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The Effect of Choice in Exercise Intensity on Affect and Cognition

Annegracien Delaunay
Western Kentucky University, annegracien.delaunay@topper.wku.edu

THE EFFECT OF CHOICE IN EXERCISE INTENSITY ON AFFECT AND COGNITION

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Steven R. Wininger

Steven R. Wininger, Ph.D.
Director of Thesis

Lance W. Hahn

Lance W. Hahn, Ph.D.

Andrew Mienaltowski

Andrew Mienaltowski, Ph.D.

Kinchel C. Doerner 12-Aug-2011

Dean, Graduate Studies and Research Date

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Directed by: Dr. Steven R. Wininger, Dr. Lance W. Hahn, Dr. Andrew Mienaltowski

Department of Psychology Western Kentucky University

While there are studies linking positive psychological outcomes with exercise, few have focused on choice as a moderating factor. The research that has examined choice as a moderator yielded mixed results. Currently no research has looked at the impact of choice of exercise intensity on the psychological benefits of acute exercise; specifically, affective and cognitive gains. According to Landers (2008), acute exercise refers to a single bout of exercise usually lasting a short duration, whereas chronic exercise refers to long term repeated bouts of exercise (e.g., weeks, months, or years). Participants in this study consisted of 117 collegiate psychology students. The study consisted of two trials. The first trial was used to establish a baseline. Next, students were randomly assigned to one of four conditions for the second trial. Everything stayed consistent from the first trial to the second trial, except the extent of choice given with regard to exercise intensity. Affect and cognition measures were given to all participants on both days. For trial two, group 1 was given full choice, e.g., they were able to exercise at their own pace. Group 2 had to exercise at the average pace from their first session, group 3 exercised at a pace equivalent to two rate of perceived exertion (RPE) levels above their average pace from the first session, and group 4 exercised at a pace two RPE levels below their average pace from the first session. A mixed model MANOVA was used to analyze the participants' cognitive and affective data. Although the outcomes

of the study were limited, Group 1 (choice) performed better on two of the executive function measures (Trail Making Test, Letter Number Sequence) for the second trial than the other experimental groups.

Introduction

Exercise has been linked to a slew of positive outcomes, both physical and psychological (Paluska & Schwenk, 2000; Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991; Scully, Kremer, Meade, Graham, & Dudgeon, 1998). John Ratey and Eric Hagerman (2008) wrote a book titled: *Spark: the revolutionary new science of exercise and the brain.* Within this book, Ratey presented new research and case studies linking the mind and body to support the thesis that exercise is a great defense against everything from mood disorders, ADHD, addiction, menopause, and even Alzheimer's (Ratey & Hagerman, 2008). In addition, these benefits are accrued from both long term and acute exercise. Research on benefits of chronic exercise consistently shows positive gains in both cognition and affect (Berger & Motl, 2000; Etnier et al., 1997; Petruzzello, et al., 1991). Studies on the benefits of acute bouts of exercise show some positive gains in both affect and cognition, but the results are not entirely consistent as some studies report little or no effects (Davranche, Hall, & McMorris, 2009; Etnier et al., 1997; Kamijo, Hayashi, Sakai, Yahiro, & Tanaka, 2009; Sibley & Etnier, 2003; Tomporowski, Davis, Miller, & Naglieri, 2008; Wipfli, Rethorst, & Landers, 2008). Variables that significantly affected the small or null effect sizes in acute exercise included: the method of sampling (random sampling produced greater effect sizes), the cognitive measure used (academic achievement showed the greatest effect size), the size of the exercise group (larger than 20 people), and the sex of the participants (females produced greater effect sizes).

These inconsistencies may also be attributed to several factors within the experiments, such as the intensity or mode of exercise, measurement of affect or cognition, choice, and/or motivation of the participant. For example, some people do not enjoy exercising, thus anxiety about exercising may mediate its benefits; others simply may not be motivated to exert much effort (Deci & Ryan, 2002; Lutz, Lochbaum, & Turnbow, 2003). Also, some exercise situations undermine the control of the exerciser; for example, children in physical education (P.E.) classes or an individual engaging in rehabilitation under a doctor's orders. Most schools require students to take P.E. classes (National Association for Sport and Physical Education, 2011). Not only are P.E. classes required, they are also strictly controlled and tailored by the instructor. Could providing more choices in P.E. improve enjoyment, increase voluntary participation, and even improve cognitive benefits? This question lies at the heart of the current study.

Purpose

While there have been numerous studies (Colcombe & Kramer, 2003; Etnier et al., 1997; Wipfli et al., 2008) linking positive outcomes with exercise, these studies involve chronic exercise. There appears to be a dearth in the amount of work examining the impact of acute exercise currently in the literature. Acute exercise is defined as a single bout of exercise usually lasting a short duration (Landers, 2008). This shortage in the literature also fails to identify consistent factors that may moderate or mediate the personal benefits of exercise. The current study aims to examine the impact of choice of exercise intensity on the psychological benefits of acute exercise; specifically affective and cognitive gains. The purpose of the present review is to evaluate previous studies that have examined the effects of exercise on cognitive functioning, affective gains, and the effects of choice on affective gains.

Psychological Benefits of Acute Exercise

Cognitive functioning and exercise. Cognitive functioning refers to numerous mental processes such as attention, memory, comprehension, and decision making (Tomporowski et al., 2008). It also can refer to executive functioning, or the ability to quickly organize and apply information to tasks in which one is involved. As mentioned, chronic exercise can improve cognitive performance over time. However, research on the impact of acute bouts of exercise on cognition has not been as consistent when compared to chronic exercise (Etnier & Chang, 2009). The current study examines the impact of an acute bout of exercise on executive functioning. Executive functioning has been operationalized in many different ways in prior research, making it difficult to pinpoint exactly how this ability may benefit from exercise.

Researchers agree that executive functioning is not one-dimensional and that it encompasses a broad range of abilities (Etnier & Chang, 2009; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000; Tomporowski et al., 2008). "The executive functions' broadly encompass a set of cognitive skills that are responsible for the planning, initiation, sequencing, and monitoring of complex goal-directed behavior" (Royall et al., 2002, p. 378). The centrality of executive functioning to many psychological processes makes it a prime target for investigation in studies that examine the potential benefits to cognition created by exercise.

Etnier et al. (1997) conducted a meta-analysis on the influence of physical fitness and exercise upon cognitive functioning. This meta-analysis included 134 studies that were coded for the exercise protocol that they used (i.e., chronic or acute, mixed acute) and their design type (e.g., cross-sectional, correlational, etc.). Studies were also coded for the cognitive measures that were assessed. A total of 106 different cognitive tests were used, including reaction time, verbal comprehension, the Stanford-Binet Intelligence Quotient, the Wechsler Memory Scale, the Sternberg Number Task, the Stroop test, etc. These different tests were then categorized into different abilities such as memory, perception, processing speed, etc. For example the Wechsler Memory Scale, the Sternberg Number Task both tap into the memory category, so the authors investigated how memory was impacted by exercise by examining differences in these memory tests as a function of the type of exercise regimens implemented in the sampled studies. The results yielded mixed effect sizes. The overall mean effect size for all of the studies was found to be small but positive, Cohen's d of 0.25. Because the results are significantly different from zero, it suggests that exercise improves cognitive functioning. When examining the effects of different exercise paradigms on cognition, research showed that chronic exercise (*ES*=0.33) yielded greater effect sizes than acute exercise (*ES*=0.16). Etnier and colleagues attributed this difference to the small and temporary effect that acute exercise has on physiological parameters.

Colcombe and Kramer (2003) completed a meta-analysis of eighteen studies to examine the impact of physical activity on older adults' cognitive performance. Their analyses focused on four cognitive constructs (speed, visuospatial, controlled processing and executive control). The speed construct was measured by finger-tapping reaction time. Visuospatial ability was measured by memory of visual and spatial information, such as looking at line drawings and then from memory replicating those drawings. The controlled processing construct measured inhibition, which is the ability to go against one's first natural response. The executive control construct included planning, as well as inhibition and scheduling; which required participants to not only respond to a cue, but also suppress irrelevant cues that were next to the target cue. All the cognitive tasks included in the meta-analysis were coded with respect to each theoretical variable. For example the Erickson flanker task was coded as a measure of executive control; reaction time to a flash of light was coded as a measure of speed; Benton Visual Retention Task was coded as a measure of visuospatial ability; choice reaction time task was coded as a measure of control. The results indicated that overall exercise (g=0.478) yielded a greater effect on cognition than the non-exercise group. When the authors solely compared the type of exercise, chronic exercise (g=0.674) yielded greater effects on cognition than acute exercise (g=. 176). Chronic exercise was defined by the exercise program duration: short- which lasted 1-3 months; medium-which lasted 4-6 months; and long- which lasted 6+ months. Acute exercise was categorized in three types: short-where exercise lasted 15-30 min; moderate- where exercise lasted 31-45 min; and long- where exercise lasted 40-60 min. The comparison between the chronic and acute exercise is a bit awkward because the authors did not specify how long participants where exercising during the chronic exercise sessions, they just simple stated the duration of the program. Among the four cognitive constructs in the exercise groups, executive control (g=0.68) had the greatest effect from exercise when compared to controlled (g=.461), spatial (g=.426), and speed tasks (g=274).

The results of both meta-analyses are interpreted as support for exercise causing cognitive gains. Research on adults engaging in chronic exercise consistently showed greater and more positive effects on cognition. Within studies examining the impact of acute exercise on cognition, variables that significantly increased the effect sizes were:

the method of sampling, the number of threats to internal validity, the cognitive test used, and the sex of the participants (Etnier et al., 1997). Females, random sampling, zero threats, and motor skills showed the strongest effect sizes.

While there have been many studies conducted to investigate the link between exercise and cognition for adults, there has been considerably less research on children (Sibley & Etnier, 2003). It is plausible that the cognitive gains from exercise can be extended to predict the same improvements in children's cognitions. Physical activity has many benefits for children in developing physical and mental health, but research suggests that it may also facilitate learning (Tomporowski et al., 2008).

Sibley and Etnier (2003) examined 44 studies relevant to the relationship between physical activity and cognition or academic performance in children (4-18 years old). Effect sizes (ESs) were calculated for each study and an overall ES and average for specific moderator variables were reported. The exercise designs coded in this study included acute, chronic, or cross-sectional. There were four activity types: resistance training, aerobic training, perceptual-motor and PE program. These activity types, however, were not operationalized which is a limitation of this study. Studies were also coded for cognitive assessment tools. The eight categories measured were perceptual skills, intelligence quotient, achievement, verbal tests, math tests, memory, developmental level/achievement readiness, and other (creativity, concentration, and cross-disciplinary batteries).

The results of the meta-analysis showed an overall improvement in cognition via physical activity ($g=0.32$). When comparing findings for acute exercise versus chronic exercise, there were no significant differences in the average ESs, $g=0.37$ and $g=0.29$.

All eight categories of cognitive assessments were significantly greater than zero except for the memory test. A limitation of this meta-analysis is that the different exercise designs and categories of cognitive assessments were not operationally defined making it difficult to compare with other studies. The lack of specificity between the different exercise designs could have led to both the smaller effect size and insignificant differences between each design. Another limitation of this study is the quality of research articles included in the meta-analysis. Sibley and Etnier (2003) noted that only nine studies used a true-experimental design.

The meta-analyses reported above demonstrate that exercise has a positive effect on cognition. Chronic exercise consistently showed the greatest gains when compared to acute exercise in adults. This consistency is not present in exercise research in children due to limitations in current children's research (Chang & Etnier, 2009; Sibley & Etnier, 2003). The limitations in the children's research are primarily due to improper studies being conducted, such as the task used to measure the variables. It is more difficult to gather enough children participants to make a study. The strength of the effect sizes were related to the type of test used in each study. When executive functioning was included it demonstrated the greatest effect size (Colcombe & Kramer, 2003). Although executive functioning demonstrates the greatest gains in exercise, within the executive function research, there are inconsistencies. These inconsistencies come from how authors define executive function and how it's measured.

Hillman, Snook, and Jerome (2003) looked at the effects of acute cardiovascular exercise on cognitive function in 20 undergraduates. The authors noted that executive functioning allows one to make decisions and execute a response; which is controlled by two distinct mechanisms (contention scheduling and supervisory attentional system). "Contention scheduling is the lower-order level of control that automatically selects action schemas to execute well-learned processes, while the supervisory attentional system arbitrates by providing increased inhibition or activation to competing schemas when contention scheduling does not result in the emergence of a dominant action schema" (p. 308). Executive function was measured by comparing neuroelectric responses with behavioral performance. Both tasks, however, measured attention and working memory. The Eriksen flanker task was used to measure executive function. The flanker task required participants to respond quickly and accurately to a target letter (i.e. F or X) that was either between opposing target stimuli (i.e. FXF or XFX) or neutral letters (i.e. LFL, LXL). Participants were directed to respond with their left index finger if the target letter was "F" or their right index finger if the target letter was "X". Five blocks of 144 trials were given. Event-related brain potential (ERP) was used to assess the amplitude of the P3 component. Hillman et al. (2003) proposed that the amplitude P3 component reflects parts of attention and resources of working memory resources. These are activities that are essential to the participants' responses during the flanker task. Results suggest that acute bouts of cardiovascular activity affect executive functioning on the neuroelectric level by improving attention and memory resources; however, no effects were found on the behavioral measure on the flanker task. Specifically, greater P3 amplitudes were found when participants exercised.

Kamijo et al. (2009) investigated the effects of aerobic exercise on cognition in twenty-four healthy males. These males were then grouped by older and younger adults. Each participant performed a baseline session (no exercise) and a light (30 % VO_{2max})

and moderate (50 % VO_{2max}) cycling exercise session. VO_{2max} was defined as participant's maximal oxygen uptake. The measurement of VO_{2max} was taken before the experiment when participants completed a graded exercise test (GXT). Each exercise session consisted of 20 min. Executive function was defined as "a subset of cognitive functions involving working memory, mental flexibility [shifting], and inhibitory control" (p.356). Participants ERP's and behavioral responses during a modified flanker task were measured during the baseline session. ERP was used to assess the P3 component. The participants were allowed a practice trial and then began the modified flanker task. The modified flanker task included arrowheads instead of letters. The modified flanker task required participants to respond quickly and accurately to the direction of arrowheads (i.e. < or >) that was surrounded by arrowheads that were in the same direction (i.e. < < < < < or > > > > >) or the opposite direction (i.e. > > < > > or < < > < <). Participants were to press a button with their thumbs based on the direction of the arrowhead (left or right) and a total of 160 trials were given. Heart rate (HR), VO_2 and rating of perceived exertion (RPE) were recorded every 5 minutes. The RPE is a scale that can be used to estimate a person's level of exercise intensity (Borg, 1998).

Results showed that HR and RPE were significantly higher following moderate exercise (50 % VO_{2max}) when compared to light exercise (30 % VO_{2max}). No significant main effect or interaction for participant's age was present. Post hoc analysis revealed faster reaction time (RT) following moderate exercise when compared to the light exercise. Younger adults had a better RT mean when compared to the older adults; as is consistent with the cognitive decline observed in aging (Etnier & Chang, 2009; Kamijo et al., 2009). P3 amplitude analysis only revealed a significant main effect for exercise for the younger group. An analysis indicated that when the younger group exercised at a moderate rate, acute exercise influenced executive control processes greater than the baseline session. No effects were observed for the older group.

The main findings overall revealed shorter RTs following moderate exercise, when compared with the baseline and light exercise for both age groups. P3 amplitude following moderate exercise was larger than the baseline only for the younger group. Kamijo et al. (2009) explained that the younger group had a higher degree of confidence in the difficult task than the older group. This study supports the hypothesis that executive processes of attention and working memory resources should improve and executive processes of reaction time should decrease following moderate exercise for younger participants.

Studies examining the effects of acute bouts of exercise overall yield cognitive gains (Colcombe & Kramer, 2003; Etnier et al., 1997; Hillman et al., 2003; Kamijo et al., 2009; Sibley & Etnier, 2003;). In terms of chronic exercise, research shows greater cognitive effects when compared to acute exercise. Authors have provided several hypotheses explaining the influence that exercise has on the brain. One study presented that both acute and chronic exercise increased levels of neurotransmitters, however, chronic exercise was shown to have larger increases of neurotransmitters (as shown in Etnier et al., 1997). Another study solely presented the increases found in gray and white matter volume in the prefrontal cortex following chronic exercise (Kamijo et al., 2009). Etnier and Chang (2009) reported that chronic exercise showed the greatest effects in the frontal lobe. Based on the literature, it is evident that chronic and acute exercise influences the brain differently, which can be an explanation for the stronger and more consistent outcomes found in the chronic exercise literature.

When studies included executive functioning in the comparison of cognitive processes, executive functioning showed the greatest gains in chronic exercise (Colcombe & Kramer, 2003). When studies looked at the neuroelectric level (P3 amplitude) and behavioral measures (e.g. flanker, stroop, etc.) of executive function, the neuroelectric measure yielded greater effects when compared to the behavioral measures (Hillman et al., 2003; Kamijo et al., 2009). Previous authors indicated that neuroelectric measures are more sensitive than behavioral measures to the effects of acute exercise (Hillman et al., 2003; Kamijo et. al, 2007, 2009). It is possible that even though the behavioral measures (i.e. Stroop task or Flanker) used might not always be sensitive enough to influence a significant outcome, exercise will still influence a reaction in neuroelectric level (i.e. P3 amplitude) because previous studies have shown a link between physiological phenomena and psychological constructs (Cacioppo, Tassinary, & Berntson, 2000). Also, moderate exercise yielded greater effects when compared to high or light intensity exercise; consistent with the Yerkes-Dodson law (Clark, 2004; Yerkes, & Dodson, 1908). The Yerkes-Dodson law presents the inverted U-shaped concept, stating that performance decreases when levels of arousal (from exercise intensity) are too high or too low and optimal performance yields from moderate arousal (Clark, 2004).

Measurements of cognition. A potential limitation of previous studies on executive function is the method of measurement for executive function. Most studies used one behavioral test to try to measure executive function. Knowing that executive function consists of three or more elements and underlying processes (Hillman et al., 2003; Kamijo et al., 2009; Tomporowski et al., 2008), it is important to use a set of measures that taps into more than one element (Etnier & Chang, 2009). Miyake et al. (2000) linked three executive function processes to frontal lobe activity: "shifting between tasks or mental sets, updating and monitoring of working memory representations, and inhibition of dominant or prepotent responses" (Miyake et al., 2000; p. 54). The three executive function processes in this study were included because they were frequently used or described in important executive functioning literature (Colcombe & Kramer, 2003; Hillman et al., 2003; Kramer et al., 1999). Taking into consideration the three processes, three cognitive measures were used in this thesis that tapped into each of the specific processes outlined above.

A test that is commonly used to measure executive function is the Trail Making Test (TMT). "The TMT requires a variety of mental abilities for successful performance, including letter and number recognition, mental flexibility, visual scanning, and motor function" (Corrigan & Hinkeldey, 1987, p. 403). TMT Parts A and B scores are based on the number of seconds participants complete the task, (Corrigan & Hinkeldey, 1987). TMT Parts A and B were found to be correlated highly with many other measures of neuropsychological ability such as the Wechsler Memory Scale, Impairment Index and the Full Scale IQ from the Wechsler Adult Intelligence Scale-fourth edition (Corrigan & Hinkeldey, 1987). "The test is given in two parts: Trail Making, Part A (TMT-A) involves drawing a line connecting consecutive numbers from 1 to 25. Part B (TMT-B) involves drawing a similar line, connecting alternating numbers and letters in sequence (i.e., 1-A-2-B and so on)" (Arbuthnott & Frank, 2000, p. 518). This subtest requires participants to hear random numbers and letters, and then orally produce the numbers and letters in numerical then alphabetical order (Wechsler, 1997).

Researchers believe that overall, there are cognitive gains from exercise; these gains are more consistent in chronic exercise. Previous studies describe how chronic exercise causes more of a long-term change in the brain such as increases in gray and white matter, capillary density in the cerebellum, and/or dopamine receptor density (Kamijo et al., 2009) and increases in neurotransmitter levels (Colcombe & Kramer, 2003; Etnier et al., 1997). Previous studies describe how acute exercise also causes increases in neurotransmitter levels (Etnier et al., 1997) and arousal (Kamijo et al., 2009), however the long-term increases are less than those produced by chronic exercise. The different effects that acute and chronic exercise has on the brain structure can be leading to the difference in outcomes in the research (Colcombe & Kramer, 2003; Etnier et al., 1997). Inconsistencies in the research can also be due to the little consensus regarding the formal definition of executive function; difficulty in defining executive function may lead to a difficulty in measuring executive function (Etnier & Chang, 2009). Another potential explanation for mixed results in research in acute exercise and executive functioning could be due to the fact that studies usually only use one behavioral task to measure executive functioning. Since executive functioning encompasses three major processes, more tasks should be used to measure executive function to tap into each process (Etnier & Chang, 2009). In order to capture the three elements of executive functioning (shifting, updating, and inhibition), three different measures were used in this study (TMT, LNS, and DB).

Affect. There have been several meta-analyses examining the positive effects of acute bouts of exercise on affect (Arent, Landers, & Etnier, 2000; Ekkekakis & Petruzzello, 1999; McDonald & Hodgdon, 1991; Reed & Buck, 2009). Reed and Buck (2009) examined 105 studies focusing on the effects of aerobic exercise on positive-activated affect (PAA). The results showed that aerobic exercise programs produce encouraging increases in PAA (Cohen's d=. 57). Results showed a positive relationship with exercise frequency, and larger effects for the lowest and highest intensities. Chronic exercise (10-12 weeks) also yielded greater effects than acute exercise.

Wipfli et al. (2008) examined the effects of 49 studies regarding exercise on anxiety. An overall effect size of g= -0.48 suggests that exercise groups showed a greater reduction in anxiety when compared to control groups. When exercise was compared to other forms of anxiety-reducing treatments, exercise groups yielded greater reductions (g=-0.19). The results showed that chronic exercise had a greater impact on affect when compared to acute exercise, which was evidenced by greater reductions in anxiety.

A review by Daley (2008) provided a synthesis of the evidence regarding the positive link of exercise in the management of depression in adults. Published reviews and meta-analyses between January 1990 and November 2007 were included. One of the analyses reviewed by Daley (2008) included an analysis by Craft and Landers (1998). The meta-analysis showed an effect size of g=-0.72, showing an association with reduced depression after exercise (as cited in Daley, 2008). Based on the available evidence, Daley (2008) concluded exercise has both mental and physiological benefits.

Studies on the effects of chronic exercise on affect yield consistent and positive results on affect. However, research on acute bouts and affect do not yield this same level of consistency. Chronic exercise and moderate intensities yielded the highest effect sizes and these effects were associated with decreases in anxiety, depression, and negative moods, and increases in psychological well-being. While there were inconsistent results for acute exercise, it is important to note that there were still positive emotional responses; these results just yielded lower average effect sizes when compared to chronic exercise which may be due to potential unidentified mediating variables.

Choice. Inconsistency in results for the effects of acute exercise on affect and cognition could be attributed to moderating variables. Examples of potential moderating variables include the duration that participants exercise, the age of participants, measures employed, and autonomy in selecting whether to exercise as well as how to exercise. The majority of previous studies on intensity of exercise have imposed the intensities on the participants (Ekkekakis, 2009; Szabo, 2003). Most research on self-selection and exercise has shown an increase in affective responses with an increase in autonomy (Ekkekakis & Lind, 2006; Moller, Deci, & Ryan, 2006; Szabo, 2003). A theoretical explanation for why individuals report more enjoyment and affective gains when able to self-select the intensity at which to exercise can be derived from the Self-Determination, Theory (Deci & Ryan, 1985; Lutz et al., 2003; Parfitt & Gledhill, 2004).

Self-determination theory (SDT) is a general theory of human motivation and is concerned with identifying factors which facilitate versus forestall intrinsic motivation, self-regulation, and psychological well-being (Deci & Ryan, 2002). The authors explain that in order to reach this level of psychological well-being, three basic needs must be met (the need for competence, relatedness, and autonomy). These needs provide the basis for categorizing aspects of the environment as supportive to optimal human functioning

(Deci & Ryan, 2002). "The need for competence leads people to seek challenges that are optimal for their capacities and to persistently attempt to maintain and enhance those skills and capacities through activity" (p. 7). "The need for autonomy refers to being the perceived origin or source of one's own behavior" (p. 8). "The need for relatedness refers to feeling connected to others to caring for and being cared for by others" (p. 7). These are some motives that may distract people from activities that could provide basic need fulfillment which takes away from their well-being (Deci & Ryan, 2002). SDT formulates that if needs are not met it may lead to negative consequences (Moller et al., 2006). In this current study, the need for autonomy will be the focus.

Choice and affect. According to the Self-determination theory, allowing participants to have a choice as compared to having exercise parameters assigned, should increase their feeling of self-determination and consequently result in higher feelings of intrinsic motivation or positive affect (Lutz et al., 2003; Parfitt & Gledhill, 2004). Several studies have focused on the differences between imposed versus self-selected or preferred exercise intensities on affect (Parfitt, Rose, & Markland, 2000), and some studies have even focused on selection of modality (i.e. cycling, treadmill, resistance, etc.) (Parfitt & Gledhill, 2004). Either way, choice was the moderating factor under examination. Researchers found that when participants were given a choice of intensity or mode of exercise, participants reported more positive affective gains (Parfitt & Gledhill, 2004; Szabo, 2003).

Parfitt and Gledhill (2004) investigated the effects of choice of exercise mode (cycle ergometer, Concept II rower, and treadmill) on psychological responses. Twenty participants exercised for 20 minutes for each mode of exercise on three separate occasions. For the first session, participants became familiar with the three modes of exercise and were then asked to rank the three modes for preference. During the second and third sessions, participants completed a 20 min exercise bout for the high-preference and low-preference mode of exercise. The intensity was standardized at 70% maximum heart rate. The RPE scale was used to estimate their exercise intensity. The Subjective Exercise Experiences Scale (SEES) (McAuley & Courneya, 1994) was used to assess psychological affect during and after exercise. Results indicated that affect and RPE were influenced favorably during the preferred mode exercise trial. Analysis revealed positive psychological well-being, lower fatigue, and lower distress in the high-preference condition. Parfitt and Gledhill conclude that choice in exercise had a positive influence in psychological responses.

An experiment conducted by Bixby and Lochbaum (2008) examined the influence of modality choice on affect during and after exercise. Forty-two female participants experienced each of the three conditions. Participants either performed their most preferred activity, least preferred activity, or a non-exercise control condition randomly on separate days. Affect, arousal, and RPE were assessed prior to each condition, 3 times during the activity, and 2 times during recovery. Results indicated that participants reported higher pleasant activated states following the preferred activity when compared to the other two trials (η=.55).

Based on the two studies reviewed above, choice of modality seems to have a consistent positive effect on affective changes experienced from exercising. However, the results are not as consistent when individuals' choice in intensity (self-selected pace, vs. imposed pace) is manipulated.

Szabo (2003) examined psychological benefits of self-selected exercise intensity. Ninety-six students were instructed to run or jog at a self-selected pace for 20 minutes. Unlike some of the other studies, intensity of exercise was not considered in this study. Affect was compared from before and after exercise. The Profile of Mood States (POMS, Grove & Prapavessis, 1992) inventory was used to measure affect. MRM-ANOVA analyses indicated that acute exercise at self-selected intensity yielded significant affective benefits. Total mood disturbance significantly decreased from pre-to post-exercise (Cohen's d = .49). Results indicate that besides just looking at intensity of exercise, self-selection also plays an important role in affective gains. When the author compared the effect size of the present study with other previously reported results just looking at the intensity as a variable, the effect was either comparable or higher.

The effect of prescribed (65 % of $VO_{2\ max}$) versus preferred exercise intensity on affect was investigated by Parfitt et al. (2000). Participants consisted of 26 active healthy undergraduates. Affect was measured using the Subjective Exercise Experiences Scale (SEES, McAuley & Courneya, 1994). The SEES includes three subscales: positive well-being (PWB), psychological distress (PD), and fatigue. Affect was measured before exercise, 5-minutes into exercise, and 5- minutes post-exercise. Heart rate, RPE, and enjoyment were measure during each session. Twenty-six participants exercised for 20 minutes on the treadmill; each participant experienced both the prescribed and preferred exercise intensity. Results indicated that even though participants worked significantly harder in the preferred trial (71%) as compared to the prescribed (65%), there was no significant difference in affect between the two trials. However, affect rated before exercise played an influential role in the affective responses to exercise. Parfitt and colleagues reported that "participants high in PD and fatigue prior to exercise showed a decrease over time, while participants low in PD and fatigue remained stable" (p. 237). Although there were also no differences found for interest/enjoyment between prescribed (Mean=34.57) and preferred trials (Mean=35.11), the preferred trial yielded a slightly higher mean.

Rose and Parfitt (2007) analyzed the difference between an individual's affective responses to different exercise intensities (below lactate threshold (LT), at LT, above – LT, and self-selected). Nineteen women volunteered to run 20 min on a treadmill. The participants were tested under the four intensities mentioned. To measure LT levels, participant's heart rate and blood lactate was measured at rest. A heart rate monitor was worn on the participants' chest. A finger prick was taken to analyze the lactate level during the first visit. Then during exercise, HR and RPE were recorded every 5 minutes. Blood lactate was measured after 10 and 20 minutes to confirm intensity levels. Feeling Scale (FS) (Hardy & Rejeski, 1989) was used to measure affective valence (pleasure-displeasure). Affect was measured, pre-, during and post- exercise. The self-selected trial was significantly more positive compared with the above-LT (η^2 =. 28), but not the below-LT or at-LT trials. Affect was the least positive during the above -LT Trial and the most positive during the self-selected and below-LT conditions. Results show that self-selected intensity was only statistically superior to above -LT assigned intensity condition.

Research supports that there are differences between persons who are allowed to self-select exercise modality versus those assigned a non-preferred modality with regards to affective gains. However research shows inconsistent results in regards to control of intensity and the levels of intensity prescribed. Even though some studies found no significant differences, the methodologies employed are questionable (Ekkekakis & Lind, 2006; Farrell, Gates, Maksud, & Morgan, 1982; Parfitt et al., 2000; Szabo, 2003). Manipulation checks were absent or independent and dependent variables were not operationally defined. Only one study conducted a manipulation check for the degree of choice/autonomy and enjoyment (Parfitt et al., 2000). The current study includes a manipulation check for the degree of choice and enjoyment. According to SDT enjoyment is connected to autonomy, so it is important to ensure that the experimental manipulation worked.

Research shows positive associations between exercise and cognitive and affective gains. Research, however, has only looked at choice as a mediating factor in affect. This study addresses how autonomy positively impacts changes in both cognition and affect. A question raised in the current study is that if participants are forced to exercise at a specific intensity (other than their preferred), will this negatively impact cognitive resources (as expressed in SDT), resulting in lower affective and lower executive function?

Overview of Study and Hypotheses

This study consisted of two sessions. In the first session participants exercised at preferred rate for 25 min. Affect was assessed before, during, post exercise, and 15 minutes post exercise. Executive functioning was assessed following exercise. For the second session, participants were randomly assigned to one of four exercise groups. The first group exercised at their preferred rate for the 25 min bout of exercise. Rated Perceived Exertion (RPE) is defined as a self-report measure of perceived effort during exercise condition (Borg, 1982). The second group exercised at an average RPE taken from the first session and not allowed to change the speed. The third group exercised at an average of two RPE levels below the RPE measured during the first session. The fourth group exercised at an average of two RPE levels above the RPE measured during the first session. Affect and executive functioning were assessed at the same time points for the second session. It was hypothesized that participants who had a choice with regards to exercise intensity, such as group one (choice group), would have affective and cognitive gains relative to their performance from trial one, whereas the other groups would experience a decrease in both the affective and cognitive variables. The rationale was that a reduction in autonomy would decrease the potential benefits of exercise on affect and executive functioning.

Method

Participants

Participants were recruited through the psychology department's study board. In total there were 117 participants (female = 57, male = 60) with an average age of 19.27 (SD= 1.99). All participants passed a risk assessment and provided informed consent. The HSRB committee approved the study (see approval letter in *Appendix*). The participants were randomly assigned to one of four groups after session one was completed. Group distribution was as followed: Group 1(choice group) n= 29, Group 2 (same RPE) n = 30, Group 3 (2 RPE above) n =28, and Group 4 (2 RPE below) n = 30. Only seven participants were smokers. There were not a disproportionate number of smokers assigned to any one group, chi-square (3, 117) = 1.670, p = .644. Body Mass

Index (BMI) is based on an individual's body weight and height. According to the World Health Organization, the normal range of BMI is from 18.5 to 24.9. The average BMI for the participants in current study was (M=23.62, SD=3.76). There were no significant differences among the four groups for BMI, $F(3, 113) = .974$, $p = .408$.

An additional demographic variable assessed for this study was Stage of Change. The Stages of Change was originally created to assess and track change in individuals to a healthier life (Prochaska & DiClemente, 1983). This model includes five distinct stages that individuals can move to and from at any given time: an individual in the precontemplation stage does not currently exercise and is not thinking about starting; an individual in the contemplation stage does not currently exercise, but is thinking of starting in the near future; an individual in the preparation stage has already planned and started exercising, just not regularly; someone in the action stage have started to exercise regularly (i.e., three exercise sessions per week for at least 30 min per session), and have been doing so for less than 6 months; an individual in the maintenance stage have been exercising regularly for 6 months or more (Marcus, Selby, Niarua, & Rossi, 1992; Prochaska & Diclemente, 1983; i.e., Transtheoretical Model). The reliability and validity of this measure has been previously investigated and shown to be both strong and stable (Marcus & Simkin, 1993; Wininger, 2007).

Materials

There were three cognitive tests used in this study: Wechsler Adult Intelligence Scale-fourth edition -Letter Number Sequencing (LNS), Digit Span Backwards (DSB), and Trail Making Test (TMT). The TMT, Digit Span, and Letter-Number Sequencing were chosen because they capture the three processes outlined earlier in the literature review. The three functioning as a whole are believed to give a good overall measurement of executive function (Miyake et al., 2000).

Cognitive measures. The LNS and DB are subtests from the WAIS-IV, which is a standard measure of intelligence (The Psychological Corporation, 1997). According to the manual, reliability coefficients ranged from .70-.93 and when the WAIS-IV was compared to other intelligence test, the validity was in the high .80s (Wechsler, 2008; Zohrab, 2007). According to The Psychological Corporation (1997), the WAIS-IV is highly valid and reliable.

LNS require participants to hear random numbers and letters, and then orally produce the numbers and letters in numerical then alphabetical order (Wechsler, 1997). LNS measures updating because it requires the participant to sequence from first ordering the numbers heard, then the letters.

DB is another subtest from the WAIS-IV. This subtest requires the participant to repeat numbers in reverse order (Wechsler, 1997). This measures working memory because participants are not only required to remember the numbers, but long enough to say them backwards.

The TMT has two parts: part A requires participants to quickly connect numbers, and then part B requires participants to connect numbers, however alternating between numbers and letters (Arbuthnott & Frank, 2000; Kortee, Horner, & Windham, 2002). Validity and reliability scores are shown to be sufficient (Corrigan & Hinkeldey, 1987). The TMT measures shifting function because it requires participants to shift from numbers to letters.

Rated perceived exertion. The Borg Scale is a simple method of measuring RPE and can be used to gauge a person's level of exercise intensity (Borg, 1998). RPE is how heavy and exhausting the exercise feels to the participant. The scale ranges from six (no exertion at all) to twenty (maximal exertion), which is designed to match the typical range of heart rates (60-200 bpm) when RPE is multiplied by 10. A person's exertion rating is a good estimate of the actual heart rate during an activity (Borg, 1998). According to Laskowki from the Mayo clinic, the average resting heart rate for a healthy adult is approximately 60-100 beats per minute (Laskowki, 2010). The average maximum heart rate is usually calculated at 220 minus age; this explains the range of 6 to 20 on the RPE scale (Borg Scale, 2011). For example, from the scale, if a person mentioned that their RPE is 9, then 9 X 10 =90; that individual's heart rate would be estimated to be beating 90 beats per minute (Quinn, 2004).

Affective ratings. Thayer's Activation-Deactivation Adjective Checklist (AD ACL) is a multidimensional self-rating measure constructed for assessment of arousal states (Thayer, 1978, 1986). There are two forms of the AD ACL, the long and short form; this study will use the short form. The AD ACL short form includes four self-descriptive adjectives for each factor: Energy, Tiredness, Tension, and Calmness. Scoring is based on four-point scale for each adjective (Thayer, 1978, 1986). The points are described with "definitely do not feel", "cannot decide", "feel slightly" and "definitely feel". The points range from 1 (definitely feel) to 4 (definitely do not feel). The AD ACL's reliability and construct validity are well established (Thayer, 1978, 1986). Validity estimates include the following correlations: heart rate and energy (.49), heart rate and calmness (.43), as well as skin conductance and tension (.49) (Thayer, 1978).

Using the Spearman-Brown formula, consistency estimates varied from .89 - .92 (Thayer, 1978).

The Intrinsic Motivation Inventory (IMI) was used to measure participants' levels for SDT constructs (Ryan, 1982). This inventory includes four individual dimensions of SDT: interest/enjoyment, competence, effort/importance, and pressure/tension (McAuley, Duncan, & Tammen, 1989). Responses are scored on a 7- point likert scale ranging from (1) not at all true to (7) very true (Ryan, 1982). Only the Perceived Choice and Interest/Enjoyment scales were used in this study. The Interest/Enjoyment scale is described to be a self-measurement of intrinsic motivation and the Perceived Choice scale assesses autonomy (Ryan, 1982). The Interest/Enjoyment scale and the Perceived Choice scale showed coefficient alphas of .86 and .83 in previous research supporting the internal consistency of the scales (McAuley et al., 1989). According to the Self-Determination Theory website (2008), the subscales in the IMI have all been shown to be both strong and stable. The authors ensured a factor loading of at least 0.6 on the subscales included in the IMI (Self-Determination Theory website, 2008).

Procedure

Participants visited the lab at the same time and day of the week on two separate occasions. Sessions took approximately 35-60 minutes. The first session began by having the participant read and sign an informed consent, take a risk assessment, and complete a demographics form. After the participant was given instructions about how to use the RPE scale, participants proceeded with a 25 minute bout of self-paced treadmill exercise. RPE was reported at 5, 15, and 22 minutes during exercise. Affect was measured prior to exercise, 15 minutes into exercise, post exercise, and 15 minutes post exercise. Executive function measures were given upon completion of the exercise bout. The assessment of executive functioning consisted of the Trail Making Test, Digit Span Backwards, and Letter-Number Sequencing. The second session also included a 25 minute exercise bout on the treadmill and same sequence of measures. Participants were randomly assigned to one of four groups for the second session. Group assignment determined which set of instructions the participant received regarding intensity. The four groups were differentiated by the participants' ability to: 1) Exercise at preferred rate and be allowed to change speed throughout exercise. 2) Exercise at their average preferred rate from the previous session but not be allowed to change speed throughout exercise. 3) Exercise at two RPE levels below their average preferred rate. 4) Exercise at two RPE levels above their average preferred rate.

Results

Stage of Change

The breakdown of participants across groups and stages of change are reported in Table 1. The data shows that there are no systematic deviations in the stage of change distribution across the four groups ($X^2(12, 117) = 8.722, p = .726$).

Table 1

Frequencies for Stage Change by Group Assignment

	Group Assignment			
Stage change	Group 1	Group 2	Group 3	Group 4
Precontemplation	1	0	0	1
Contemplation	1	1	2	1
Preparation	5	9	9	5
Action	13	12	13	14
Maintenance	9	8	4	10
Total	29	30	28	30

Manipulation Checks

A manipulation check of the intensity levels (via RPE) showed that there was a significant difference between groups in the expected directions. Group 1 (choice group) and 2 (mean RPE) did not change from session one to two. Group 3 (2 RPE above) participants reported on average RPEs two levels higher the second session. Group 4(2 RPE below) participants had RPEs on average two less on the second session. The interaction between RPE across sessions and group assignment was significant, which is shown in Figure 1, $F (3, 110) = 64.906$, $p<.001$, partial $\eta^2=.639$.

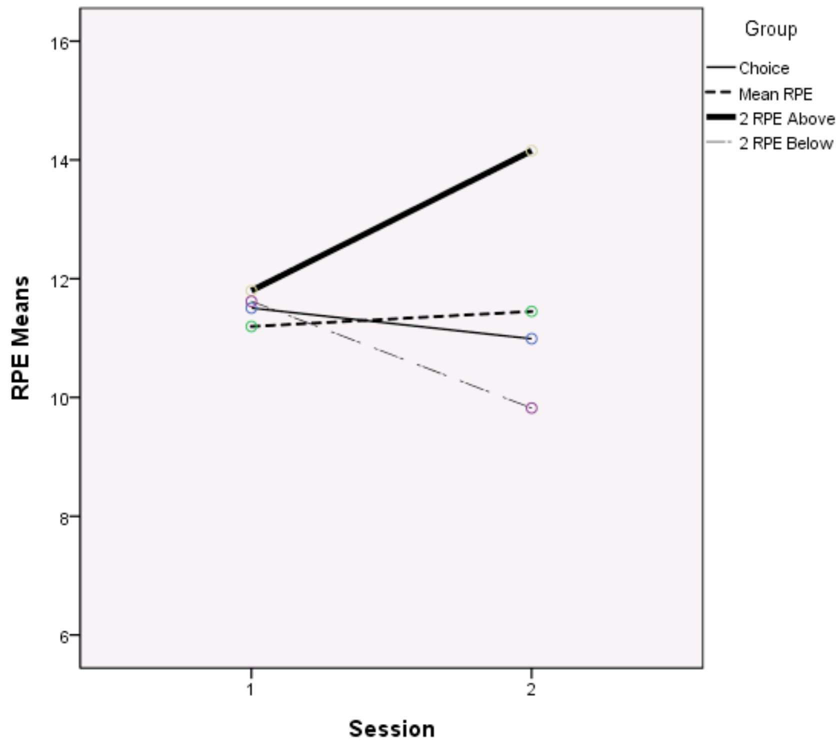

Figure 1. Manipulation Check for RPE

A manipulation check of autonomy also supported the efficacy of the experimental methods (shown in Figure 2). Group 1 maintained a high level of perceived choice, while other three groups showed a decrease in autonomy (F (3,105) = 6.655, p<.001, partial η^2=.16). Unexpectedly, an examination of enjoyment scores (via IMI) showed that the group that got to choose, did not rate their second session as more enjoyable compared to the other three groups (F(3, 108) = .635, p=.594, η^2=.017**)**, contrary to what was expected (see Figure 3).

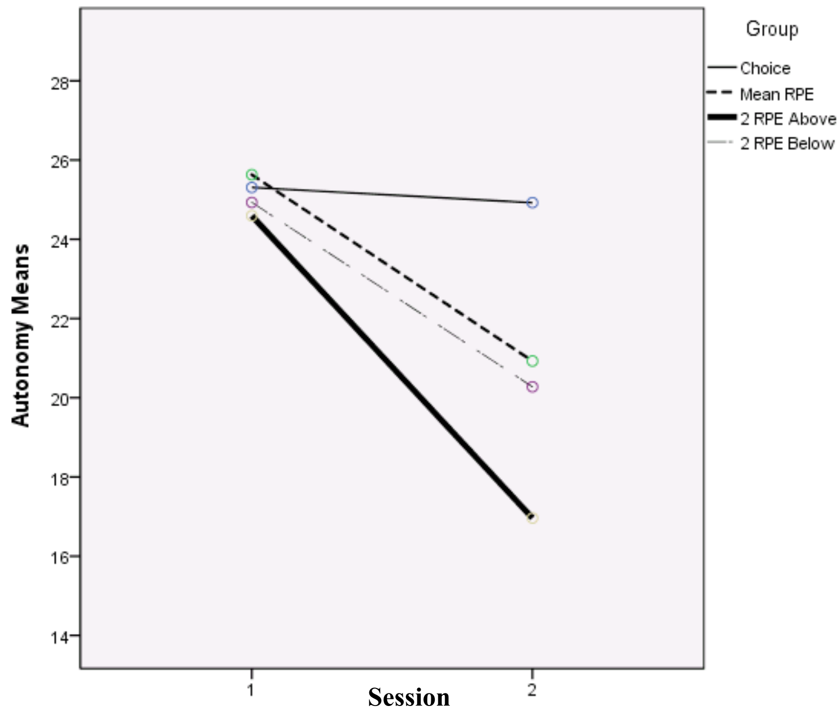

Figure 2. Manipulation Check of Autonomy

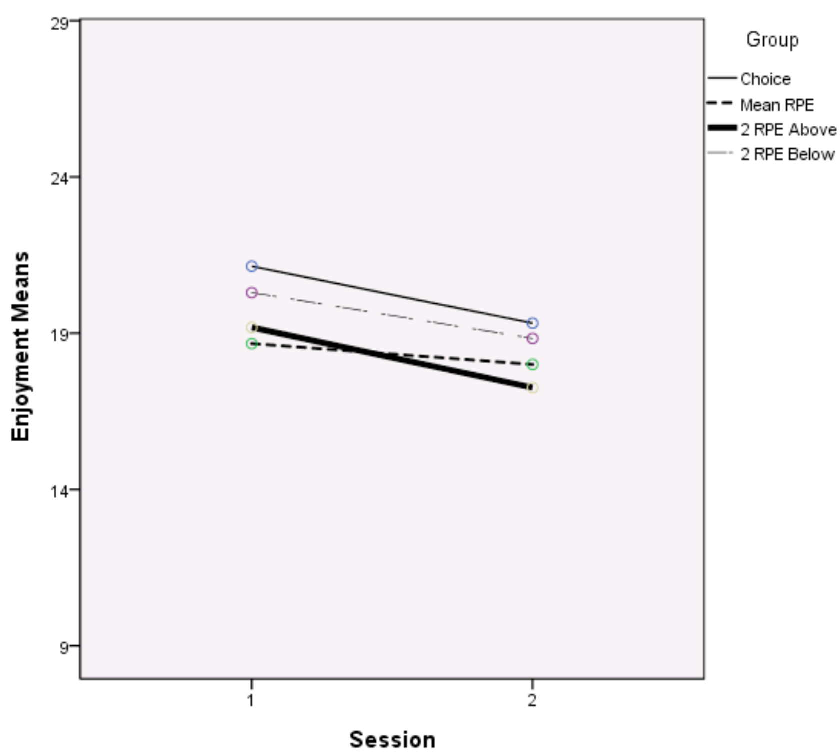

Figure 3. Manipulation Check of Enjoyment

Affective Responses

Reliability coefficients for each affective subscale across trials are reported in Table 2. An examination of each affect subscale is reported in figures 4-7; there is a separate figure for each session, e.g., 4a and 4b. The hypothesis was examined via mixed within subjects MANOVA for Affect 4(condition) x4(affect measure) x2(bouts). Examination of the analyses did not reveal a significant linear interaction for trial x factor x group for any affective dimension: Energetic (F (3, 111) = .152, p=.928, Tired (F (3, 109) = 1.060, p=.309, Tension (F (3, 109) = .791, p=.501, Calmness (F (3, 110) = 2.329, p=.078.

Table 2

AD ACL Subscale Reliability Coefficients

Subscale	Self- Selected				Experimental			
	Pre	During	Post	Post-15	Pre	During	Post	Post-15
Energetic	.757	.686	.646	.797	.824	.689	.733	.823
Tiredness	.853	.671	.569	.736	.910	.815	.784	.817
Tension	.654	.605	.571	.770	.516	.588	.660	.738
Calmness	.610	.559	.626	.758	.719	.642	.755	.779

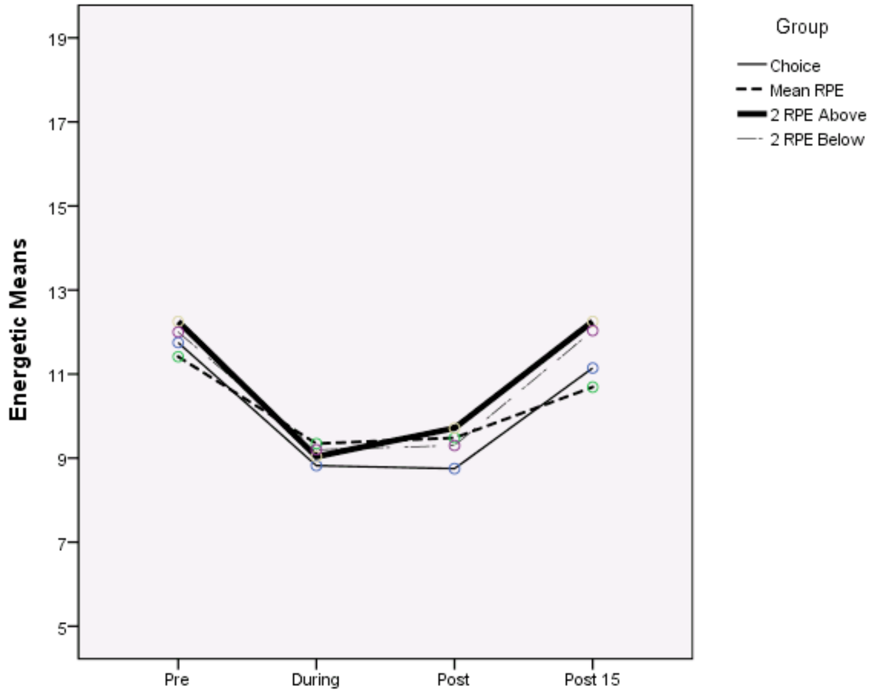

Figure 4a. Results of MANOVA for Energetic at Trial 1

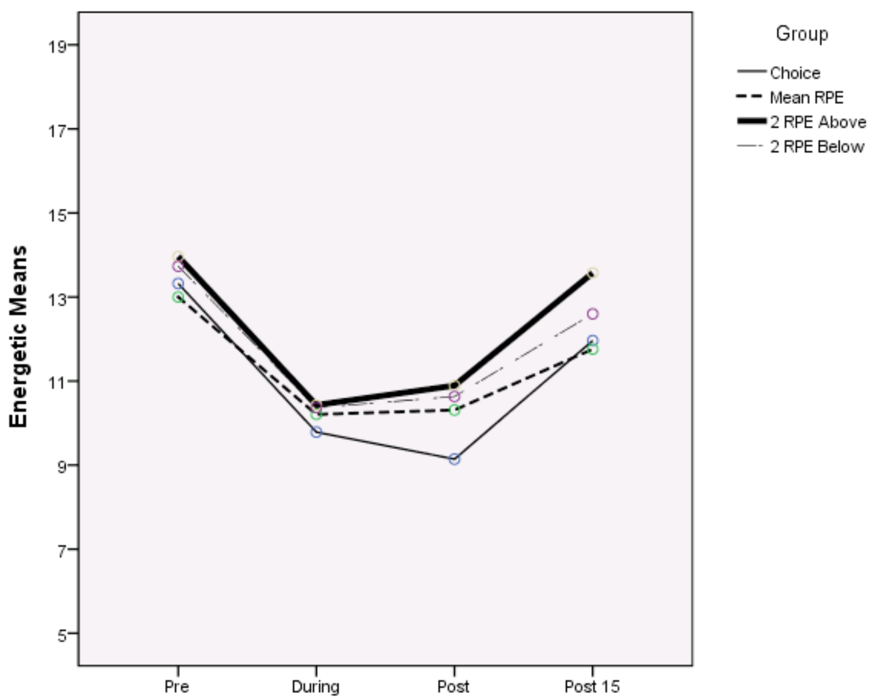

Figure 4b. Results of MANOVA for Energetic at Trial 2

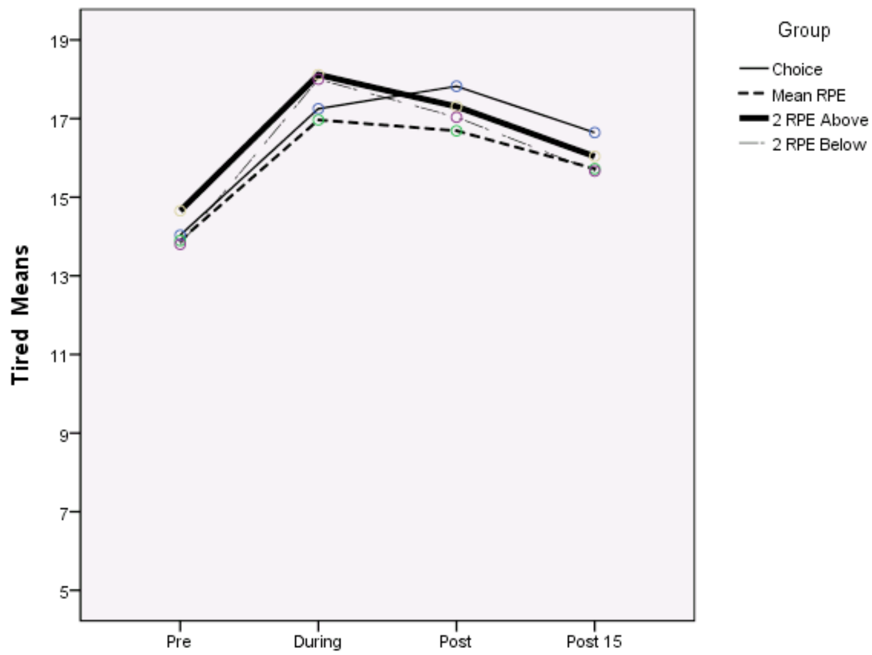

Figure 5a. Results of MANOVA for Tired at Trial 1

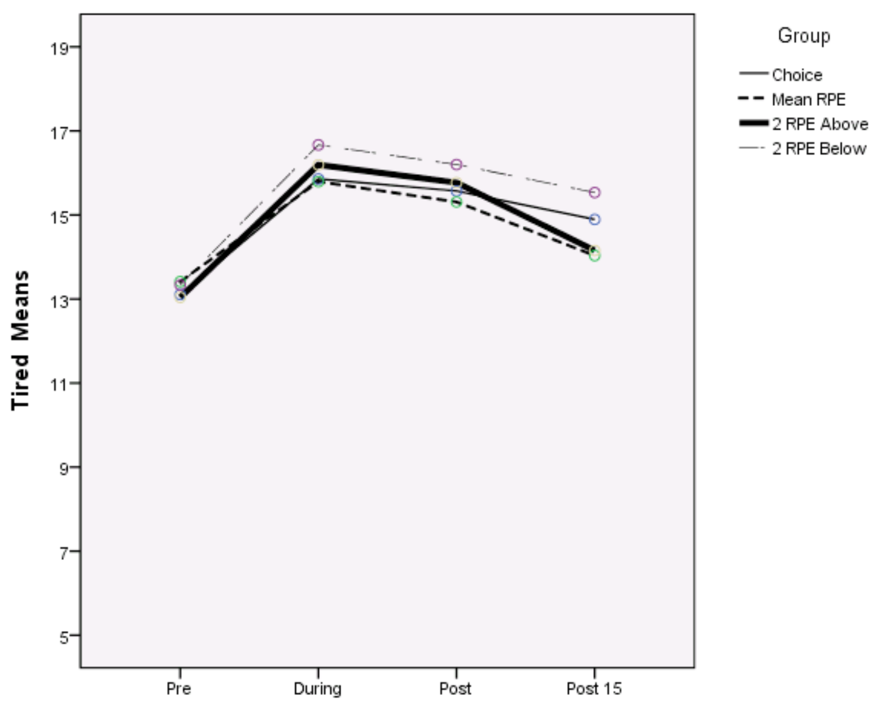

Figure 5b. Results of MANOVA for Tired at Trial 2

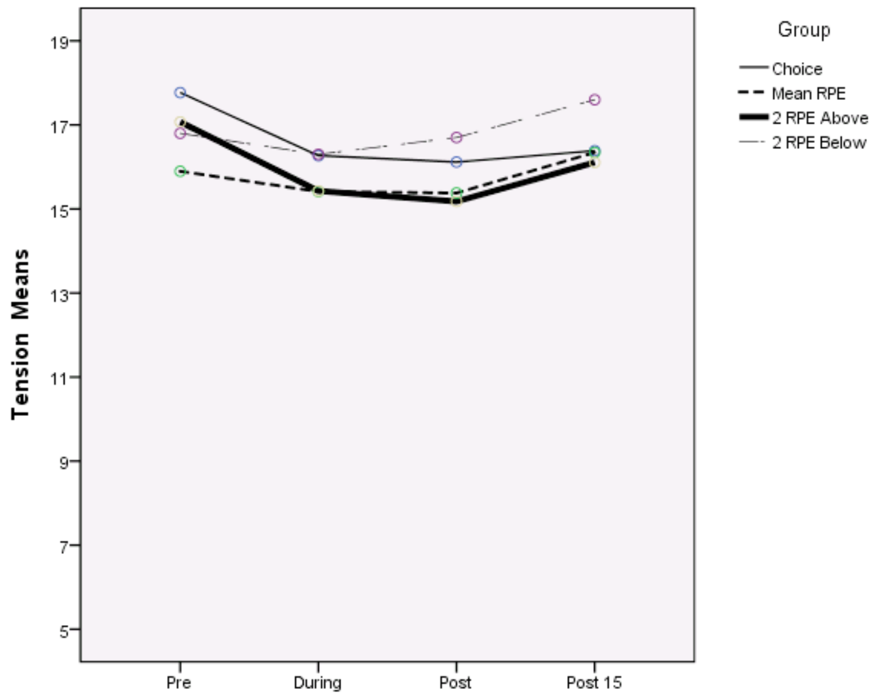

Figure 6a. Results of MANOVA for Tension at Trial 1

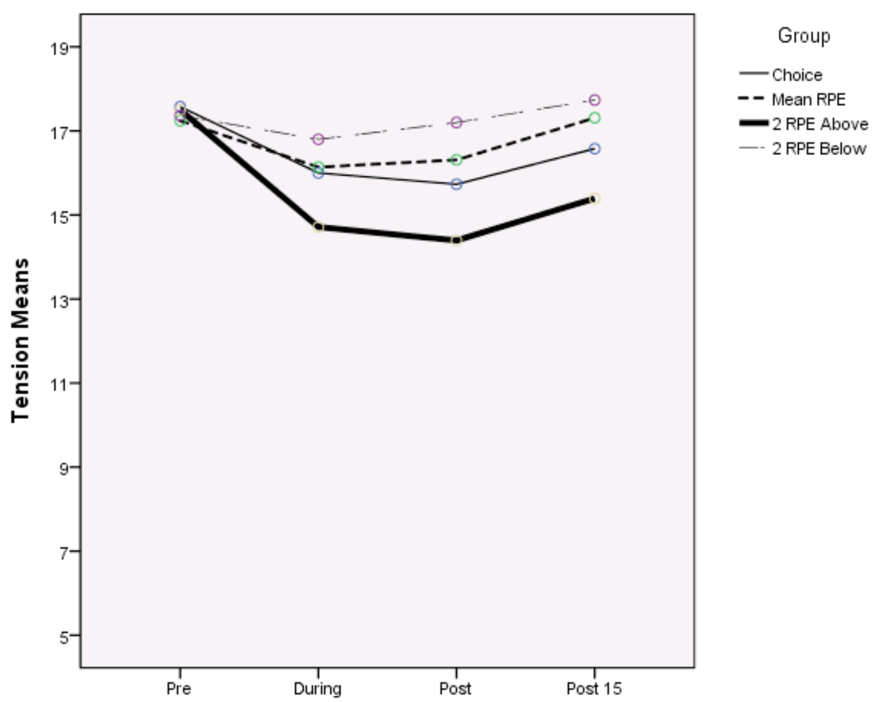

Figure 6b. Results of MANOVA for Tension at Trial 2

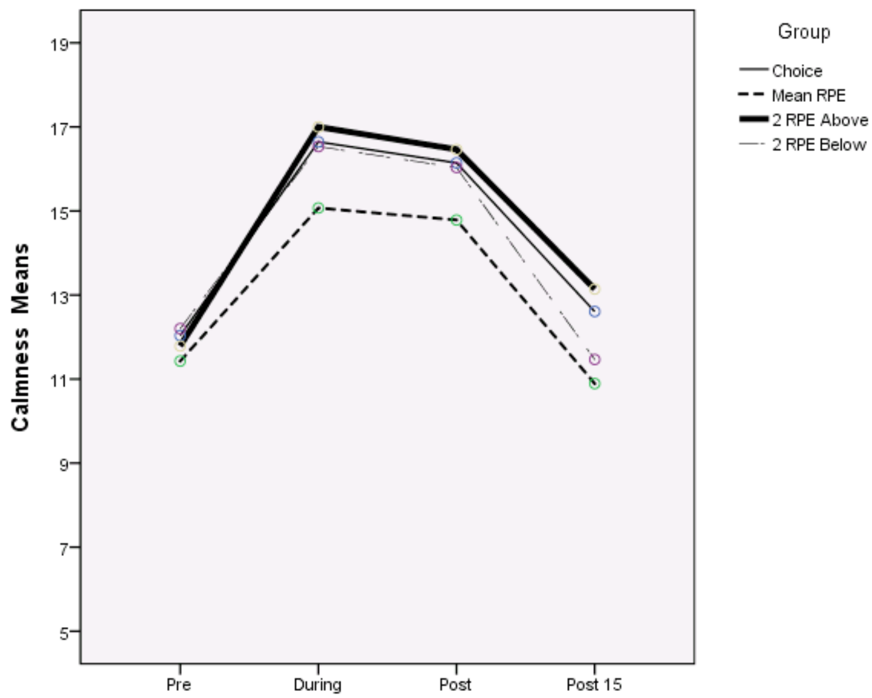

Figure 7a. Results of MANOVA for Calmness at Trial 1

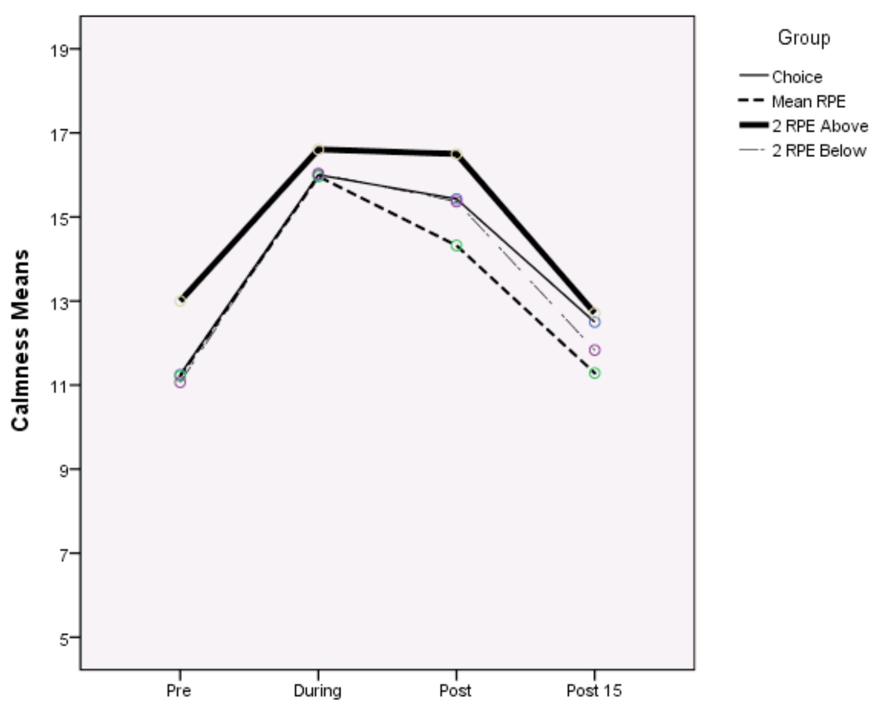

Figure 7b. Results of MANOVA for Calmness at Trial 2

Cognitive Responses

Hypotheses were assessed using a mixed within subjects MANOVA 4(condition) x2(bouts). An examination of the analyses did not reveal a significant interaction for any of the executive function measures: Letter-Number Sequencing (F (3, 113) = .553, p = .647, Digit Span Backwards (F (3, 113) = .350, p = .789, and Trail Making Test, F (3, 81) = 1.481, p = .226. Higher numbers are better for LNS and DSB, and lower numbers are better for TMT. There were some weak trends for all three. As hypothesized, the group which had control of intensity during the second session (group 1) showed the most increase on the second session for LNS and DSB as well as the largest decrease for the TMT. These results are graphed on Figures 8-10.

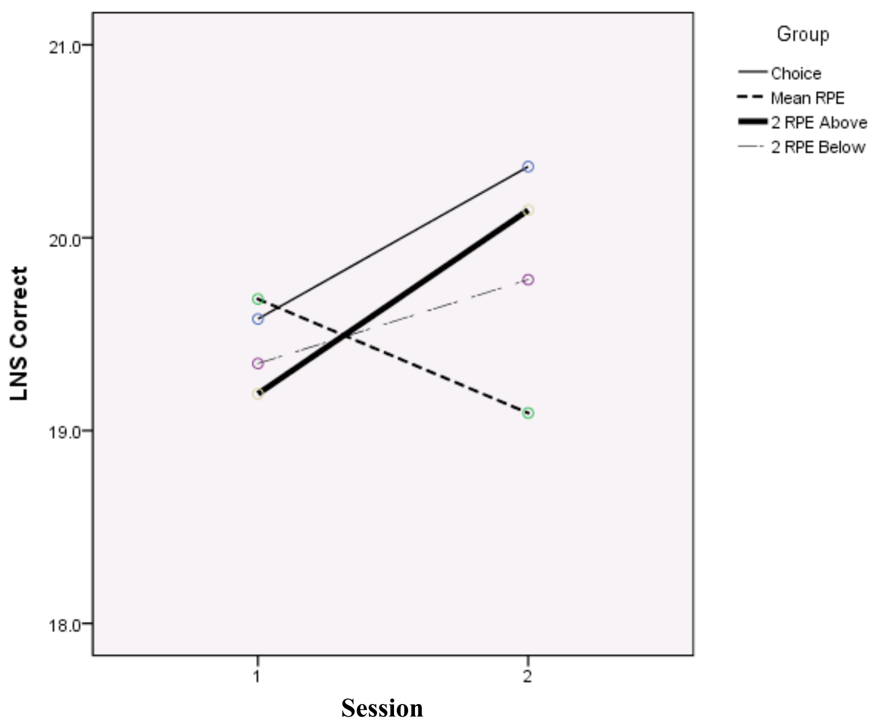

Figure 8. Results of Estimated Mean of LNS

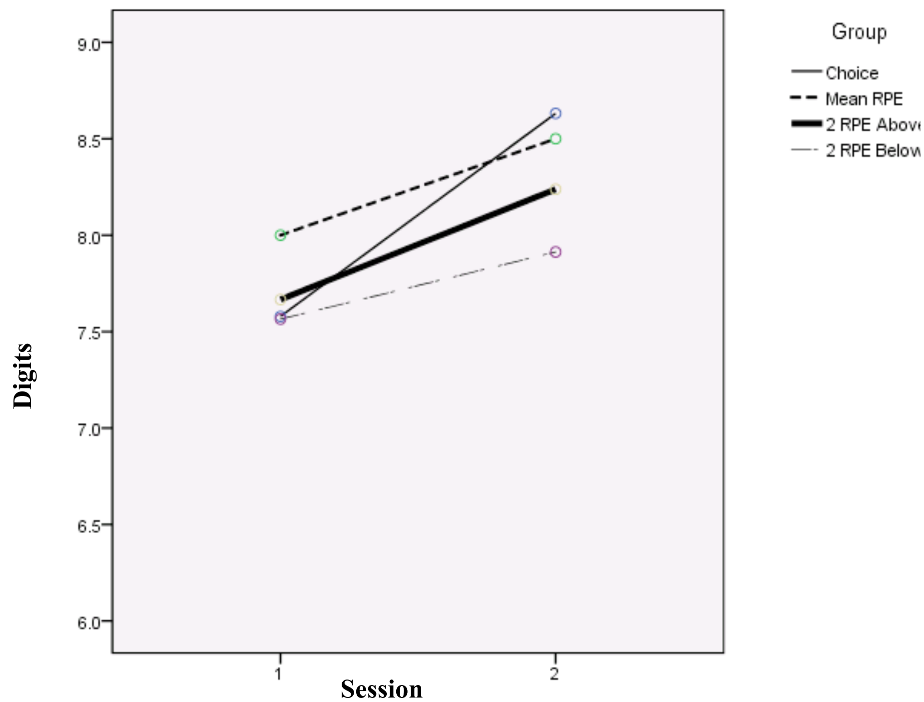

Figure 9. Results of Estimated Mean of DSB

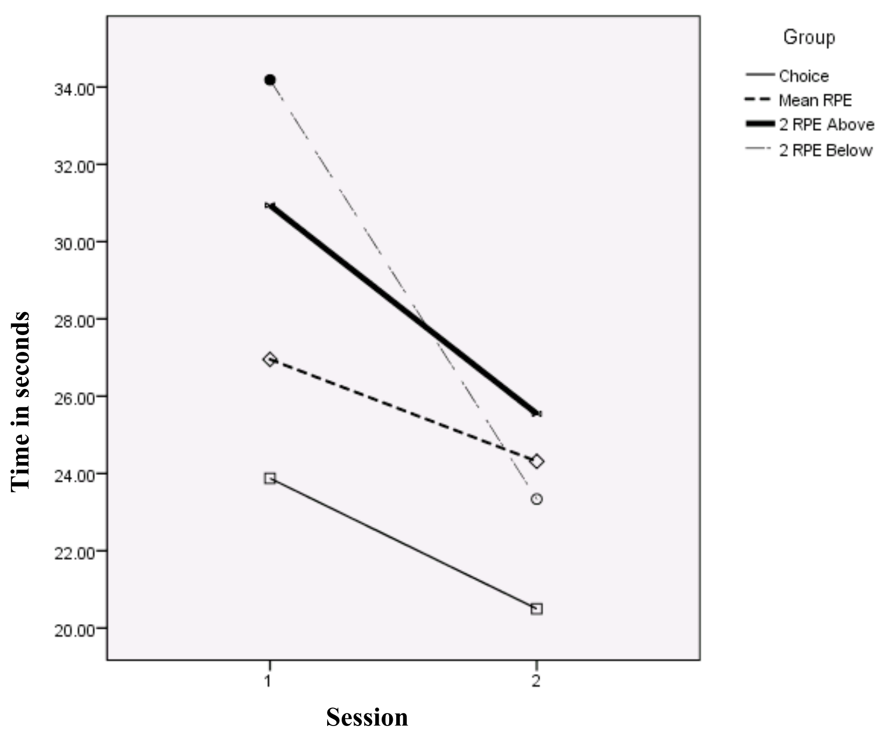

Figure 10. Results of Estimated Mean of TMT.
Note. Lower scores of TMT mean faster time completion.

Discussion

The purpose of this study was to examine the impact of choice of exercise intensity on the psychological benefits of acute exercise; specifically affective (energetic, tired, tension, and calmness) and the 3 executive functioning processes. The research question addressed was: how does reducing autonomy influence the affective and executive function gains accrued from exercising. It was hypothesized that participants who had a choice (group 1) would have consistent affective and cognitive gains from trial one, whereas the other group would experience decreases in affect and cognition.

A manipulation check of intensity levels showed a significant difference between groups in the expected directions. A manipulation check also showed there was a considerable variation in the choice subscale in the predicted directions. The choice group experienced greater perceived choice. However, participants in the choice group did not rate their second session as more enjoyable when compared to the other groups. This low feeling of enjoyment, which is a measure of affect, could help to explain the trivial results. Based on the SDT model, enjoyment is linked to intrinsic motivation (Ryan, 1982). Since this psychological need was not met, this could have led to a negative or null consequence (Deci & Ryan, 2002). Research shows that positive mood has a positive influence on cognition especially executive function (Ashby, Valentin, & Turken, 2002; Phillips, Bull, Adams, & Fraser, 2002). It may also be important to note that this null finding is consistent with study by Parfitt et al. (2000) reviewed earlier.

The data do not support the research hypothesis. There were no impactful interactions across trials and between groups for affect or cognition. Current data are consistent with research from Parfitt et al. (2000) in finding insignificant interactions between choice in exercise and change in affect. However, these results are contrary to findings by Szabo (2003) as well as the two studies on choice of modality (Bixby and Lochbaum, 2008; Parfitt and Gledhill, 2004) when they found significant interactions between choice in exercise and affect. While, there were no statistically noteworthy interactions across the four conditions by exercise session, there were trends exhibited in affect for the energetic subscale. The choice group had lower energetic scores immediately after exercise compared to the other three groups during the second session, but the effect appears to dissipate within fifteen minutes (as shown in figure 4b). Lower energetic scores are better because responses range from 1 (definitely feel) to 4 (do not feel); participants would need to respond whether they (1) definitely feel energetic or (4) do not feel energetic. The SDT supports this trend, in that positive benefits (such as feeling more energized) arise from a participant's sense of autonomy.

There were also some non-significant trends for all three executive functioning measures. The groups who had a choice and who exercised at 2 RPEs above trial one's intensity during the second session recalled more numbers for the LNS measure (as shown in figure 8). Only the choice group showed a marked increase in Digit Span performance (as shown in figure 9) compared to session one. The 2 RPE below group demonstrated the most marked improvement in performance for the TMT. The LNS measure was the most useful, as it reached the closest to a noteworthy effect. The LNS subtest is different from past research because it measures sequencing, which is an aspect of executive functioning not usually covered. It was hypothesized that the choice group would maintain performance and the other groups would decline in performance. Results of the current study were inconsistent with the hypothesis.

Although, the results showed no significant interactions, the trends suggest the need for more research to better understand the relationship between choice and psychological benefits of exercise. There are several variables that should be taken into consideration which could have impeded the desired results and specific suggestions for future research which will be outlined in the paragraphs below.

Limitations and Suggestions for Future Research

A possible limitation of the current study is the variability in cognitive performance with all the groups in session one. Since there was no baseline measure of cognitive performance before exercise, it makes it difficult to speculate on reasoning for this variability. Even though there showed no significant effects in cognitive measures, it would have been of interest to see if exercise as a whole improved cognitive performance. Future research should continue to measure cognitive performance before and after exercise. Research shows that children, older adults, and elderly with mild cognitive impairments, low mental capabilities, and Alzheimer disease, showed a significant increase in cognitive performance after exercise (Scully et al., 1998; Wipfli et al., 2008). It is possible that lower performing populations are more sensitive to positive cognitive gains, similar to regression towards the mean. The amount of change may be less in healthy college students who may be approaching the limits of human performance on these tasks.

Research has also compared chronic exercise with acute exercise. The most cognitive gains were exhibited in the chronic exercise studies. This could have been the explanation of less impact on cognition and affect from acute bouts of exercise. Chronic manipulation of choice of intensity may yield stronger effects based on previous studies.

Chronic exercise results in more structural changes in the brain while acute exercise results in physiological state changes (Etnier et al., 1997; Kamijo et al.2009; Tomporowki et al., 2008).

Previous research indicates that choice of modality is a consistent moderating variable for affective gains (Bixby & Lochbaum, 2008; Parfitt & Gledhill, 2004). Future research should focus on various modes of exercise allowing participants to have full control. In addition, the effect of choice of modality (e.g., treadmill, cycle, resistance, or swimming) on cognitive gains should be examined to determine if the effects are the same as those reported for affect gains. Future research should also consider examining the effects of autonomy on benefits accrued from chronic exercise. Researchers' may also want to consider examining the outcomes of behavioral and physiological responses to exercise in order to capture finer differences in executive functioning in participants with normal functioning. Future research should consider using a nonexercise group as the control. A control group would have added to the strength of the current study. Another interesting area that could be addressed is comparing cognitive gains from exercise in children diagnosed with ADHD versus normal functioning children.

Conclusion

Results from the current study do not support choice of intensity as a moderator of psychological gains accrued via exercise. However, it is important to note that there were some positive non-significant trends exhibited. The most important trend that was observed was in the LNS measure, as it was the closest to reach a significant result. Inconsistencies continue to be exhibited for the effects of acute exercise on psychological outcomes. The more consistent effects of exercise from reviews of previous literature are exhibited for chronic exercise when compared to acute bouts of exercise as well as modalities with regard to choice and acute exercise. If researchers are going to consider using acute bouts of exercise, it is recommended that participants' motivation and effort for criterion tasks are assessed and that power analyses be conducted a priori to ensure adequate sample sizes due to small effects.

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Appendix

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A LEADING AMERICAN UNIVERSITY WITH INTERNATIONAL REACH

HUMAN SUBJECTS REVIEW BOARD In future correspondence, please refer to HS10-152, January 21, 2010

Dr. Steve Wininger
Annegracien Delaunay
Psychology WKU

Dr. Steve Wininger
Annegracien Delaunay:

Your research project, *Impact of Choice on Psychological Benefits of Exercise,* was reviewed by the HSRB and it has been determined that risks to subjects are: (1) minimized and reasonable; and that (2) research procedures are consistent with a sound research design and do not expose the subjects to unnecessary risk. Reviewers determined that: (1) benefits to subjects are considered along with the importance of the topic and that outcomes are reasonable; (2) selection of subjects is equitable; and (3) the purposes of the research and the research setting is amenable to subjects' welfare and producing desired outcomes; that indications of coercion or prejudice are absent, and that participation is clearly voluntary.

1. In addition, the IRB found that you need to orient participants as follows: (1) signed informed consent is required; (2) Provision is made for collecting, using and storing data in a manner that protects the safety and privacy of the subjects and the confidentiality of the data. (3) Appropriate safeguards are included to protect the rights and welfare of the subjects.

This project is therefore approved at the Expedited Review Level until May 31, 2010.

2. Please note that the institution is not responsible for any actions regarding this protocol before approval. If you expand the project at a later date to use other instruments please re-apply. Copies of your request for human subjects review, your application, and this approval, are maintained in the Office of Sponsored Programs at the above address. Please report any changes to this approved protocol to this office. A Continuing Review protocol will be sent to you in the future to determine the status of the project. Also, please use the stamped approval forms to assure participants of compliance with The Office of Human Research Protections regulations.

Sincerely,

Paul J. Mooney, Compliance Coordinator Office of Sponsored Programs Western Kentucky University

HUMAN SUBJECTS REVIEW BOARD WKU APPROVED

10 to 5/31/10
EXEMPT EXPEDITED

DATE APPROVED _L/JLL/1$3

HSRB APPLICATION #

APPROVED JJIL

cc: HS file number Wininger HS10-152