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RESEARCH ARTICLE

Music Tempo and Reaction Time in NCAA Division II Athletes

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Abstract

The purpose of this study was to examine the relationship between music tempo and reaction time in collegiate athletes and consider its implications for coaching practice and applied sport science. 45 NCAA Division II athletes aged 18–27 completed the Deary-Liewald Reaction Task under four auditory conditions: no music, slow-tempo music (72 beats per minute [bpm]), moderate-tempo music (100 bpm), and fast-tempo music (184 bpm). A within-participant design was used across two testing days, with simple and complex reaction tasks completed under each condition. Results: The repeated-measures analysis of variance indicated a significant effect of task and a significant task × auditory condition interaction (both $p < .001$), but no overall effect of auditory condition ($p = .495$). Mean simple reaction time was shortest without music (294.97 milliseconds), whereas mean complex reaction time was shortest at 100 bpm (432.07 milliseconds). However, no individual condition comparison was significant after Bonferroni adjustment. These findings suggest the pattern of reaction times across music conditions differed by task complexity, but they do not establish an optimal music tempo or demonstrate that music improves athletic performance. Coaches and sport practitioners need practical ways to evaluate whether music supports the intended demands of training and athlete preparation. Rather than prescribing a specific tempo, coaches can evaluate music strategies in relation to task demands and athlete responses.

Keywords: Music Tempo, Athletes, Reaction Time, Decision Making.

1. Introduction

Music is a familiar feature of athlete preparation and training, making it a practical topic for coaching innovation. Athletes report using music to manage emotion and motivation (6), while a meta-analytic review supports benefits across several exercise and sport outcomes (9). For coaches, however, the relevant question is whether a music strategy serves the purpose of a particular activity. A playlist that athletes find energizing may not produce a measurable advantage in rapid responding. Evaluating this distinction provides an opportunity to apply sport science to an everyday coaching decision.

Innovation in coaching can involve systematically evaluating accessible tools already embedded in practice. Music tempo is one such variable because it can be deliberately adjusted and examined alongside a defined performance outcome. Coaches and sport scientists can therefore ask whether an auditory environment supports the demands of preparation, physical training, or response selection. Evidence across exercise and sport offers a rationale for investigating music, but it does not establish that a particular tempo will improve every component of performance (3, 9). This makes task-specific testing more useful than assuming that faster music necessarily produces faster responses.

Reaction time offers a focused outcome for examining this question. The Deary-Liewald task distinguishes a simple response to one visual stimulus from a complex

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response requiring selection of the corresponding key (2). Although both tasks measure response speed, they differ in response-selection demands. This distinction is relevant to coaching because activities vary in the information athletes must detect and the responses they must choose. Computer-based reaction tasks do not reproduce the anticipation, movement, and interpersonal demands of competition; they provide a controlled starting point for investigating one aspect of performance.

Research on music and cognition also suggests task demands deserve attention. Gonzalez and Aiello (5) found cognitive performance varied with music, task, and performer characteristics. Bishop et al. (1) examined music presented before a reactive task, illustrating the importance of distinguishing preparation music from music played during performance. These studies support examination of the listening context without establishing a general coaching prescription. Evidence from other settings, including work on music tempo and prolonged driving (7), provides additional reasons to investigate attention and response demands, but transfer to athletic performance requires direct testing.

Tempo may influence responses through changes in activation or attention, although those mechanisms cannot be inferred from tempo alone. Nguyen and Grahn (8) examined music-induced mood and arousal across memory tasks, and athletes describe intentional emotional and motivational uses of music (6). Together, these findings suggest that an athlete's experience of music may matter alongside the task being performed. Measuring reaction time under different tempos can test a performance outcome; establishing why that outcome changes would additionally require measures of arousal, attention, preference, or motivation.

The purpose of this study was to examine reaction time under no-music and three music-tempo conditions in NCAA Division II athletes performing simple and complex tasks. The hypothesis was that moderate-tempo music at 100 beats per minute would produce shorter reaction times than slower music at 72 beats per minute and faster music at 184 beats per minute. The present article considers the findings in relation to coaching innovation and the role of sport science in evaluating training environments. Its applied contribution is to inform how music strategies might be tested, rather than to establish a universal tempo recommendation.

2. Materials and Methods

2.1 Participants

Participants included 45 NCAA Division II athletes aged 18–27, recruited by email for voluntary participation. An a priori G*Power calculation using $\alpha = .05$, an effect size of $f = .30$, and power of .80, with a target sample of 34 (4). Athletes completed all four auditory conditions in a within-participant design across two testing days. IRB approval was granted by an ethics board and participants signed informed consent paperwork before testing acknowledging that participation was voluntary.

2.2 Procedures

Participants sat at a computer and wore headphones during the testing conditions. The conditions were no music, slow-tempo music at 72 beats per minute, moderate-tempo music at 100 beats per minute, and fast-tempo music at 184 beats per minute. The same song was used across music conditions, with playback altered to vary tempo. Tempo selection was informed by research on emotional responses to music (10). The no-music and 72-beats-per-minute conditions were completed on Day 1; the 100- and 184-beats-per-minute conditions were completed on Day 2. Condition order was counterbalanced within each day. The simple task always preceded the complex task within each condition. Athletes completed eight practice trials and 20 test trials for the simple task, followed by eight practice trials and 40 test trials for the complex task. A 30-second rest separated tasks, and a one-minute rest separated auditory conditions. Music stopped during the rest periods, and participants kept their headphones on.

The Deary-Liewald Reaction Task (2) was used to measure reaction time in milliseconds. During the simple task, participants pressed the space bar when an X appeared in a single box. During the complex task, participants pressed the key corresponding to the location of an X in one of four boxes; the response keys were z, x, comma, and period. The program recorded trial reaction times, and mean reaction times were analyzed separately for the simple and complex tasks.

2.3 Data Analyses

The statistical analysis was a 2 (task: simple, complex) × 4 (auditory condition: no music, 72, 100, and 184 beats per minute) repeated-measures ANOVA. Paired-samples t tests examined all six condition comparisons within each task. Bonferroni-adjusted

p values were used to control for the six comparisons within each task, with significance evaluated at .05.

3. Results

The ANOVA showed longer reaction times for the complex task than for the simple task, $F(1, 44) = 269.18$, $p < .001$, partial $\eta^2 = .91$. The main effect of auditory condition was not significant, $F(1.51, 42.28) = 0.63$, $p = .495$, partial $\eta^2 = .02$. The task by auditory condition interaction was significant, $F(2.56, 71.78) = 9.47$, $p < .001$, partial $\eta^2 = .25$ (Table 1). Thus, the pattern across conditions differed by task, without an overall advantage for one auditory condition.

Table 1. *Repeated Measures ANOVA for Reaction Time by Task and Music Condition*

Effect	df_1	df_2	F	p	ηp^2
Task	1	44	269.18	< .001	.91
Music condition	1.51	42.28	0.63	.495	.02
Task × Music condition	2.56	71.78	9.47	< .001	.25

Note: *Task had two levels (simple and complex); music condition had four (no music, 72, 100, and 184 bpm).*

For the simple task, mean reaction time was shortest without music (294.97 ms), followed by 72 beats per minute (306.28 ms), 100 beats per minute (307.48 ms), and 184 beats per minute (316.14 ms). For the complex task, mean reaction time was shortest at 100 beats per minute (432.07 ms), followed by 184 beats per minute (436.38 ms), 72 beats per minute (452.07 ms), and no music (456.14 ms). Descriptive values are presented in Table 3.

None of the six paired comparisons within either task was significant after Bonferroni adjustment (Table 2). Adjusted p values ranged from .435 to 1.000 for the simple task and from .058 to 1.000 for the complex task. Although the complex mean at 100 beats per minute was 24.07 ms shorter than the no-music mean and 20.00 ms shorter than the 72-beats-per-minute mean, the corresponding adjusted p values were .058 and .085. These descriptive differences do not establish a reliable advantage for moderate-tempo music.

Table 2. *Bonferroni Adjusted Paired Samples t Tests for Reaction Time*

Task	Comparison	Mean difference (ms)	t(44)	p
Simple	Control - 72 bpm	-11.31	-1.87	.435
Simple	Control - 100 bpm	-12.52	-1.75	.544
Simple	Control - 184 bpm	-21.17	-1.82	.478
Simple	72 - 100 bpm	-1.21	-0.23	1.000
Simple	72 - 184 bpm	-9.86	-1.07	1.000
Simple	100 - 184 bpm	-8.66	-1.05	1.000
Complex	Control - 72 bpm	4.07	0.77	1.000
Complex	Control - 100 bpm	24.07	2.78	.058
Complex	Control - 184 bpm	19.76	1.75	.544
Complex	72 - 100 bpm	20.00	2.61	.085
Complex	72 - 184 bpm	15.69	1.58	.747
Complex	100 - 184 bpm	-4.31	-0.78	1.000

Note: *Mean difference equals the first condition minus the second; positive values indicate slower reactions in the first condition. All tests are paired, two tailed, and based on n = 45. Adjusted p values use Bonferroni correction for six comparisons within each task.*

Table 3. *Mean Reaction Times by Task and Music Condition*

	N	*M*
Simple Control	45	294.97
Complex Control	45	456.14
Simple 72BPM	45	306.28
Complex 72BPM	45	452.07
Simple 100 BPM	45	307.48
Complex 100 BPM	45	432.07
Simple 184 BPM	45	316.14
Complex 184 BPM	45	436.38

4. Discussion

This study examined an accessible training-environment variable through a controlled comparison of music tempo and reaction time in collegiate athletes. The reported interaction suggests the pattern across auditory conditions depended on the task being performed. There was no overall condition effect, and no individual condition comparison remained significant after adjustment.

The different patterns across tasks are compatible with a broader account in which music's effects depend on the music, performer, and activity (5). However, compatibility does not establish the mechanism. The complex task required athletes to identify a location and select a response, whereas the simple task required one predetermined response. The lower descriptive mean at 100 beats per minute on the complex task warrants further testing, particularly because Gonzalez and Aiello (5) reported interference during complex cognitive performance under other music conditions. The differences between these tasks and music manipulations caution against treating cognitive complexity as a sufficient basis for predicting benefit.

The study also extends a coaching-relevant distinction between music used before an activity and music heard during it. Bishop et al. (1) investigated pre-task music and subsequent reactive performance. Sport scientists can help coaches specify when music is intended to act and evaluate that period rather than generalizing results across preparation and performance. Arousal and attention remain possible explanations, rather than measured pathways.

Research on music-induced mood and arousal (8) and athletes' emotional and motivational uses of music (6) supports their relevance to future investigation. Future work should measure psychological responses alongside performance to distinguish feeling prepared from responding more effectively. The testing schedule also limits interpretation. The no-music and slower-tempo conditions occurred on Day 1, whereas the moderate- and faster-tempo conditions occurred on Day 2. Counterbalancing within days does not remove possible confounding between condition and testing day. Familiarization, fatigue, or other day-related influences could contribute to the observed pattern.

5. Conclusion

As a contribution to sport literature and coaching innovation, the study supports an evaluative approach rather than a validated new intervention. The results indicate a task by auditory condition interaction, but neither an overall condition effect nor a significant adjusted comparison between individual conditions. The study therefore does not identify an optimal tempo for athletes. However, it does indicate a significant difference in reaction time when music tempo is combined with task complexity. Therefore, coaches are encouraged to explore explicit evaluation of music in relation to the activity and intended outcome. Applied sport science can help translate this question into representative testing while maintaining appropriate limits on performance claims.

5.1 Applications in Sport

For coaches, the clearest practical finding is that reactions differed substantially between simple and complex tasks, while no individual music condition showed a reliable advantage after adjustment for all pairwise comparisons. Music choices during warm-ups and training can instead be considered in relation to the demands of the upcoming activity, including whether athletes need to monitor instructions, communicate, or make rapid decisions.

Athletes may value music for preparation, motivation, and emotional regulation, as described by Laukka and Quick (6). The present results do not suggest that athletes must stop using music. They do suggest separating an athlete's subjective benefit, such as feeling energized or focused, from a demonstrated improvement in reaction time. An athlete who wants to evaluate a pre-performance playlist could compare how different selections affect perceived readiness and performance during representative practice drills, while keeping the rest of the routine as consistent as possible.

Sport psychology practitioners and coaches can also use these findings to guide individualized conversations about when music helps and when it competes with attention. For example, music may be useful during preparation, while a quieter environment may be preferable when an athlete needs to hear tactical cues or practice complex responses. These are practical options to evaluate with athletes rather than conclusions established by this study. Future applied testing should examine preferred music, perceived activation, and sport-specific performance together before recommending a particular tempo.

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