negative one with mindfulness. Rock music can improve emotion and motivation (Tripathy & Chaudhari, 2021). Genres impact cerebral hemodynamic responses, and deep learning algorithms can successfully categorise these effects. Musical emotions affect attentional performance, particularly arousal (Fernandez et al., 2021). Music indirectly improves athletic performance by influencing the physiological and psychological conditions of athletes. Synchronizing the pace of music with the rhythm of the sport can assist athletes in maintaining a consistent and efficient movement tempo, hence enhancing the overall efficiency of the sport.

According to the aforementioned theories and research, we anticipated that music has a substantial impact on enhancing the performance of those engaged in athletic activities. As presented in in Table 6, findings support H6 postulating that the motivation of individuals in group has a significant impact on their physical performance.

### *The performance or outcome of physical activity is significantly influenced by the attention of participants*

According to affective response theory and music psychology, different genres of music can evoke varied emotional responses, altering an individual's mental and physiological state. The concept of rhythmicity posits that the tempo of music may synchronise with an individual's rate of movement, influencing movement efficiency and physiological response. Focusing one's attention is critical for improving workout performance. Vast et al. (2010) observed a high correlation between positive emotions like excitement and enjoyment and the capacity to maintain attention. This increased degree of attention helps to improve PA and overall sport performance. As a result of their different musical characteristics, numerous music genres influence an individual's emotional state, capacity to focus, and levels of physiological arousal, impacting physical performance and psychological well-being in various ways.

Emotions in sport can affect an athlete's performance by influencing their degree of arousal, focus of attention, and decision-making ability. According to current studies, athletes who successfully manage their emotions perform better under pressure (Lane & Terry, 2000). Kinanti et al. (2023) and Röglin et al. (2023) offered additional support for these findings, with Kinanti proving that fast-paced music improved attention and Röglin revealing that a high-intensity exergame entertained children. Musical emotions can influence attentional performance, namely the arousal component (Fernandez et al., 2021). According to Bishop et al. (2009), upbeat music significantly impacts attention during exercise, raising arousal, enhancing emotion, and promoting more engagement and pleasure.

According to the ideas and research outlined above, music is expected to significantly improve physical performance. Table 6 shows that the findings confirmed H7, affirming that participants' attention significantly influences their physical performance.

### *Participants' emotions significantly impact their physical activity performance or outcomes*

According to affective response theory and music psychology, music may modulate and impact an individual's mental state and motor performance in certain circumstances or conditions. Emotions have a significant influence on one's physical performance. According to Kita (2012), emotional functions such as stress management, emotion regulation, and regulating sadness or anxiety influence athletic performance because they cause physical and functional changes in brain areas that are critical for emotional regulation. Furthermore, music influences participants' emotional reactions, psychological arousal, and physiological states during certain physical activities, improving physical performance and psychological experience. According to Bigliassi et al. (2019), music's rhythm and melodies stimulate the brain's emotional and

motor areas, resulting in increased emotion and physical performance. They observed that music activates brain systems related to emotional regulation and motor control, which can dramatically improve workout pleasure and efficiency. Music, particularly those with strong rhythmic features, can synchronise with an individual's movement, lowering perceived effort and enhancing endurance during physical exercise. This synchronisation and emotional connection explain why music is such an effective tool for improving exercise's psychological and physiological elements (Bigliassi et al., 2019).

Emotions in sport can affect an athlete's performance by influencing their degree of arousal, focus of attention, and decision-making ability. According to recent studies, athletes who can efficiently manage their emotions perform better in high-pressure circumstances. Furthermore, athletes who feel good emotions, such as excitement and joy, are more motivated and perform better than those who experience negative emotions, such as worry and fear (Woodman et al., 2009). Jakupčević et al. (2021) found a positive association between music absorption and emotion regulation, whereas a negative correlation was found for mindfulness. Rock music has been shown to boost emotion, provoke emotions, and motivate listeners (Tripathy & Chaudhari, 2021). Music genres may be efficiently classified based on their influence on cerebral hemodynamic responses, with deep-learning models performing well (Rahman et al., 2022). Musically-induced emotions can influence attentional performance, namely the arousal component (Fernandez et al., 2021). Emotional intelligence has a major influence on music learning performance, mediated by motivation. Background music can influence cognitive control, and musical arrangement judgements are significant (Yoo et al., 2022). Musicians control their emotions throughout practice to support their goal orientation, with others preferring a mixed emotional state (Breaden Madden & Jabusch, 2021).

According to the aforementioned views and studies, music is expected to improve the performance of those participating in physical activities significantly. The results confirm H8, demonstrating that participants' emotions significantly influence their physical performance. This finding aligns with the Proposed Theoretical Model, highlighting the critical role of emotional states in enhancing physical outcomes during activities.

*Table 6.* Hypothesis testing outcomes

| Hypotheses | p | T | Establishment situation |
|---|---|---|---|
| *H3a: Upbeat music has a significant effect toward improving participants' motivation during physical activities.* | 0.001 | 3.181 | supported |
| *H3b: High-tempo music has a significant effect toward improving participants' motivation during physical activities.* | 0.007 | 2.700 | supported |
| *H3c: Motivational music has a significant effect toward improving participants' motivation during physical activities.* | 0.001 | 3.190 | supported |
| *H3d: Rhythmic music has a significant effect toward improving participants' motivation during physical activities.* | 0.001 | 3.280 | supported |
| *H3e: Self-selected music has a significant effect toward improving participants' motivation during physical activities.* | 0.002 | 3.079 | supported |
| *H4a: Upbeat music has a significant effect toward improving participants' attention during physical activities.* | 0.003 | 2.925 | supported |
| *H4b: High-tempo music has a significant effect toward improving participants' attention during physical activities.* | 0.004 | 2.909 | supported |
| *H4c: Motivational music has a significant effect toward improving participants' attention during physical activities.* | 0.000 | 3.492 | supported |
| *H4d: Rhythmic music has a significant effect toward improving participants' attention during physical activities.* | 0.139 | 1.479 | not supported |
| *H4e: Self-selected music has a significant effect toward improving participants' attention during physical activities.* | 0.001 | 3.455 | supported |
| *H5a Upbeat music has a significant effect toward improving participants' emotion during physical activities.* | 0.001 | 3.363 | supported |
| *H5b: High-tempo music has a significant effect toward improving participants' emotion during physical activities.* | 0.308 | 1.021 | not supported |
| *H5c: Motivational music has a significant effect toward improving participants' emotion during physical activities.* | 0.005 | 2.820 | supported |
| *H5d: Rhythmic music has a significant effect toward improving participants' emotion during physical activities.* | 0.002 | 3.097 | supported |
| *H5e: Self-selected music has a significant effect toward improving participants' emotion during physical activities.* | 0.004 | 2.893 | supported |
| *H6: The motivation of the participant significantly influences the performance or outcome of the physical activity.* | 0.002 | 3.096 | supported |
| *H7: The attention of the participant significantly influences the performance or outcome of the physical activity.* | 0.000 | 3.955 | supported |
| *H8: The emotion of the participant significantly influences the performance or outcome of the physical activity.* | 0.000 | 5.606 | supported |

## Conclusion

This study explored the effects of various music genres on physical exercise, focusing on changes in motivation, attention, and emotion and their impact on performance. Except for two hypotheses, sixteen were supported by the results of data analysis. Out of the 18 hypotheses tested, 16 were supported by the data analysis. These results confirm that vibrant, rhythmic, and motivational music significantly

enhances motivation and evokes positive emotions, contributing to improved physical performance. Self-selected music demonstrated the strongest effects, emphasising the importance of personal preference in achieving optimal outcomes. However, H4d, predicting the impact of rhythmic music on attention, and H5b, anticipating high-tempo music's influence on emotion, were not supported, indicating the nuanced and context-dependent nature of music's effects on psychological and physical factors.

Nonetheless, the study is limited by its cultural context and sample size, which may affect the generalizability of the results. Future research should involve more extensive and diverse samples to examine the impact of personalised music interventions on physical performance across different cultural settings. Despite the study's limitations, findings contribute to the ongoing discourse on the benefits of incorporating music into physical education and sport to enhance the overall experience and promote PA.

## Statement of Research and Publication Ethics

This study, "The Effects of Incorporating Music in Physical Education on the Physical Performance of Students in Chinese Sports Universities," adheres to rigorous publishing ethics. These include informed consent, confidentiality, data integrity, transparency, non-bias, and compliance with ethical norms for proper attribution and plagiarism avoidance, as approved by the Institutional Ethics Committee (IEC) from UCSI University and the Institutional Review Board (IRB) of the Shandong Sport University on 20/08/2022.

## Acknowledgements & Funding Statement

We acknowledge the Department of Education, Faculty of Social Sciences and Liberal Arts, UCSI University, for providing ample opportunities to develop this research. We also extend our gratitude to the Shandong Sports University for offering useful materials, facilities, and a workplace so that the program could be completed and to Yufei Liu of the Shandong Sports Science Research Center for his support and help.

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## References


Abadi, F. H., Khairah, N. A. M., Lee, A. C., Zainudin, F. F., & Motevalli, S. (2022). The musculoskeletal injury profile of aquatic sports athletes: A case study in UPSI. *International Journal of Human Movement and Sports Sciences, 10*, 55-60. https://doi.org/10.13189/saj.2022.101309

Abadi, F. H., Tiis, N. H. a. A., Zainuddin, F. F., Choeibuakaew, W., Elumalai, G., Sankaravel, M., & Motevalli, S. (2022). The impact of combination of core stabilization exercise and walking on pain perception and low-back pain disability. *Pedagogy of Physical Culture and Sports, 26*(5), 276-283. https://doi.org/10.15561/26649837.2022.0501

Anghelcev, G. (2013). The impact of attentional focus on advertising effectiveness: the case of congruity effects. *International Journal of Integrated Marketing Communications, 5*(2), 77-90.

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. https://doi.org/10.3390/jfmk6020033

Banu, S., Jehan, M., & Pasha, S. A. (2022). The impact of physical activities on the academic performance and burnout of female medical students in India. *Health Sciences Journal, 1*(1), 20-25. https://doi.org/10.59365/hsj.1(1).2022.25

Behm, D. G., & Carter, T. B. (2021). Empathetic factors and influences on physical performance: a topical review. *Frontiers in Psychology, 12*, 686262. https://doi.org/10.3389/fpsyg.2021.686262

Biagini, M. S., Brown, L. E., Coburn, J. W., Judelson, D. A., Statler, T. A., Bottaro, M., Tran, T. T., & Longo, N. A. (2012). Effects of self-selected music on strength, explosiveness, and mood. *The Journal of Strength & Conditioning Research, 26*(7), 1934-1938. https://doi.org/10.1519/JSC.0b013e318237e7b3

Bigliassi, M., Karageorghis, C. I., Hoy, G. K., & Layne, G. S. (2019). 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. https://doi.org/10.1016/j.psychsport.2018.06.010

Bishop, D. T., Karageorghis, C. I., & Kinrade, N. P. (2009). Effects of musically-induced emotions on choice reaction time performance. *The Sport Psychologist, 23*(1), 59-76. https://doi.org/10.1123/tsp.23.1.59

Borges, J. C., de Oliveira Filho, G. G., de Lira, C. A. B., da Silva, R. A. D., Alves, E. d. S., Benvenutti, M. J., & Rosa, J. P. P. (2021). Motivation levels and goals for the practice of physical exercise in five different modalities: a correspondence analysis. *Frontiers in Psychology, 12*, 793238. https://doi.org/10.3389/fpsyg.2021.793238

Breaden Madden, G., & Jabusch, H.-C. (2021). Instrumental and hedonic motives for emotion regulation in musical practice. *Frontiers in Psychology, 12*, 643974. https://doi.org/10.3389/fpsyg.2021.643974

Brown, R. A. (2012). Music preferences and personality among Japanese university students. *International Journal of Psychology, 47*(4), 259-268. https://doi.org/10.1080/00207594.2011.631544

Christakou, A., Zervas, Y., Psychountaki, M., & Stavrou, N. A. (2012). Development and validation of the attention questionnaire of rehabilitated athletes returning to competition. *Psychology, Health & Medicine, 17*(4), 499-510. https://doi.org/10.1080/13548506.2011.630402

Clark, J. C., Baghurst, T., & Redus, B. S. (2021). Self-selected motivational music on the performance and perceived exertion of runners. *The Journal of Strength & Conditioning Research, 35*(6), 1656-1661. https://doi.org/10.1519/JSC.0000000000002984

Consorti, A., Di Marco, I., & Sansevero, G. (2021). Physical exercise modulates brain physiology through a network of long-and short-range cellular interactions. *Frontiers in Molecular Neuroscience, 14*, 710303. https://doi.org/10.3389/fnmol.2021.710303

Di Corrado, D., Quartiroli, A., & Coco, M. (2021). Psychological and motor associations in sports performance: a mental approach to sports. *Frontiers in Psychology, 12*, 629944. https://doi.org/10.3389/fpsyg.2021.629944

Eysenck, M. W., & Brysbaert, M. (2018). *Fundamentals of cognition*. Routledge.

Fernandez, N. B., Vuilleumier, P., Gosselin, N., & Peretz, I. (2021). Influence of background musical emotions on attention in congenital amusia. *Frontiers in Human Neuroscience, 14*, 566841. https://doi.org/10.3389/fnhum.2020.566841

Folkman, S. (2020). Stress: appraisal and coping. In *Encyclopedia of Behavioral Medicine* (pp. 2177-2179). Springer. https://doi.org/10.1007/978-3-030-39903-0_215

Gawor, A., Hogervorst, E., & Wilcockson, T. (2021). Does an acute bout of moderate exercise reduce alcohol craving in university students? *Addictive Behaviors, 123*, 107071. https://doi.org/10.1016/j.addbeh.2021.107071

Gill, D. L., Gross, J. B., & Huddleston, S. (1983). Participation motivation in youth sports. *International Journal of Sport Psychology, 14*(1), 1-14. https://api.semanticscholar.org/CorpusID:149616397

Goldbeck, F., Xie, Y. L., Hautzinger, M., Fallgatter, A. J., Sudeck, G., & Ehlis, A.-C. (2021). Relaxation or regulation: the acute effect of mind-body exercise on heart rate variability and subjective state in experienced Qi Gong practitioners. *Evidence-Based Complementary and Alternative Medicine, 2021*. https://doi.org/10.1155/2021/6673190

Homagain, A., & Ehgoetz Martens, K. A. (2023). Emotional states affect walking performance. *BioRxiv*, 2023.2003. 2029.534813. https://doi.org/10.1101/2023.03.29.534813

Hove, M. J., Martinez, S. A., & Shorrock, S. R. (2022). Physical exercise increases perceived musical pleasure: modulatory roles of arousal, affect, or dopamine? *Psychology of Music, 50*(3), 849-861. https://doi.org/10.1177/03057356211013400

Hutchinson, J. C., Jones, L., Vitti, S. N., Moore, A., Dalton, P. C., & O'Neil, B. J. (2018). The influence of self-selected music on affect-regulated exercise intensity and remembered pleasure during treadmill running. *Sport, Exercise, and Performance Psychology, 7*(1), 80. https://doi.org/10.1037/spy0000115

Jakupčević, K. K., Ercegovac, I. R., & Dobrota, S. (2021). Music as a tool for mood regulation: the role of absorption vs. Mindfulness. *Primenjena Psihologija, 14*(2), 229-248. https://doi.org/10.19090/pp.2021.2.229-248

James, W. (2007). *The principles of psychology* (Vol. 1). Cosimo, Inc.

Jawwad, G., Khan, H. F., Iftikhar, M., Hussain, A., Arshad, S., & Siddique, L. (2022). Exercise induces autonomic and neuro-endocrine response among psychologically stressed medical students. *Pakistan Journal of Medical & Health Sciences, 16*(06), 135-135. https://doi.org/10.53350/pjmhs22166135

Jebabli, N., Granacher, U., Selmi, M. A., Al-Haddabi, B., Behm, D. G., Chaouachi, A., & Haj Sassi, R. (2020). Listening to preferred music improved running performance without changing the pacing pattern during a 6 minute run test with young male adults. *Sports, 8*(5), 61. https://doi.org/10.3390/sports8050061

Jones, L., Karageorghis, C., Lane, A., & Bishop, D. (2017). The influence of motivation and attentional style on affective, cognitive, and behavioral outcomes of an exercise class. *Scandinavian Journal of Medicine & Science in Sports, 27*(1), 124-135. https://doi.org/10.1111/sms.12577

Jones, M. V., Lane, A. M., Bray, S. R., Uphill, M., & Catlin, J. (2005). Development and validation of the sport emotion questionnaire. *Journal of Sport and Exercise Psychology, 27*(4), 407-431. https://doi.org/10.1123/jsep.27.4.407

Kagawa, F., Yokoyama, S., Takamura, M., Takagaki, K., Mitsuyama, Y., Shimizu, A., Jinnin, R., Ihara, H., Kurata, A., & Okada, G. (2022). Decreased physical activity with subjective pleasure is associated with avoidance behaviors. *Scientific Reports, 12*(1), 2832. https://doi.org/10.1038/s41598-022-06563-3

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

Karageorghis, C. I., Hutchinson, J. C., Bigliassi, M., Watson, M. P., Perry, F. A., Burges, L. D., Melville-Griffiths, T., & Gomes-Baho, T. J. (2019). Effects of auditory-motor synchronization on 400-m sprint performance: an applied study. *International Journal of Sports Science & Coaching, 14*(6), 738-748. https://doi.org/10.1177/1747954119879359

Karageorghis, C. I., Jones, L., Howard, L. W., Thomas, R. M., Moulashis, P., & Santich, S. J. (2021). When it HIITs, you feel no pain: psychological and psychophysiological effects of respite–active music in high-intensity interval training. *Journal of Sport and Exercise Psychology, 43*(1), 41-52. https://doi.org/10.1123/jsep.2019-0335

Khodi, A. (2021). The affectability of writing assessment scores: a G-theory analysis of rater, task, and scoring method contribution. *Language Testing in Asia, 11*(1), 30. https://doi.org/10.1186/s40468-021-00134-5

Khodi, A., Khezerlou, H., & Sahraei, H. (2022). Dependability and utility of using e-portfolios in assessing EFL learners' speaking proficiency. *Computer Assisted Language Learning*, 1-23. https://doi.org/10.1080/09588221.2022.2093379

Khodi, A., Ponniah, L. S., Farrokhi, A. H., & Sadeghi, F. (2024). Test review of Iranian English language proficiency test: MSRT test. *Language Testing in Asia, 14*(1), 4. https://doi.org/10.1186/s40468-023-00270-0

Kinanti, A. D., Maharani, C., Syahputri, D. A., Yogiswara, A., & Farisandy, E. D. (2023). Fast tempo increases attention: the effect of music tempo on attention. *Psikostudia: Jurnal Psikologi, 12*(1), 1-7. https://doi.org/10.30872/psikostudia.v12i1.8924

Kita, I. (2012). Behavioral neuroscience of emotion and exercise. *The Journal of Physical Fitness and Sports Medicine, 1*(3), 363-367. https://doi.org/10.7600/jpfsm.1.363

Koelsch, S., Vuust, P., & Friston, K. (2019). Predictive processes and the peculiar case of music. *Trends in Cognitive Sciences, 23*(1), 63-77. https://doi.org/10.1016/j.tics.2018.10.006

Krejcie, R., & Morgan, D. (1970). Determining sample size for research activities. *Educational Psychol Meas*. https://doi.org/10.1177/001316447003000308

Kumar, G. V., & Sivachandiran, S. (2022). The teaching physical exercise with music–pedometric evaluation. *EAI Endorsed Transactions on e-Learning, 8*(2), e3-e3. https://doi.org/10.4108/eetel.v8i2.3073

Lane, A. M., & Terry, P. C. (2000). The nature of mood: Development of a conceptual model with a focus on depression. *Journal of Applied Sport Psychology, 12*(1), 16-33. https://doi.org/10.1080/10413200008404212

Langmeyer, A., Guglhör-Rudan, A., & Tarnai, C. (2012). What do music preferences reveal about personality? *Journal of Individual Differences*. https://doi.org/10.1027/1614-0001/a000082

Lazarus, R. S. (1991). *Emotion and adaptation*. Oxford University Press.

Liu, C., Li, Z., & Du, X. (2021). The effect of musical stimulation in sports on sports fatigue of college students. *Journal of Internet Technology, 22*(1), 187-195. https://jit.ndhu.edu.tw/article/view/2472

Liu, H., Liang, J., Wang, K., Zhang, T., Liu, S., & Luo, J. (2023). Mood status response to physical activity and its influence on performance: are chronotype and exercise timing affect? *International Journal of Environmental Research and Public Health, 20*(4), 2822. https://doi.org/10.3390/ijerph20042822

McFerran, K., Crooke, A., Kalenderidis, Z., Stokes, H., & Teggelove, K. (2022). What young people think about music, rhythm and trauma: An action research study. *Frontiers in Psychology, 13*, 905418. https://doi.org/10.3389/fpsyg.2022.905418

Meetei, N. S. (2023). Sports and physical activities on academic performance and overall personal development: a longitudinal case study/**運動與體育活動對於學業表現及全人發展的關聯: 一個個案的長期研究**. *European Journal of Physical Education and Sport Science, 9*(5). https://doi.org/10.46827/ejpe.v9i5.4743

Méndez-Alonso, D., Prieto-Saborit, J. A., Bahamonde, J. R., & Jiménez-Arberás, E. (2021). Influence of psychological factors on the success of the ultra-trail runner. *International Journal of Environmental Research and Public Health, 18*(5), 2704. https://doi.org/10.3390/ijerph18052704

Meng, X., Li, G., Jia, Y., Liu, Y., Shang, B., Liu, P., Bao, X., & Chen, L. (2020). Effects of dance intervention on global cognition, executive function and memory of older adults: a meta-analysis and systematic review. *Aging Clinical and Experimental Research, 32*, 7-19. https://doi.org/10.1007/s40520-019-01159-w

Milona, M., Threadgill, H., & Gable, P. (2024). Hope and enthusiasm/excitement. In *Emotion Theory: The Routledge Comprehensive Guide* (pp. 218-231). Routledge.

Mohamed, M. N., Sani, N. Q. A. M., Rahman, M. W. A., Annur, M. S. S., Mazaulan, M., Razak, M. A., & Radzi, N. A. A. M. (2022). Association between enjoyment factor and physical activity level among tertiary education students. *Malaysian*

*Journal of Sport Science and Recreation (MJSSR), 18*(1), 24-35. https://ir.uitm.edu.my/id/eprint/60699

Motevalli, S., Sulaiman, T., Wong, K. Y., & Jaafar, W. M. W. (2022). Athletes' psycho-physical training and cognitive restructuring module to enhance university-athlete students' well-being. *The Open Psychology Journal, 15*(1). https://doi.org/10.2174/18743501-v15-e221018-2022-13

Ouergui, I., Jebabli, E., Delleli, S., Messaoudi, H., Bridge, C. A., Chtourou, H., Franchini, E., Ballmann, C. G., & Ardigò, L. P. (2023). Listening to preferred and loud music enhances taekwondo physical performances in adolescent athletes. *Perceptual and Motor Skills, 130*(4), 1644-1662. https://doi.org/10.1177/00315125231178067

Pang, P. (2022). A method of personal music psychological recognition based on psychological and physiological signals. *Scientific Programming, 2022*(1), 8577034. https://doi.org/10.1155/2022/8577034

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. https://doi.org/10.3389/fpsyg.2020.00074

Piatkowski, T. M., Neumann, D. L., Keane, C., & Dunn, M. (2024). "More drugs means more stress on my body": exploring enhancement and health among elite strength athletes who use performance and image enhancing drugs. *Addiction Research & Theory, 32*(5), 333-338. https://doi.org/10.1080/16066359.2023.2271839

Rahman, J. S., Caldwell, S., Jones, R., & Gedeon, T. (2022). Brain melody interaction: understanding effects of music on cerebral hemodynamic responses. *Multimodal Technologies and Interaction, 6*(5), 35. https://doi.org/10.3390/mti6050035

Rakhmatullayevna, A. D. (2023). Psychological health as a factor of personal sports results. *Frontline Social Sciences and History Journal, 3*(01), 79-87. https://doi.org/10.37547/social-fsshj-03-01-08

Ransom, P. F. (2015). Message in the music: do lyrics influence well-being. *Master of Applied Positive Psychology (MAPP) Capstone Projects, 94*, 1-45. http://repository.upenn.edu/mapp_capstone/94

Rentfrow, P. J., & Gosling, S. D. (2003). The do re mi's of everyday life: the structure and personality correlates of music preferences. *Journal of Personality and Social Psychology, 84*(6), 1236-1256. https://doi.org/10.1037/0022-3514.84.6.1236

Reyes-Bossio, M., Corcuera-Bustamante, S., Veliz-Salinas, G., Villas Boas Junior, M., Delgado-Campusano, M., Brocca-Alvarado, P., Caycho-Rodríguez, T., Casas-Apayco, L., Tutte-Vallarino, V., & Carbajal-León, C. (2022). Effects of psychological interventions on high sports performance: a systematic review. *Frontiers in Psychology, 13*, 1068376. https://doi.org/10.3389/fpsyg.2022.1068376

Röglin, L., Stoll, O., Ketelhut, K., Martin-Niedecken, A. L., & Ketelhut, S. (2023). Evaluating changes in perceived enjoyment throughout a 12-week school-based exergaming intervention. *Children, 10*(1), 144. https://doi.org/10.3390/children10010144

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: classic definitions and new directions. *Contemporary Educational Psychology, 25*(1), 54-67. https://doi.org/10.1006/ceps.1999.1020

Shirehjini, S. N., Farahani, M. S., Ibrahim, M. K., Salman, H. M., Motevalli, S., & Mohammadi, M. H. (2023). Mechanisms of action of noninvasive brain stimulation with weak non-constant current stimulation approaches. *Iranian Journal of Psychiatry, 18*(1), 72. https://doi.org/10.18502/ijps.v18i1.11415

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. https://doi.org/10.1037/bul0000216

Thakare, A. E., Mehrotra, R., & Singh, A. (2017). Effect of music tempo on exercise performance and heart rate among young adults. *International Journal of Physiology, Pathophysiology and Pharmacology, 9*(2), 35.

Tong, F. (2024). Human motion and musical expression: Exploring the link between physical movement and emotional resonance in performance. *Molecular & Cellular Biomechanics, 21*(2), 401-401. https://doi.org/10.62617/mcb.v21i2.401

Tran Minh, T. (2022). The effect of popular music on female students' fitness in physical education courses. *Annals of Applied Sport Science, 10*(1), 0-0. https://doi.org/10.52547/aassjournal.1120

Tripathy, M., & Chaudhari, M. (2021). The impact of rock music on Indian young adults: a qualitative study on emotions and moods. *Revista Geintec-Gestao Inovacao E Tecnologias, 11*(4), 5361-5374.

Vast, R. L., Young, R. L., & Thomas, P. R. (2010). Emotions in sport: perceived effects on attention, concentration, and performance. *Australian Psychologist, 45*(2), 132-140. https://doi.org/10.1080/00050060903261538

Wang, F., & Zheng, G. (2022). Examining positional difference in basketball players' field goal accuracy using Bayesian hierarchical model. *International Journal of Sports Science & Coaching, 17*(4), 848-859. https://doi.org/10.1177/17479541221096772

Weinberg, R. S., & Gould, D. (2023). *Foundations of sport and exercise psychology* (8th ed.). Human kinetics.

Williams, A. S., Park, B., & Pedersen, Z. P. (2023). The influence of music on self-paced fitness consumers' perceived motivational qualities and optimal level of emotional state and satisfaction with exercise experience. *International Journal of Sport Management and Marketing, 23*(4), 310-326. https://doi.org/10.1504/IJSMM.2023.131950

Woodman, T., Davis, P. A., Hardy, L., Callow, N., Glasscock, I., & Yuill-Proctor, J. (2009). Emotions and sport performance: an exploration of happiness, hope, and anger. *Journal of Sport and Exercise Psychology, 31*(2), 169-188. https://doi.org/10.1123/jsep.31.2.169

Yang, Y. (2022). Psychological motivation of athletes' physical training based on deep learning model. *International Transactions on Electrical Energy Systems, 2022*. https://doi.org/10.1155/2022/1962461

Yoo, G. E., Lee, S., Kim, A. J., Choi, S. H., Chong, H. J., & Park, S. (2022). Differential background music as attentional resources interacting with cognitive control. *International Journal of Environmental Research and Public Health, 19*(22), 15094. https://doi.org/10.3390/ijerph192215094

Zhang, S., Roscoe, C., & Pringle, A. (2023). Self-compassion and physical activity: the underpinning role of psychological distress and barrier self-efficacy. *International Journal of Environmental Research and Public Health, 20*(2), 1480. https://doi.org/10.3390/ijerph20021480