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Effects of Respite Music on Repeated Upper-body Resistance Exercise Performance

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ABSTRACT

***International Journal of Exercise Science* 15(7): 79-87, 2022.** The purpose of this study was to investigate the effects of self-selected respite music on upper-body resistance exercise performance. In a crossover, counterbalanced study design, resistance-trained males (n = 10) participated in two bench press trials each with a different condition: 1) No music (NM), 2) Listening to respite music (RM; i.e. during rest periods). Following a warm-up, participants completed 3 sets × repetitions to failure (RTF) at 75% of 1-RM separated by 2 minutes of rest. During the 2-minute rest, participants either listened to NM or RM until the next subsequent set. A linear position transducer was used to measure mean barbell velocity during the first 3 repetitions and averaged for analysis. Rate of perceived exertion (RPE) and motivation were obtained after each set. Results indicate that mean velocity was higher during set 2 (p = 0.009; d = 1.34) and set 3 (p = 0.048; d = 0.95) while listening to RM versus NM. Furthermore, motivation was significantly higher following set 2 (p = 0.005; d = 1.15) and set 3 (p < 0.001; d = 1.79) while listening to RM compared to NM. No changes in RTF or RPE were noted between conditions (p > 0.05). These findings indicate listening to music during recovery may enhance subsequent explosive resistance performance and suggest that listening to music in between bouts of maximal effort could be an effective tool for optimizing performance during competition or training.

KEYWORDS: Bench press, velocity, motivation

INTRODUCTION

A multitude of evidence exists showing that listening to music enhances exercise performance (1, 28). This has been shown in multiple exercise types including endurance, sprint, and resistance-based exercise (6, 11, 19, 22). The benefits of listening to music may be mediated through various mechanisms including psychological (i.e. motivation, mood), physiological (i.e. oxygen uptake, autonomic control), and psychophysiological (i.e. rate of perceived exertion, arousal) (1). While music and responses to exercise have been widely described, the optimal timing of the application of music is still unclear, especially in resistance exercise.

Listening to music during resistance exercise has been studied while music is being played before and during exercise. Overall, music has shown positive benefits towards resistance exercise performance although some conflicting evidence exists (6, 7, 9). Ballmann et al. showed that listening to preferred music during resistance exercise increased barbell velocity and repetitions to failure (RTF) during a single set of bench press (6). Supporting this, Bartolomei et al. reported improved bench press strength-endurance while listening to self-selected music (7). Still, others have shown that while listening to music may not enhance repetition volume, it does improve explosive jumping and acute power performance (9). Disparities between findings are not fully known but may be due to nuances in the duration of how long music is played for or whether or not music was played continuously throughout the entirety of each trial. With regards to timing, multiple investigations have shown improvements in bench press performance when music is played before exercise (2, 3). Listening to self-selected music solely before bench press RTF has been shown to increase repetition volume and velocity of barbell movement although RPE was unaffected (3). Furthermore, preferred warm-up music has been shown to increase RTF during repeated bench press exercise but did not alter RPE (2). Thus, music not played during exercise may have less potent effects on modifying RPE and across many of the previously mentioned studies, music-induced increases in motivation appear to be crucial in allowing for optimal effort and performance (2, 3, 6). Anecdotally, music is played at competitions and sporting events before and/or during breaks of gameplay. However, many athletes and competitors are not permitted to listen to music during competition thus making it difficult to practically apply previous findings of improved performance while listening to music during exercise. While there is evidence suggesting benefits of listening to music before resistance exercise, virtually no research exists determining if listening to music solely during rest periods is advantageous during resistance exercise.

Respite music, or music during rest/recovery, has recently been studied in high-intensity exercise but benefits remain equivocal (16, 18). Jones et al. showed that listening to respite music had little effect on affective responses during a high-intensity interval training session although performance was not measured (18). Hutchinson et al. reported that listening to stimulative respite music between repeated Wingate anaerobic tests resulted in increased arousal and peak power development (16). Thus, it is possible that listening to music during rest periods could serve as an effective ergogenic tool to allow for better subsequent exercise performance. However, no studies to date have determined the efficacy of listening to respite music on repeated resistance exercise performance. The purpose of this study was to investigate the effects of self-selected respite music on upper-body resistance exercise (i.e. velocity, repetition volume), specifically bench press exercise. We hypothesized that respite music would result in better maintenance of barbell velocity and repetition volume during bench press exercise. Furthermore, we predicted that RPE would be lower and motivation higher with respite music.

METHODS

Participants

An *a priori* power analysis using statistical software (G*power V 3.1.9.4) was completed to determine an adequate sample size. Previous work from our lab measuring bench press velocity between preferred and non-preferred music using similar loads showed increases in barbell velocity with an estimated effect size of d = 1.6 (6). To obtain minimal sample size number, the following parameters were used: test = t-test (matched pairs), d = 1.6, α = 0.05, 1-β = 0.8. This revealed a minimum sample size of 6 for adequate power. In agreement with previous literature (2, 3, 6), 12 resistance-trained males were recruited to participate, and 2 participants were excluded via screening and due to noncompliance to pre-test procedures. Descriptive characteristics of participants (n = 10) are shown in [Table 1]. Resistance-trained was defined according to the American College of Sports Medicine as accumulating a minimum of 2-3 days of resistance exercise each week (26). Screening for the safety of exercise was completed using a physical activity readiness questionnaire (PARQ) (26). Individuals were excluded if they reported an upper-extremity injury within the last 6 months that disrupted training, cardiovascular disease, musculoskeletal disease, metabolic disease, or other health problems (13, 30). Before each exercise session, participants were asked to refrain from caffeine, nicotine, and alcohol 12 hours prior and vigorous upper body exercise 24 hours prior (26). Informed consent was obtained from each participant before data collection and all experimental procedures were approved by the Samford University Institutional Review Board (IRB). This research was carried out in accordance with the ethical standards of the International Journal of Exercise Science (23).

Table 1. Descriptive Characteristics (n = 10)

Characteristic	Mean ± SD
Age (yrs)	20.7 ± 1.1
Height (cm)	180.8 ± 5.8
Body Mass (kg)	81.8 ± 13.2
1RM (kg)	101.5 ± 18.4
Relative strength [(1RM (kg)/ BM (kg)]	1.3 ± 0.1
Training Experience (yrs)	4.2 ± 2.7

1RM = 1 Repetition Maximum; BM = Body mass

Protocol

To determine the appropriate load for subsequent experimental trials, participants first completed a separate 1RM testing trial for bench press exercise to determine maximal strength as previously described by our lab (3, 6, 17, 30). Briefly, participants began by completing a warm-up consisting of 5 repetitions at 50% and 3 repetitions at 70% of their initial self-reported bench press 1RM separated by 2 minutes of rest. After the warm-up, participants began to complete true 1RM bench press attempts with the barbell weight progressively increased by 2.5 – 20.0 kg for each attempt. This was completed until the participant could not complete the concentric phase of the lift. Each attempt was separated by a 3-minute rest period within a maximum of four attempts. To familiarize participants with lifting explosively, participants lifted a standard 20-kg Olympic bar as fast and as explosively as possible for three repetitions, and form was corrected as needed (3, 30).

In a randomized and counterbalanced, crossover study design, participants completed 2 experimental visits following the 1-RM trial with a differing condition: 1) no music (NM), 2) respite music (RM; i.e. during rest/recovery). To begin, participants completed a standardized bench press warm-up which included 5 repetitions at 40% 1-RM followed by 3 repetitions at

60% 1-RM. Each warm-up set was separated by 1 minute of rest. Following an additional 3 minute rest, participants then completed 3 sets × repetitions to failure (RTF) at 75% 1RM as explosively as possible (30). There were 2 minutes of passive rest between each set of RTF. During these periods, RPE and motivation were immediately measured and then participants either listened to NM or RM. Rate of perceived exertion (RPE) was determined using a 1–10 scale where 1 was "not tired at all" to 10 "so tired cannot continue" (5, 29). Motivation to exercise was then measured using a visual analog scale as previously described by our lab (2, 6, 21). Briefly, participants were presented with a 100 mm line and asked to mark how motivated they felt to exercise where 0 was "zero motivation" and 100 was "extremely motivated". For the RM condition, participants chose any song of their liking, as long as it had a tempo of ≥ 120 BPM (mean tempo = 150.3 bpm ± 10.7) and listened to it through headphones at a standardized volume (3, 19). The chosen song was played on loop and all music was stopped immediately before subsequent RTF. For the NM condition, the participant sat quietly. To measure velocity during each set of RTF, a linear position transducer (GymAware; Kinetitech Performance Technology, ACT, Australia) was attached to the barbell. This device has been previously validated for measuring during resistance exercise and has shown excellent test-retest reliability in our lab: [ICC] = 0.932 (13, 30). The first 3 repetitions for each set were averaged together to use for barbell velocity analysis (2, 6).

Statistical Analysis

All data were analyzed using Jamovi software (Version 0.9; Sydney, Australia). Statistical analysis was conducted using a 2 × 3 [Condition × Set] repeated measures ANOVA with a Bonferroni-Holm post-hoc test as warranted. Estimates of effect size for main effects were calculated using eta squared (η^2) and interpreted as: 0.01—small; 0.06—medium; ≥ 0.14—large (12, 15). If warranted, Cohen's *d* effect sizes (*d*) were calculated between conditions and interpreted as: 0.2—small; 0.5—moderate; 0.8—large (12, 15). Significance was set at $p \leq 0.05$ *a priori*. All data are presented as mean ± standard deviation (SD).

RESULTS

Repetitions to failure (reps; RTF), mean velocity ($m \cdot s^{-1}$), and mean power (watts) are shown in [Figure 1]. For RTF, there was a significant main effect for set ($p < 0.001$; $\eta^2 = 0.667$) but not for condition ($p = 0.999$; $\eta^2 < 0.001$). No significant interaction between set × condition was observed ($p = 0.250$; $\eta^2 = 0.009$). In particular, RTF were lower in both set 2 ($p < 0.001$; $d = 1.85$) and set 3 ($p < 0.001$; $d = 2.55$) compared to set 1. Additionally, RTF were lower for set 3 compared to set 2 ($p = 0.004$; $d = 1.27$). For mean velocity, there was a significant main effect for both set ($p < 0.001$; $\eta^2 = 0.560$) and condition ($p < 0.001$; $\eta^2 = 0.096$). There was also a significant interaction for set × condition ($p = 0.028$; $\eta^2 = 0.024$). Regardless of condition, mean velocity was lower during set 2 ($p < 0.001$; $d = 2.31$) and set 3 ($p < 0.001$; $d = 2.94$) compared to set 1. Furthermore, mean velocity during set 3 was also lower than set 2 ($p < 0.001$; $d = 1.63$). Mean velocity was lower in the NM condition compared to RM during set 2 ($p = 0.009$; $d = 1.34$) and set 3 ($p = 0.048$; $d = 0.95$). For mean power, there was a significant main effect for both set ($p < 0.001$; $\eta^2 = 0.180$) and condition ($p < 0.047$; $\eta^2 = 0.102$). There was also a significant interaction for set × condition ($p = 0.048$; $\eta^2 = 0.021$). Regardless of condition, mean power was lower during set 2 ($p = 0.005$; $d = 1.11$) and set 3 ($p = 0.039$; $d = 2.18$) compared to set 1. Also, mean power during set 3 was also lower than set 2 ($p < 0.001$; $d = 0.98$). Mean power was lower in the NM condition compared to RM during set 2 ($p = 0.045$; $d = 0.89$) and set 3 ($p = 0.041$; $d = 0.75$).

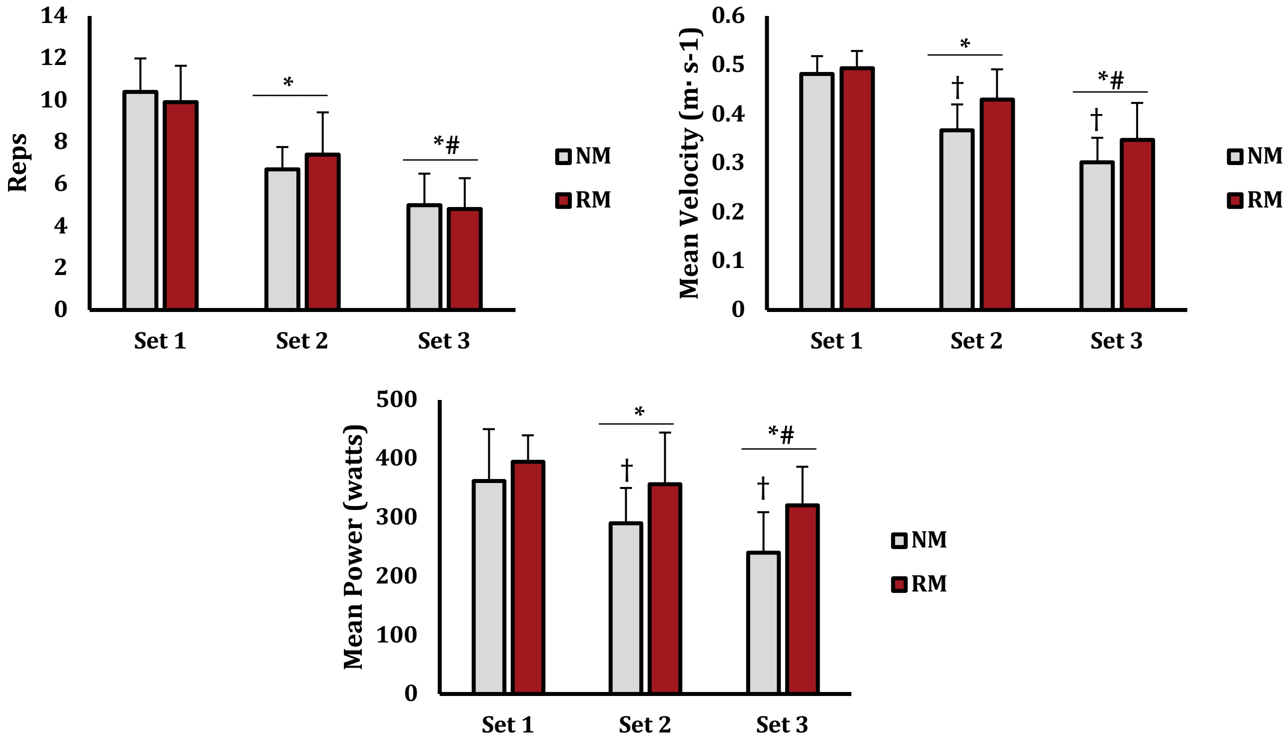

Figure 1. *Top Left*: Repetitions (reps), *Right*: mean velocity ($m \cdot s^{-1}$) between no music (NM; grey) and respite music (RM; red) condition over 3 × sets of repetitions to failure bench press exercise. Data are presented as mean ± SD. * indicates significantly different from set 1 ($p \leq 0.05$). # indicates significantly different from set 2 ($p \leq 0.05$). † indicates significantly different from RM ($p \leq 0.05$).

Rate of perceived exertion (1-10 scale; RPE) and motivation (mm) are shown in [Figure 2]. For RPE, there was a significant main effect for set ($p < 0.001$; $\eta^2 = 0.476$) but not for condition ($p = 0.129$; $\eta^2 = 0.012$). No significant interaction between set × condition was observed ($p = 0.322$; $\eta^2 = 0.009$). Irrespective of condition, RPE was higher in both set 2 ($p = 0.035$; $d = 0.51$) and set 3 ($p < 0.001$; $d = 2.17$) compared to set 1. Additionally, RPE was higher for set 3 compared to set 2 ($p = 0.002$; $d = 1.23$). For motivation, there was a significant main effect for condition ($p < 0.001$; $\eta^2 = 0.206$) but not set ($p = 0.969$; $\eta^2 = 0.001$). There was a significant interaction for set × condition ($p = 0.002$; $\eta^2 = 0.080$). Overall, motivation was lower during the NM condition compared to RM ($p < 0.001$; $d = 0.72$). More specifically, motivation was significantly lower during set 2 ($p = 0.005$; $d = 1.15$) and set 3 ($p < 0.001$; $d = 1.79$) with NM compared to RM.

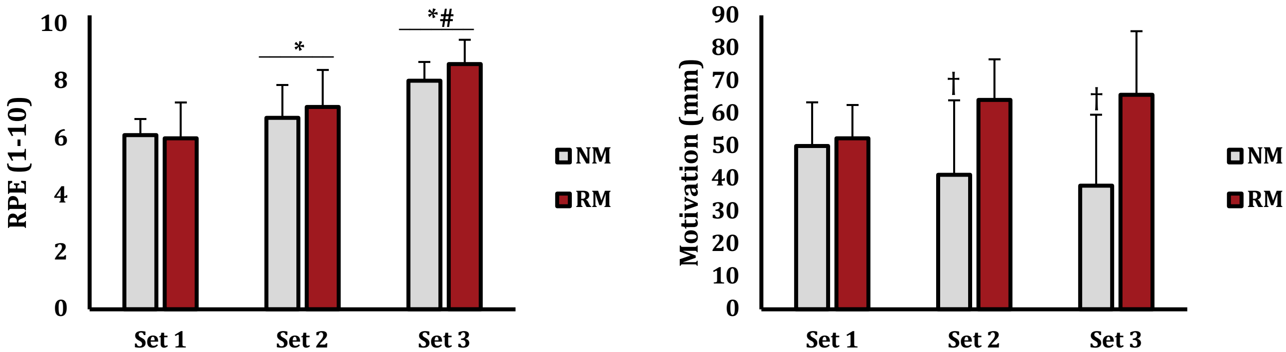

Figure 2. *Left*: Rate of perceived exertion (RPE; 1-10 scale), *Right*: Motivation (mm) between no music (NM; grey) and respite music (RM; red) condition over 3 × sets of repetitions to failure bench press exercise. Data are presented as mean ± SD. * indicates significantly different from set 1 ($p \leq 0.05$). # indicates significantly different from set 2 ($p \leq 0.05$). † indicates significantly different from RM ($p \leq 0.05$).

DISCUSSION

Previous studies have shown that listening to music prior to and during resistance exercise imparts performance-enhancing effects on barbell velocity and repetition volume (3, 6). Furthermore, respite music has been shown to increase measures of arousal and improve repeated sprint ability (16). However, it is unclear whether respite music influences repeated resistance exercise performance. Present findings suggest that listening to RM attenuates velocity loss over multiple bench press sets compared to NM while repetition volume was similar between conditions. RPE increased following each set regardless of condition. However, motivation to exercise was higher during sets followed by listening to RM versus NM. While mechanisms for ergogenic benefits are not fully understood from these data alone, there are important practical applications of these findings for enhancing inter-set recovery for resistance exercise trainees and competitors.

Currently, mean velocity was higher in sets followed by listening to RM compared to NM. This supports previous work which observed improved peak power during Wingate anaerobic sprint tests with RM (16). Furthermore, it also bolsters previous findings of increased bench press velocity while listening to music before and during exercise (3, 6). Likely, these effects are unpinned by increased motivation with RM currently observed. Increases in motivation while listening to music during resistance exercise have been reported by multiple studies (2, 3, 6). Higher motivation with music may lead to greater effort allowing for individuals to lift with higher velocities. Indeed, higher motivation from music has been shown to improve the performance of repeated agility movements (8). Although speculative, increases in velocity may also be due to physiological factors. Yamamoto et al. showed increased catecholamine responses after listening to fast tempo music before exercise (31). Anticipatory catecholamine increases have been linked to improved muscular force and performance (14). It is plausible that listening to RM resulted in higher catecholamines levels thus allowing participants to lift with greater force and velocity. Furthermore, psychological factors, such as motivation, may in part mediate physiological determinants of performance and the anticipatory response to exercise. However, it is unknown how RM influences physiological mediators of performance and future study will be needed to confirm previously mentioned mechanism or others.

Presently, repetition volume decreased from set to set in both conditions and was largely unaffected by RM. This is in contrast to previous investigations showing improved bench press repetition volume with listening to music (2, 3, 6). For example, a recent study showed increased RTF over two sets of bench press after listening to preferred warm-up music (2). Disparities between findings may be due to differences in the timing of which the listening of music was initiated. Previous investigations reporting improvements in repetition volume had participants begin listening to music in a non-fatigued state (2, 3). Whereas currently, RM was not played until after participants had already completed one set of RTF and may have been in a semi-fatigued state. Lopes-Silva et al. showed little to no ergogenic benefit during cycling if music is applied in a fatigued state (20). Therefore, RM may have less potent effects on repetition volume given the fatigue state in which music is applied. RPE was also unaffected by RM which supports other reports when music was played solely before a warm-up (1, 2, 19). Music has been repeatedly shown to cause dissociation and serve as a distraction from the discomfort of exercise (1, 22, 24, 28). However, the effectiveness of music in reducing RPE has been suggested to be reliant on the music being played during the actual bout of exercise. Since RM was not played during the bouts of bench press, it may have not instilled dissociation thus not affecting RPE. Collectively, listening RM may not be an effective strategy for improving repetition volume or increasing levels of dissociation.

While current data show novel ergogenic benefits of listening to respite music during resistance exercise, there were several limitations. First, the sample size was relatively small and homogenous. Because of this, it is unknown if these results will fully translate to other populations including female, aged, or differentially trained populations which have been previously suggested to have varying responses to music (4, 25). Future studies should include larger and more diverse samples in attempts to reinforce findings. Also, only a single load (75% 1RM) and rest period duration was used which was chosen in attempts to maximize translation to individuals training for hypertrophy and muscular power (17, 26). But it is unknown if performance-enhancing effects of RM will transfer to lower/higher loads or shorter/longer rest periods during maximal resistance exercise performance. Lastly, many intrinsic characteristics outside of tempo and volume were not controlled for including genre and lyrical content. As some of these characteristics have been shown to differentially affect the efficacy of music during resistance exercise (10, 27), more investigation is needed to decipher which specific characteristics of RM are influential on performance.

In conclusion, RM improves explosive ability during upper-body resistance exercise but does not improve repetition volume or RPE. RM also increased motivation to exercise. Collectively, this study suggests that listening to music during rest periods may enhance inter-set recovery and allow for athletes and competitors to maintain explosiveness and motivation to exercise over multiple sets of resistance exercises. Future investigations are needed to determine the ideal load, rest period, and form of exercise to allow for maximum efficacy of respite music. Additionally, translation of these findings to game-play or practice situations in various sports needs to be examined.

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