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Cognitive Strategies During Moderate-Intensity Running: Psychologicaland Performance Outcomes in Non-Elite Runners

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COGNITIVE STRATEGIES DURING MODERATE-INTENSITY RUNNING: PSYCHOLOGICAL AND PERFORMANCE OUTCOMES IN NON-ELITE RUNNERS

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ABSTRACT

Cognitive strategies allow athletes and recreational exercisers to shift their focus of attention to achieve psychological benefits and performance enhancements. The types of cognitive strategy utilized, association and dissociation, can differentially affect individuals' psychological and performance outcomes. The purpose of the current study was to examine the potential relationships between cognitive strategies and enjoyment, mood, time to completion, heart rate, perceived exertion, and self-efficacy by randomly assigning participants to two interventions: an Association intervention and a Dissociation intervention. Participants ($N = 12$) included male, college-age recreational exercisers who exercised for at least 120 minutes per week in the previous month. Participants completed two 1.5-mile jogging sessions under both the Associative and Dissociative interventions. During the exercise, heart rate and ratings of perceived exertion were recorded every four laps, and time to completion and state enjoyment were recorded following the completion of the run. Self-efficacy and mood states were measured pre- and post-exercise. No evidence was produced to indicate that state enjoyment was influenced by the interventions (i.e., cognitive strategies). When using the Association intervention first, there was a main effect for Depression between Association and Dissociation; however, this result was independent of Time. When using the Dissociation intervention first, the participants' mood states of Fatigue and Confusion were found to decrease while Vigor increased, but only during the dissociation intervention. Time to completion, heart rate, ratings of perceived exertion, and task or scheduling self-efficacy were not significantly influenced by the type cognitive strategy used; however, participants did report increases in RPE over time and increases in coping self-efficacy pre- to post-exercise. It was concluded that the cognitive strategy intervention, independent of order, did not directly influence any dependent variables.

Nonetheless, following a 20-minute exercise, male recreational exercisers were able to enhance positive psychological outcomes. Future research should examine various modes and intensities of exercise as well as participants' preferred exercise to further study the use of cognitive strategies during exercise.

ACKNOWLEDGEMENTS

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INTRODUCTION

Athletes and exercisers often utilize cognitive strategies in endurance sports to shift direction of attention towards or away from the present moment (Morgan & Pollock, 1977). Direction of attentional focus is defined on a spectrum from internal to external (Nideffer, 1976) or association and dissociation (Schomer, 1986). Association refers to paying attention to the body, acknowledging physical sensations, and having an internal focus while dissociation refers to diverting attention away from the body, ignoring physical sensations, and having an external focus (Stevinson & Biddle, 1998). The use of cognitive strategies plays an integral role in athletic performance. When attention is appropriately focused, it can positively impact sport performance (Stoate & Wulf, 2011; Hebert & Williams, 2017).

Association allows individuals to self-regulate their performance and concentrate on the current activity so that they are able to adjust their effort based on physiological feedback (Esteve-Lanao, Lucia, deKoning & Foster, 2008). Dissociation offers distraction from discomfort resulting in less fatigue and physical symptoms of exercise, such as sweaty hands and sore muscles (Pennebaker & Lightner, 1980). A strategic combination of these cognitive strategies can result in desirable performance outcomes in endurance athletes, as individuals have the ability to shift between internal focus and distraction to balance race strategy and body regulation with necessary mental breaks (Silva & Appelbaum, 1989).

In regards to general exercisers, association and dissociation can impact multiple psychological characteristics, such as enjoyment, mood, perceived exertion, and self-efficacy, which will be assessed in the current study. Overall, association tends to have a negative correlation with mood and enjoyment and a positive correlation with perceived effort, whereas dissociation tends to be positively correlated with mood and enjoyment and negatively correlated with perceived effort (Emad, Neumann & Abel, 2017; Hutchinson, Karageorghis & Jones, 2015; Overstreet et al., 2017).

Enjoyment of physical activity can change in relation to the use of different cognitive strategies (Salmon, Hanneman & Harwood, 2010). Jones (2015) found that participants' reported similar state enjoyment scores during moderate-intensity exercise whether they were associating or dissociating; however, overall, participants reported the prescribed running sessions to be less enjoyable than their trait enjoyment of exercise, emphasizing that exercise conditions can impact enjoyment regardless of cognitive strategies utilized. The lack of correlation between cognitive strategy used and enjoyment is inconsistent with the findings of several recent studies. Being mindful of the body and accepting physical sensations during moderate-intensity exercise with a non-judgmental perspective was shown to be associated with higher enjoyment than a control condition (Cox, Roberts, Cates & McMahon, 2018). Additionally, viewing T.V. while completing a moderate-intensity cardio activity was correlated with dissociation from the present activity and higher exercise enjoyment than a no T.V. condition regardless of the program being shown (Rider et al., 2016; Overstreet et al., 2017).

Using appropriate cognitive strategies that allow individuals to dissociate from exercise can positively impact mood. Hutchinson, Karageorghis, and Jones (2015) found that self-selected music and music video allowed runners to dissociate from the present task and have a greater positive affect during and post-task. Additionally, it was reported that music and music video had greater positive impact on affect during high intensity running than low intensity because individuals are more vulnerable to change in affect at a higher workload.

Despite the positive impact of dissociation on mood states while exercising, Cox, et al. (2018) have shown that mindfulness can also elicit positive affect valance. Having participants attend to physical sensations (i.e., associate) in a non-judgmental manner while running resulted in greater positive affect than the control condition despite greater associative focus than the control condition. It is expected that changes in mood in the current study will be similar to the observed changes in the original study by Jones (2015) given that the participants are read the same association and dissociation instructions. It is hypothesized that when participants exercise using dissociation and association strategies in a randomized order, participants who exercise under Dissociation first will report decreases in Confusion, Depression, and Tension while participants who exercise under Association first will report decreases in Confusion. Moreover, it is hypothesized that all participants will nearly achieve an Iceberg Profile with Vigor above the 50^{th} *T-score* percentile and negative mood scores below the 50^{th} percentile (Morgan, 1980).

Self-regulation related to performance, such as pace, technique, and cadence can help runners optimize pace and movement economy while not increasing effort perception; however, excessive association related to body sensations can increase perceived effort (Brick, MacIntyre, & Campbell, 2015). Emad, Neumann, and Abel (2017) corroborated that task-irrelevant thoughts, or dissociation, were negatively correlated with perceived exertion, and task-relevant external cues (e.g., total distance run) or association, were positively correlated with perceived exertion.

Recently, researchers have shown that adopting cognitive reappraisal and/or mindfulness while running has a positive impact on perceived exertion (Cox, et al., 2018; Giles et al., 2018). Both of these cognitive strategies are similar to association in that they emphasize acknowledging how the body is feeling; however, unlike association, feelings are accepted and either interpreted in a valuable way (cognitive reappraisal) or neutralized (mindfulness). Giles et al. (2018) found that cognitive reappraisal significantly lowered perceived exertion while distraction did not significantly differ from lack of cognitive intervention or cognitive reappraisal. Cox et al. (2018) found that when participants were in the mindful condition versus the control condition, they reported lower RPE scores despite paying more attention to physical sensations. Jones (2015) did not confirm a significant relationship between cognitive intervention and perceived exertion, as participants in the association and dissociation interventions did not report any differences. The current study will re-analyze whether perceived exertion differs based on cognitive intervention utilized.

Self-efficacy has not been studied in relation to cognitive strategies; however, self-efficacy is a strong predictor of exercise adherence and habitual exercisers tend to report higher self-efficacy than individuals who exercise less frequently or irregularly (Shin, Jang & Pender, 2001; Allen & Morey, 2010). Jones (2015) found that exercise impacted participants' coping and task self-efficacy, but did not impact scheduling self-efficacy.

The purpose of the current study was to examine the potential relationships between cognitive strategies and enjoyment, mood, perceived exertion, and self-efficacy by replicating the study by Jones (2015). The results were analyzed separately and compared to the results of Jones (2015). The effects of cognitive strategies were assessed by randomly assigning all participants to two interventions: an Association intervention and a Dissociation intervention.

METHOD

Participants

Participants ($N = 12$) from Bowling Green State University in Bowling Green, Ohio volunteered to for the study after being informed of the commitment required via recruitment handouts. No participants were excluded following completion of eligibility questionnaires. All participants were males and were required to have participated in at least 150 minutes/week of regular exercise for the past month. This eligibility requirement ensured that participants were capable of running continuously for 1.5 miles. All participants completed a Medical History Questionnaire to verify that they were healthy according to ACSM guidelines (2018).

The demographic characteristics of the participants are shown in Table 1. The participants averaged 20.8 years of age and the majority were European Americans (n = 11) with the exception of one participant identifying as Asian/Pacific Islander (n = 1). The majority of participants were undergraduates (n = 10) with the exception of two graduate students (n = 2). Although all participants did not run habitually, all still maintained 150 minutes per week of exercise whether it be resistance training, cardiovascular training, or both. In regards to preferred attentional strategy, engaging in association (n = 5) and a combination of both strategies (n = 5) were the most common preferences, followed by dissociation (n = 2). The mean BMI was 24.5 kg/m^2, which classifies the participants as normal weight (< 25 kg/m^2) but near the cut off to overweight, despite their participation in regular exercise; however, BMI does not factor in muscle mass.

Table 1

Participants' Demographic Characteristics (N=12; all males)

Variable	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**
Age (years)	20.8	1.5	18.0	24.0
BMI (kg/m^2)	24.5	3.9	19.5	35.0
Exercise Days	5.3	0.9	4.0	7.0
Exercise (minutes/day)	93.2	38.7	60.0	180.0
Running Sessions/Week	2.4	1.6	0.0	5.0
Miles/Session	4.0	3.4	0.0	10.5

Instruments

The same instruments utilized in the study by Jones (2015) were employed in the current study. The eligibility questionnaires consisted of a personal data form, medical history questionnaire, exercise history questionnaire, and Reynolds Short Form of the Marlowe-Crowne Social Desirability Scale (RSF-MCSDS; Reynolds, 1982). Participants with high social desirability (score ≥ 9) were excluded from the study. Nine was chosen as the cutoff point as it represents the top 75th percentile of social desirability scores out of 11. The 11-item short form has been shown to be a reliable measure with a correlation coefficient of .91 (Reynolds, 1982).

The Attentional Focus Questionnaire (AFQ; Brewer, Van Raalte & Linder, 1996) was completed directly after each 1.5-mile run to measure how well participants adhered to the given association and dissociation conditions. Brewer, Van Raalte, and Linder (1996) reported reliable Cronbach alpha scores of .77 for the dissociation measurements, .79 for the association measurements, and .85 for the distress measurements as well as moderate to high internal consistency (Chronbach alphas = .66 - .82). A commitment check question was also asked following each run to determine if participants adhered to their given cognitive intervention; they were asked on a scale of 1 (not at all) to 7 (all the time) to rate how much they adhered to the script that was read before the run.

The Physical Activity Enjoyment Scale-Trait (PACES-T; Kendzierski & DeCarlo, 1991) was administered before each 1.5-mile run to measure overall exercise enjoyment and the Physical Activity Enjoyment Scale-State (PACES-S; Kendzierski & DeCarlo, 1991) was administered after each 1.5-mile run to measure how much participants enjoyed the run they just completed. The PACES has been validated to effectively measure enjoyment (Motl et al., 2001).

The Profile of Mood States (POMS; McNair, Lorr & Droppleman, 2003) was administered before and after each 1.5-mile run to measure changes in overall mood disturbance as well as within the six subscales of Tension, Depression, Vigor, Fatigue, Confusion, and Anger. The POMS was reported to have high internal consistency with subscales ranging from r = .79 (Confusion) to .93 (Depression) (Bourgeois, LeUnes & Meyers, 2010).

During the 1.5-mile runs, heart rate and ratings of perceived exertion (RPE) were recorded every four laps to monitor whether participants were staying within their calculated heart rate zones and analyze whether assigned cognitive interventions affected RPE. Finish times were recorded to measure running performance.

The Multidimensional Self-Efficacy for Exercise Scale (MSES; Rogers et al., 2008) was administered before and after each 1.5-mile run to measure changes in overall self-efficacy as well as within the three subscales of task, coping, and scheduling. Rogers et al. (2008) reported high validity and internal consistency ratings of r = .78 and .85, r = .83 and .89, and r = .80 and .91 for the task, coping, and scheduling subscales of the MSES, respectively.

Procedure

After receiving approval from the Institutional Review Board at Bowling Green State University on an amendment to the study completed by Matthew Jones, undergraduate and graduate students were recruited from the University's Student Recreation Center and buildings via personal recruitment and handouts with information describing the study. Students who were interested in the study contacted the primary investigator to schedule an initial meeting time.

Meeting 1. During the first meeting, participants were fitted with a *Polar* FT1 heart rate monitor (Bethpage, NY) upon arrival. Following this, participants read and signed a consent form agreeing to participate and acknowledging that they could withdraw their participation at any time. Participants then completed a personal data questionnaire, medical history questionnaire, exercise history questionnaire, and Reynolds Short Form of the Marlowe-Crowne Social Desirability Scale. Once eligibility was established, participants sat for two minutes to achieve a resting heart rate (RHR). After two minutes, their RHR was recorded and their 40% to 60% threshold heart rates (THR) were calculated using the following equations (ACSM, 2018), respectively:

$$THR_{40\%} = [(220 - \text{age}) - RHR] \times 0.40 + RHR$$

$$THR_{60\%} = [(220 - \text{age}) - RHR] \times 0.60 + RHR$$

The Borg (1982) rating of perceived exertion (RPE) scale was explained to participants and they were given instructions to run four practice laps while keeping their heart rate between the calculated thresholds. After each lap, each participant was instructed to tell the investigator his RPE followed by heart rate. Responses were recorded. Once the four laps were complete, the participant walked two cool down laps. Before leaving, each participant set-up meeting times for the second and third meetings that were at least two days apart but within a week of each other. Participants were instructed not to do any physical activity before the next two meetings as well as not to eat, consume caffeine, drink alcohol, or take any drugs two hours prior to the meetings.

Meetings 2 and 3. During meetings 2 and 3, participants were initially fitted with a *Polar* FT1 heart rate monitor (Bethpage, NY). Following this, each participant completed the POMS, MSES, and PACES-T, respectively. After completing the questionnaires, the participant was reminded of how to use the RPE scale. To determine if the participant was in the Association or Dissociation intervention first, every other participant was asked to pick a number between one and ten; an even number corresponded to Association and an odd number corresponded to Dissociation. Based on ID number, the following participant would do the opposite intervention first. The participants were read a script that told him what to think about as he ran. The participant then ran a mile and a half on a 111-meter indoor track. Every four laps he gave an RPE and heart rate to the investigator. The investigator counted the laps and recorded finish times. Each participant walked two cool down laps and then answered the AFQ, POMS, MSES, and PACES-S, respectively. Each were then asked to give a commitment check rating and his answer was recorded on his RPE and heart rate data sheet.

All participants who completed the Association intervention first returned for their third meeting to complete the Dissociation intervention and vice versa. Once all data were collected, participants were debriefed on the purpose of the study.

Statistical Analyses

The purpose of the study was to examine the effects that the independent variables of Time, Order, and Cognitive Intervention (i.e., Association, Dissociation) while running had on the dependent variables of enjoyment, mood, perceived exertion, self-efficacy, performance, and heart rate. The Statistical Package for the Social Sciences (IBM SPSS Statistics, Chicago, IL, USA) version 20 was used to calculate all statistics.

An 2 (Intervention) × 2 (Order) multivariate analysis of variance (MANOVA) on the factor of the responses to the two subscales of the AFQ (association or dissociation) was used to determine if the independent variable (Intervention) was significant in creating two different groups of responses. This analyses also included a factor of Order to determine if responses were influenced by the Order of the intervention. In addition, all subsequent analyses included Order as a between subjects factor.

To assess differences in enjoyment between cognitive interventions, a 2 (Intervention) x 2 (Order) ANOVA with repeated measures on the Intervention factor was used. A 2 (Time) x 2 (Intervention) x 2 (Order) MANOVA on the vector of the six POMS subscales with repeated measures on the two levels of Time and Intervention was performed to assess changes in mood states before and after the jog, and between the two cognitive interventions of Association and Dissociation. A 2 (Intervention) × 2 (Order) ANOVA with repeated measures on Intervention was used to analyze the differences in time to completion between associative and dissociative interventions. A 2 (Intervention) × 6 (Laps) × 2 (Order) analysis of variance (ANOVA) with repeated measures on Laps was used to analyze RPE differences between cognitive interventions every four laps. A 2 (Intervention) × 6 (Laps) × 2 (Order) analysis of variance (ANOVA) with repeated measures on Laps was used to analyze HR differences between cognitive interventions every four laps. To assess differences in the three subscales of the MSES, a 2 (Time) × 2 (Intervention) × 2 (Order) MANOVA on the vector of the three exercise self-efficacy subscales with repeated measures on Time and Intervention was used.

RESULTS

Before analyzing the relationships between cognitive interventions and the dependent variables, a manipulation check was used to establish whether or not the participants adhered to the assigned interventions. Overall, participants reported thoughts that aligned with each intervention (i.e., associative thoughts during the Association intervention and dissociative thoughts during the Dissociation intervention) and further analyses of the results can be found in the attention manipulation section.

Attention Manipulation

To assess whether the interventions of Association and Dissociation created an effective manipulation of attention, a 2 (Intervention) × 2 (Order) MANOVA analyzed the participants' types of responses (association and/or dissociation) during the run as measured by the Attentional Focus Questionnaire. Within subjects tests revealed a non-significant interaction between the Order and the Intervention ($F_{2,9}$ = .852; p = .458; η^2 = .159; 1-β = .154) but a significant difference between the Interventions ($F_{2,9}$ = 76.995; p < .001; η^2 = .945; 1-β = 1.00). Between subjects tests revealed a non-significant difference between the Order of the interventions ($F_{2,9}$ = .084; p = .920; η^2 = .018; 1-β = .059).

A follow-up ANOVA of the significant difference between the Interventions revealed that participants in the Association intervention had significantly more association thoughts than dissociation thoughts (46.58 ± 1.51 vs. 22.17 ± 2.29, respectively; $F_{1,10}$ = 82.215; p < .001; η^2 = .892; 1-β = 1.000) and that participants in the Dissociation intervention had significantly more dissociation thoughts than association thoughts (42.75 ± 1.66 vs. 26.67 ± 3.60, respectively; $F_{1,10}$ = 20.793; p = .001; η^2 = .675; 1-β = .983).

Follow-up pairwise comparisons of the significant difference between the Order of the interventions revealed that there was no overall significant difference of association thoughts whether participants completed the Association intervention or the Dissociation intervention first (46.67 ± 5.35 vs. 46.50 ± 5.09, respectively; p = .423) and no overall significant difference of dissociation thoughts whether participants completed the Dissociation intervention first or the Association intervention first (41.00 ± 5.55 vs. 44.50 ± 5.96, respectively; p = .982).

Overall, participants followed instructions, reporting more association thoughts than dissociation thoughts using the Association intervention and more dissociation thoughts than association thoughts using the Dissociation intervention. The order in which the interventions were received did not seem to influence the types of reported thoughts, as there was no significant interaction.

Manipulation check. Ensuring that participants spent similar time and effort following the Intervention instructions, results of the manipulation check confirmed that participants spent equal time attending to the Intervention. On a scale of 1 (not at all) to 7 (all of the time), participants' reported a mean of 5.58 ± .45 in the Association intervention and a mean of 6.08 ± .45 in the Dissociation intervention. A mean score of six indicated that participants' reported spending the majority of the time thinking about what they were instructed to think about during the 1.5 mile run. These means are not significantly different from one another (t_{11} = 1.83; *p* = .081), and verify that participants spent similar time thinking about the Intervention instructions.

Distressful Thoughts

A 2 (Intervention) x 2 (Order) repeated measures ANOVA on distressful thoughts revealed an insufficient sample size to determine an Interaction between the Intervention and the Order of the intervention on distress scores. There was no significant difference in distress scores between the Interventions (i.e., main effect) ($F_{1,10}$ = 4.124; *p* = .070; η^2 = .292; 1-β = .451); however, participants tended to report more distressful thoughts when using the Association intervention (14.83 ± 8.473) than when using the Dissociation intervention (10.17 ± 3.95).

State Exercise Enjoyment

A 2 (Intervention) × 2 (Order) ANOVA indicated a non-significant Interaction between the Intervention and the Order of the interventions on state enjoyment ($F_{1,10}$ = .299; *p* = .596; η^2 = .029; 1-β = .079). Simple effects analyses revealed no significant differences in state enjoyment scores when the Association intervention was completed first ($F_{1,5}$ = .452; *p* = .531; η^2 = .083; 1-β = .086), or when the Dissociation intervention was completed first ($F_{1,5}$ = 1.398; *p* = .290; η^2 = .219; 1-β = .162). Overall, there was no evidence that the Intervention × Order

Interaction affected state enjoyment scores (i.e., no Interaction effect) and state enjoyment scores were not significantly different between the two cognitive interventions.

Trait Exercise Enjoyment

Following the jogging sessions, some participants expressed their frustration with maintaining a given exercise intensity that tended to be lower than their preferred exercise intensity. *Post-hoc* analyses were conducted in order to examine participants' enjoyment of the specific, designed exercise in relation to their trait enjoyment of most exercises. Participants' state enjoyment of each intervention was compared to their trait enjoyment of exercise using paired samples *t-tests* and are shown in Figure 1. Participants' state enjoyment in the Association intervention was significantly lower than their reported trait enjoyment (81.5 ± 15.89 vs. 105 ± 7.23, respectively; $t_{11} = 4.46$; $p < .001$) and participant's state enjoyment in the Dissociation intervention was also significantly lower than their reported trait enjoyment (90.75 ± 12.69 vs. 105 ± 7.23 respectively; $t_{11} = 3.23$; $p = .004$). In summary, participants enjoyed the 1.5-mile run at a moderate intensity significantly less than they enjoyed exercise in general.

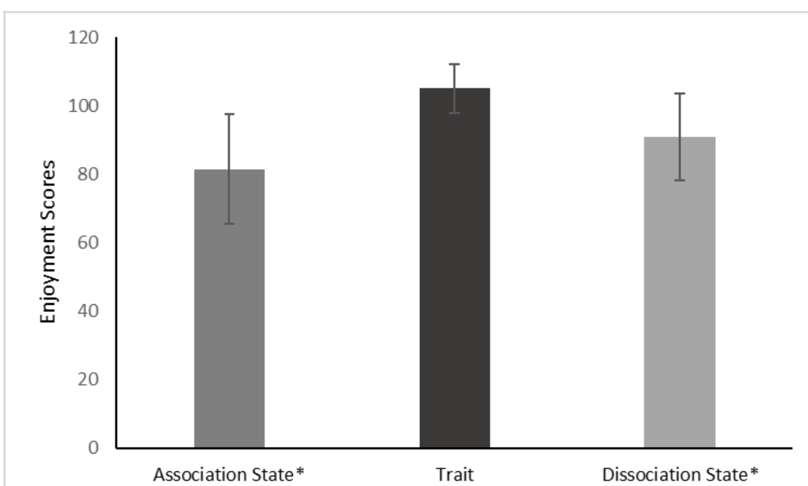

Figure 1. Comparison of trait enjoyment to state enjoyment responses for each cognitive intervention. (* $p < .05$ indicates significant difference between trait vs. state means for each cognitive intervention. SEM bars included.)

Mood

Raw scores on the POMS subscales were converted to *T-scores* based on normative college student sample means and standard deviations (McNair et al., 2003). To test the hypothesis that participants exercising in the Dissociation intervention would report greater mood benefits when measured before and after the 1.5-mile jog, a 2 (Time) × 2 (Intervention) × 2 (Order) MANOVA on the vector of the six POMS subscales with repeated measures on the two factors of Time and Intervention was performed. There was a significant difference based on Time ($F_{6,5}$ = 10.081; p = .011; η^2 = .924; 1-β = .927) and a trending two-way interaction for Intervention × Order ($F_{6,5}$ = 4.163; p = .070; η^2 = .833; 1-β = .576) and Time × Order ($F_{6,5}$ = 4.231; p = .067; η^2 = .835; 1-β = .583). Therefore, follow-up MANOVAs were conducted to assess the Interaction.

Order – Association Intervention First. Testing for an Order effect, a 2 (Time) × 2 (Intervention) follow-up MANOVA revealed that there were insufficient degrees of freedom to produce multivariate test statistics. Despite this lack of statistics, univariate analyses were examined, but should be interpreted cautiously because of the high likelihood of Type 1 errors.

The 2 (Time) × 2 (Intervention) univariate analyses revealed no significant interactions between Association and Dissociation interventions for any subscales. There was a significant main effect on the subscale of Depression when participants used the Association intervention first ($F_{1,5}$ = 8.767; p = .031; η^2 = .637; 1-β = .661). It is important to note that this difference is based on the average Depression scores for the interventions and does not factor in Time (i.e., the average of Association intervention scores pre- and post-exercise versus the average of Dissociation intervention scores pre- and post-exercise; 39.03 ± .54 vs. 37.84 ± .24). Changes in mood scores under the Association and Dissociation interventions when using the Association intervention first are shown in Figure 2.

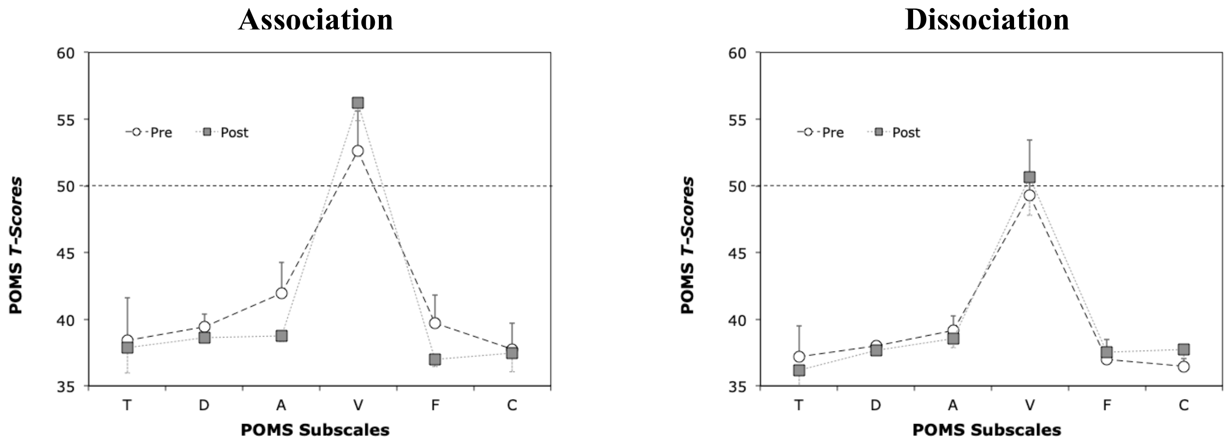

Figure 2. Changes in mood scores pre- to post-exercise for Association and Dissociation interventions when Association was used first. (Bars indicate SEM). No significant differences (all *p*'s > .05).

When participants used the Association intervention first, simple, simple effects revealed that there was no significant main effect of Time on Depression in the Association intervention ($F_{1,5}$ = .910; p = .384; η^2 = .154; 1-β = .123) or the Dissociation intervention ($F_{1,5}$ = 2.50; p = .175; η^2 = .333; 1-β = .252). Even though each intervention had no significant difference in Depression scores pre- to post-exercise, the overall main effect was most likely a result of small standard errors among Depression scores (.160-.921) not differentiated by time.

In summary, the hypothesis of greater mood benefits using Dissociation was not supported when the Dissociation intervention was completed after the Association intervention. All other mood scales of Tension, Anger, Vigor, Fatigue, and Confusion had no significant changes dependent on the Intervention, Time, and Order of the interventions (all *p*'s > .05).

Order – Dissociation Intervention First. Testing for an Order effect, a 2 (Time) × 2 (Intervention) follow-up MANOVA revealed that there were insufficient degrees of freedom to produce multivariate test statistics. Despite this lack of statistics, univariate analyses were examined but should be interpreted carefully, similar to the Association first condition.

Simple effects from the 2 (Time) × 2 (Intervention) univariate analyses revealed a significant main effect of Time on the subscales of Vigor ($F_{1,5}$ = 10.341; p = .024; η^2 = .674; 1-β = .730), Fatigue ($F_{1,5}$ = 8.330; p = .034; η^2 = .625; 1-β = .640), and Confusion ($F_{1,5}$ = 7.740; p = .039; η^2 = .608; 1-β = .609) when participants used the Dissociation intervention first.

Simple, simple effects revealed that when using the Dissociation intervention first, there was no significant main effect of Time on the subscales of Vigor ($F_{1,5}$ = .574; p = .483; η^2 = .103; 1-β = .096), Fatigue ($F_{1,5}$ = 1.071; p = .348; η^2 = .176; 1-β = .136), and Confusion ($F_{1,5}$ = 2.165; p = .201; η^2 = .302; 1-β = .225) in the Association intervention (completed second) (Figure 3), but a significant main effect of Time on the subscales of Vigor ($F_{1,5}$ = 9.173; p = .029; η^2 = .647; 1-β = .680), Fatigue ($F_{1,5}$ = 26.974; p = .003; η^2 = .844; 1-β = .982), and Confusion ($F_{1,5}$ = 11.567; p = .019; η^2 = .698; 1-β = .775) in the Dissociation intervention (Figure 3).

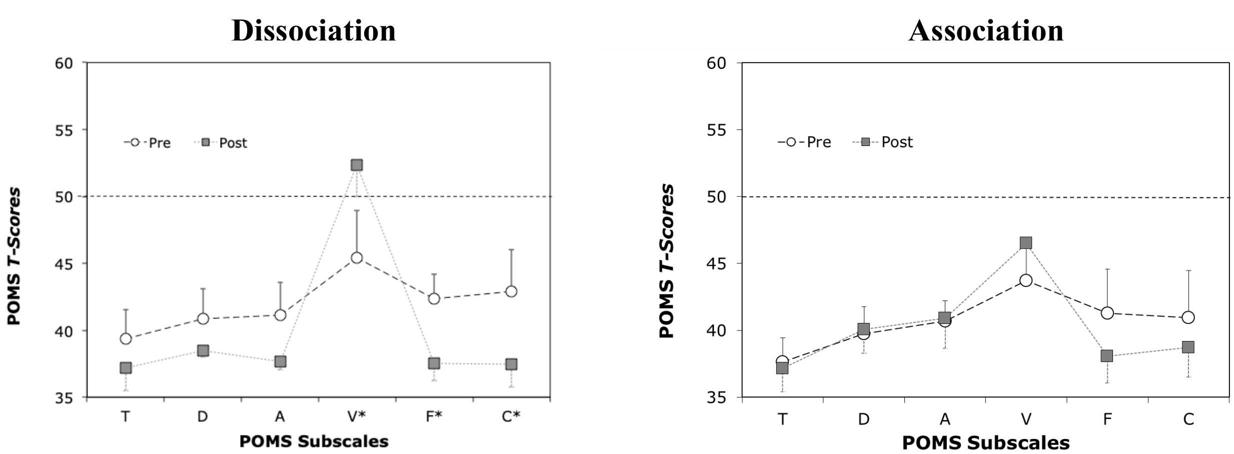

Figure 3. Changes in mood scores pre- to post-exercise for Association and Dissociation interventions when Dissociation was used first. (Bars indicate SEM.) No significant differences in Association intervention (all p's > .05). Significant differences in Dissociation intervention (* p < .05 indicates significant differences between the subscale *T-scores*).

In the Dissociation intervention, pairwise comparisons revealed that Vigor (45.39 ± 3.53 vs. 52.34 ± 2.36; p = .029) significantly increased and Fatigue (42.37 ± 1.85 vs. 37.53 ± 1.30; p = .003), and Confusion (42.88 ± 3.17 vs. 37.44 ± 1.70; p = .019) significantly decreased post-exercise as shown in Figure 3.

In summary, the hypothesis of greater mood benefits using dissociation was not supported when Dissociation intervention was used prior to the Association intervention. However, pre- to post-exercise mood benefits were found when participants used the Dissociation intervention first, reporting significant decreases in Fatigue and Confusion pre- to post-exercise under the Dissociation intervention but non-significant decreases under the Association intervention. Additionally, participants also reported significant increases in Vigor under the Dissociation intervention but non-significant increases in Vigor under the Association intervention. All other mood scales of Tension, Depression, and Anger had no significant changes dependent on the Intervention, Time, and Order of the interventions (all p's > .05).

Performance (Time to complete 1.5-mile run)

It was hypothesized that when runners were assigned the Dissociation intervention, they would take longer to complete the 1.5-mile run than when assigned the Association intervention. Results from the 2 (Intervention) × 2 (Order) analyses revealed no significant interaction between the Order of the intervention and the time to completion of each intervention ($F_{1,10}$ = 1.011; p = .338; η^2 = .092; 1-β = .149). Without Order being a significant factor, there was also no difference in time to completion between Association and Dissociation interventions ($F_{1,10}$ = .416; p = .533; η^2 = .040; 1-β = .090) and therefore, the hypothesis was rejected. Mean time to completion and standard deviations of the two interventions are displayed in Table 2.

Table 2

Comparison of Time to Completion

Interventions	Mean time to completion (min)	SD	Ranges (min)
Association	15.82	0.73	10.7-20.62
Dissociation	16.16	0.84	11.28-23.15

Note. All participants (*N* = 12) completed both interventions. Results displayed from 1.5-mile jog; min = minutes, SD = standard deviations

Heart Rate

A 2 (Intervention) × 6 (Laps) × 2 (Order) ANOVA with repeated measures on Laps was used to test the hypothesis that there would be no differences between interventions on reported exercising HR since a moderate intensity HR was a treatment condition for both interventions. There was an insufficient sample size to determine if a three-way interaction existed among the Intervention, Laps, and Order of the intervention. There was also an insufficient sample size to determine if an Order × Intervention interaction or Order × Lap interaction existed. There was no significant Lap × Intervention interaction ($F_{1,5}$ = 1.124; p = .611; η^2 = .849; 1-β = .074). There was no significant main effect of Intervention ($F_{1,5}$ = .037; p = .854; η^2 = .007; 1-β = .053) and no significant main effect of Lap ($F_{1,5}$ = 9.704; p = .239; η^2 = .980; 1-β = .169). Therefore, the hypothesis was supported and joggers were able to maintain their heart rates during exercise between the 40% and 60% HRR thresholds. Mean exercising heart rate and standard deviation for each intervention are displayed in Table 3.

Table 3

Comparison of Exercising Heart Rate

Interventions	Exercising HR (beats/min)	SEM of HR (beats/min)
Association	138.5	2.4
Dissociation	138.9	2.5

Note. All participants (*N* = 12) completed both interventions. Mean HRmax (199.3 ± 1.5) and mean HRrest (64.7 ± 7.3) were used to establish moderate exercise intensity that was between 40% HRR (118.5) and 60% HRR (145.4); HRmax = Heart Rate max, HRR = Heart Rate Reserve, SEM = Standard Error of the Mean

Ratings of Perceived Exertion

Using a 2 (Interventions) × 6 (Laps) × 2 (Order) analysis of variance (ANOVA) with repeated measures on Laps, the hypothesis that participants running under the Dissociation condition would report lower perceived exertion was not supported. There was not a significant three-way interaction among the Intervention, the Laps, and the Order of the intervention ($F_{5,6}$ = 1.080; p = .455; η^2 = .474; 1-β = .192). There also was no Intervention × Lap interaction ($F_{5,6}$ = .259; p = .920; η^2 = .177; 1-β = .080), Intervention × Order interaction ($F_{1,10}$ = .302; p = .595; η^2 = .029; 1-β = .079), and Lap × Order interaction ($F_{5,6}$ = .371; p = .852; η^2 = .236; 1-β = .093). There was no significant main effect for Order ($F_{1,10}$ = .009; p = .925; η^2 = .001; 1-β = .051), Intervention ($F_{1,10}$ = .435; p = .524; η^2 = .042; 1-β = .092), or Lap ($F_{5,6}$ = 2.254; p = .175; η^2 = .653; 1-β = .372) as shown in Figure 5. However, there was a significant within subjects effect for Laps ($F_{5,6}$ = 10.324; $p < .001$; η^2 = .508; 1-β = 1.000).

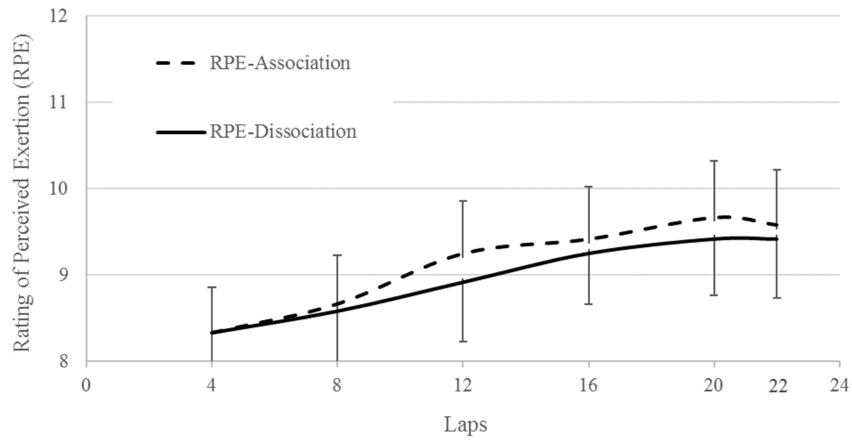

Figure 5. All participants (*N* = 12) completed both interventions. RPE scores between interventions without the Order effect. No significant difference between the two interventions (all *p*'s > .05).

Following up the significant main effect of Laps on RPE, pairwise comparisons indicated that RPE was significantly greater at Lap 20 than Lap 12 (9.54 ± .63 vs. 9.08 ± .63; *p* = .035). Even though not significant, RPE scores overall tended to increase as Lap increased from Lap 4 to Lap 20, intermittently recorded every four laps as shown in Table 4.

Table 4

Comparison of RPE Over Time

Lap	Mean	SEM
1	8.33	.51
2	8.63	.57
3	9.08	.63
4	9.33	.58
5	9.54	.63
6	9.50	.63

Note. Results displayed from 1.5-mile jog with no Order or Intervention factor. Mean is observed RPE for all participants (*N* = 12); SEM = standard errors of mean

Exercise Self-Efficacy

The Exercise Self-Efficacy measure included three subscales: coping, task, and scheduling self-efficacy. Therefore, a 2 (Intervention) × 2 (Time) × 2 (Order) MANOVA on the vector of the three exercise self-efficacy subscales with repeated measures on Time and Intervention was used. There was no significant three-way interaction among the Intervention, Time, and Order of the intervention ($F_{3,8}$ = 1.919; p = .205; η^2 = .418; 1-β = .327). Additionally, there was no Intervention × Time interaction ($F_{3,8}$ = .231; p = .872; η^2 = .080; 1-β = .078), no Time × Order interaction ($F_{3,8}$ = .072; p = .973; η^2 = .026; 1-β = .058), and no Intervention × Order interaction ($F_{3,8}$ = 1.803; p = .224; η^2 = .403; 1-β = .309). There was also no significant main effect for Order ($F_{3,8}$ = .734; p = .560; η^2 = .216; 1-β = .146), Intervention ($F_{3,8}$ = .217; p = .882; η^2 = .075; 1-β = .076) or Time ($F_{3,8}$ = 1.425; p = .305; η^2 = .348; 1-β = .250).

Despite no significant differences in self-efficacy overall, follow-up analysis of each self-efficacy scale was completed. Using a 2 (Intervention) x 2 (Time) x 2 (Order) ANOVA, results showed no significant three way Intervention × Time × Order interaction for coping self-efficacy ($F_{1,10}$ = 2.119; p = .176; η^2 = .175; 1-β = .261), no two-way Intervention × Time interaction ($F_{1,10}$ = .187; p = .674; η^2 = .018; 1-β = .068), and no Time × Order interaction ($F_{1,10}$ = .167; p = .691; η^2 = .016; 1-β = .066). There was a significant two-way Intervention × Order interaction on coping self-efficacy ($F_{1,10}$ = 5.544; p = .040; η^2 = .357; 1-β = .566). Simple analysis revealed that coping self-efficacy significantly increased over time when participants used the Association intervention first ($F_{1,10}$ = 15.0; p = .012; η^2 = .750; 1-β = .868), but revealed no change when the

Dissociation intervention was used first ($F_{1,10}$ = .928; p = .380; η^2 = .156; 1-β = .124). The task and scheduling subscales for self-efficacy revealed no change due to exercise, cognitive intervention, or whether these were measured with the Association or Dissociation intervention completed first or second.

DISCUSSION

The main purpose of the current study was to replicate the study completed by Jones (2015) that analyzed the relationship between different cognitive interventions (Association and Dissociation) and exercisers' psychological, physiological, and performance outcomes. The results did not entirely support the findings of Jones (2015); however, there were some complimentary findings. Additionally, results for attention manipulation, time to completion, heart rate, and RPE confirmed that participants adhered to their given interventions and kept their exercise at a moderate intensity level.

Attention Manipulation

Prior to analyzing the dependent variables in relation to the cognitive interventions, it was necessary to ensure that participants adhered to the given conditions. If participants did not attend to each intervention, the results for the dependent variables could not be attributed to use of a particular cognitive intervention. To determine whether the results were a byproduct of association and dissociation, participants were assigned to two different interventions. Following each of the sessions, participants reported a majority of associative or dissociative thoughts in the appropriate conditions. Order did not significantly influence participants' thoughts.

A manipulation check used to assess whether participants were focusing on their given intervention revealed that participants spent a similar amount of time engaging in the association and dissociation strategies. This finding corroborates the results of the Attention Focus Questionnaire.

Results revealed a non-significant difference in distress between cognitive interventions; however, there was a trend towards more distress during the Association intervention versus the Dissociation intervention. This trend aligns with current research that reports high levels of dissociation can cause an increase in reported pleasure pre- to post-exercise (Jones & Ekkekakis, 2019). All of the results for attention manipulation align with the results of Jones (2015).

Exercise Enjoyment

Jones (2015) found that there was no significant difference in state enjoyment based on order of interventions, but there was a trend that state enjoyment was higher in the first exercise session regardless of what the initial intervention was. The current study somewhat agrees with these results as no significant differences based on Intervention or Order were found. Furthermore, there was no trend that state enjoyment was greater in the first exercise session.

Jones (2015) reported that participants enjoyed both exercise sessions significantly less than they enjoyed exercise overall. The same results were found in the current study. Participants reported significantly lower state enjoyment scores following the Association and Dissociation interventions compared to their trait enjoyment scores. Two plausible explanations for this result could be that: (1) the participants were not exercising at their preferred intensity and (2) high-intensity interval training tends to be more enjoyable than continuous light- or moderate-intensity exercise. Most participants verbally expressed their dislike of the assigned jogging intensity following the exercise sessions stating that the pace was slower than what they would typically choose. Multiple studies have found that when comparing a prolonged lower intensity exercise session to a high intensity interval session, participants tend to enjoy high intensity intervals

(Jung, Bourne, & Little, 2014; Heinrich, Patel, O'Neal, & Heinrich, 2014; Thum, Parsons, Whittle, & Astorino, 2017). During the current study, participants were instructed to engage in a jogging session that was classified as moderate-intensity steady state.

Mood Alternation with Exercise

Jones (2015) hypothesized that participants would report greater increases in positive mood states and decreases in negative mood states when using the Dissociation intervention. Results revealed that there was an interaction between the Order of the interventions, the type of Intervention, and Time, but no other significant changes in mood following further analysis. The current study did not find a three-way interaction, but revealed a significant difference in mood based on Time as well as a trending two-way interaction for Intervention and Order, and Time and Order. A separate analysis for each of the POMS subscales was conducted in both studies.

Association Intervention First. Jones (2015) found that when participants used the Association intervention first, their levels of Confusion decreased pre- to post-exercise. Additionally, there was an interaction between Intervention and Time on the subscale of Tension, but no difference in Tension pre- to post-exercise. The current study had insufficient participants to analyze any interactions between Time and Intervention. However, follow-up tests revealed that participants reported significantly greater Depression scores in the Association intervention when the Association intervention was used first. An explanation for this may be that Depression had the lowest standard error scores across all conditions among the POMS subscales causing the difference to be significant despite the actual scores only varying by less than one (39.43 ± .92 and 38.64 ± .29 for the Association intervention and 38.0 ± .33 and 37.68 ± .16 for the Dissociation intervention).

Dissociation Intervention First. Jones (2015) found that when participants completed the Dissociation intervention first, they reported significant decreases in Confusion and Depression pre- to post-exercise. Additionally, follow-up analysis revealed that Tension significantly decreased when using the Dissociation intervention, but there was no significant difference when using the Association intervention.

In the current study, similar to the Association-first intervention, there were insufficient participants to analyze any interactions between Time and Intervention for the Dissociation-first intervention. Controlling for intervention, it was revealed that Vigor significantly increased pre- to post-exercise, while Fatigue and Confusion significantly decreased pre- to post-exercise in the Dissociation intervention. There were no significant effects of Time on Vigor, Fatigue, and Confusion in the Association intervention. An increase in Vigor and decrease in Fatigue pre- to post-exercise while dissociating would be expected based on previous literature. Goode and Roth (1993) found that runners who engaged in non-associative thoughts reported a decrease in fatigue and an increase in vigor pre- to post-running session. An explanation for reduced Confusion could be that participants were not over-thinking the run in the Dissociation intervention compared to the Association intervention. Furthermore, when the Dissociation intervention was completed first, the participants were disengaged and unaware of the instructions for the second jogging session, so they would be less likely to be focusing on the purpose of the study.

Although only significant for Vigor, Fatigue, and Confusion, all subscales showed expected differences pre- to post-exercise. The negative mood states of Tension, Depression, Anger, Fatigue, and Confusion decreased while the positive mood state of Vigor increased.

Additionally, in each intervention participants achieved the Iceberg Profile, when Vigor is above the 50^{th} percentile and all negative mood states are below the 50^{th} percentile (Morgan, 1980).

Performance (Time to completion)

Despite previous studies suggesting that running under association could result in faster performance times (Wulf, 2013), Jones (2015) found no significant difference in performance time based on intervention. The current study revealed the same result, as there was no significant difference in performance times under Association versus Dissociation. This lack of difference can be attributed to the fact that participants were instructed to maintain a certain heart rate range. If participants had run faster, regardless of whether they were doing it consciously out of preference, their heart rate would have indicated that they needed to slow down and thus, their paces would have been similar in both conditions.

Heart Rate

Due to study conditions, Jones (2015) and the current study revealed no significant differences in heart rate among the interventions. Participants were given a heart rate range to maintain while running under both conditions and within both studies, participants adhered to this range. Although a heart rate range could be a limitation because no relationships can be established between cognitive interventions and differences in heart rate, in the current study, adherence to this range was essential as it guaranteed that participants were not jogging above moderate intensity.

Exercising above moderate intensity can impact some of the dependent variables, such as exercise enjoyment. Heinrich, Patel, O'Neal, and Heinrich (2014) found that participants in a high-intensity exercise group reported greater enjoyment than participants in a moderate-intensity exercise group. Given the opportunity to run at their preferred pace, participants in the current study would have most likely run faster than a moderate pace as most of them reported disliking the "slow" pace.

Ratings of Perceived Exertion

Jones (2015) found no significant differences in RPE between Association and Dissociation interventions as well as no differences in RPE based on Order. However, as expected, Jones (2015) found that RPE increased over time within the jogging sessions. Similarly, the current study revealed that there was no difference in RPE between the cognitive interventions and that RPE tended to increase over the duration of the jogging sessions. Dissimilar to Jones (2015), the highest reported RPE in the current study was 13 versus 11, which corresponds with "somewhat hard" as opposed to "light." Nevertheless, as aforementioned, the participants never exceeded the prescribed heart rate ranges, so they were never above moderate intensity.

Jones (2015) hypothesized that RPE would be greater in the Association intervention due to the fact that participants were more focused on physical sensations. However, it is reasonable to assume that RPE would not differ between interventions because of the assigned moderate exercise intensity.

Self-Efficacy

Participants in the study by Jones (2015) reported no differences in self-efficacy between the Association and Dissociation interventions when controlling for Order. Further analysis into the three subscales: coping, task, and scheduling, revealed that coping self-efficacy increased pre- to post-exercise and was greater when the Association intervention was completed second; task self-efficacy increased pre- to post-exercise; and scheduling self-efficacy did not differ based on Time, Order, or Intervention. Unlike these results, the current study showed no significant changes in self-efficacy overall. Similar to Jones (2015), coping self-efficacy increased pre- to post-exercise; however, only the Association-first participants reported a significant change, which is the opposite intervention previously reported.

An explanation for the lack of change in self-efficacy overall could be that the exercise session was not strenuous enough to evoke increased levels of confidence. Self-efficacy is defined as "people's beliefs about their capabilities to produce designated levels of performance" (Bandura, 1994). If participants volunteered for the study under the belief that they could complete the 1.5-mile jog and did so during both exercise sessions, there would be no reason for their confidence regarding their exercise habits/capabilities to increase.

An increase in coping self-efficacy under the Association-first order could be explained by the finding that participants reported greater distress scores during the Association intervention. When participants completed the Association intervention first and focused on bodily sensations, their coping self-efficacy increased due to the fact that they felt accomplished by overcoming any feelings of discomfort. However, when the Dissociation intervention was completed first, participants were already familiar with the protocol and therefore, may have been more confident that they could complete the jogging session going into the Association intervention despite any discomfort they might experience.

Limitations and Future Research

The current study had many of the same limitations that were stated in the study by Jones (2015) given that this study was meant to replicate the previous study. One major limitation was sample size and diversity. With only 12 participants and two different order groups, some statistics were unable to be analyzed. Furthermore, the sample contained only males, an age range of six years (18 to 24), and only one participant who did not identify as European

American; therefore, it would be difficult to apply the findings to a more diverse population. Additionally, the results could not be generalized to runners despite the fact that the study was based on a jogging activity and most (75%) of the participants reported previous running experience. Overall, the mean for running sessions per week was two and miles run per session was four, which averages to only eight miles per week. Future research should focus on recruiting a larger and more diverse sample size.

A consideration should also be made to only include individuals that run a particular number of miles per week and/or run as their main form of exercise. If a participant in the current study reported little to no participation in regular running, the prescribed jogging session could have impacted their state exercise enjoyment scores. Future research should include various modes of exercise, such as high-intensity interval training, as well as participants' preferred mode of exercise.

As aforementioned, the assigned exercise intensity was a limitation as no conclusions regarding the relationship between heart rate and cognitive strategy could be established. Given the assigned moderate intensity, it was expected that participants would tend to run each jogging session at a similar pace and perceive their exertion to be relatively similar. If this had not been true, the data on distress, enjoyment, and mood could have been attributed to exercise intensity rather than cognitive strategy. In addition to various modes of exercise, exercise intensity could be varied in future research to assess differences in physiological characteristics using association and dissociation interventions.

Conclusion

Utilizing cognitive strategies during physical activity can impact enjoyment, mood, perceived exertion, and self-efficacy. In the current study, the cognitive strategies of association and dissociation were assessed in relation to these psychological variables by assigning participants to both Association and Dissociation interventions in a randomized order. Enjoyment did not change based on intervention; however, trait exercise enjoyment was significantly greater than state exercise enjoyment in both interventions. In regards to mood, when the Association intervention was used first, overall Depression scores were significantly higher in the Association intervention. When the Dissociation intervention was completed first, Vigor significantly increased pre- to post-exercise, while Fatigue and Confusion significantly decreased pre- to post-exercise in the Dissociation intervention. Perceived exertion was not significantly different between interventions, which validates that participants were adhering to the assigned exercise intensity. Coping self-efficacy showed an increase pre- to post-exercise, but only in the Association-first order. The cognitive interventions did not appear to have any impact on the measured physiological variables, which also verifies participants' adherence to the assigned intensity.

In conclusion, male college-aged recreational exercisers were able to achieve mood benefits following 1.5-mile jog at a moderate intensity while dissociating. Nevertheless, given the small sample size and previous findings that show increases in positive mood states and decreases in negative mood states regardless of cognitive strategy (Berger & Motl, 2000), college male exercisers should continue to engage in physical activity under their preferred cognitive strategy.

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