Exploring Mood Changes Based on Exercise Type and Intensity

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Declaration

I declare that this submission is my own work. Where I have read, consulted, and used the work of others, I have acknowledged this in the text.

Signed: Nicholas Rooney 

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List of Abbreviations

POMS: Profile of Mood States

TMD: Total Mood Disturbance

RPE: Rate of Perceived Exertion

BRUMS: Brunel Mood Scale

ANOVA: Analysis of Variance

Abstract

Mood is an affective state or response to the outside world which is transient and constantly fluctuating. Exercise is repetitive planned physical activity designed to enhance physical condition. Exercise can vary in type, such as aerobic and anaerobic, and intensity, such as moderate and high intensity. The Profile of Mood States is a popular mood scale to examine the effects of stimuli such as exercise on an individuals' current mood state. Little research has examined mood and exercise in an ecologically valid setting. This study aimed to explore mood state changes based on exercise type and exercise intensity with (N=140) participants in a commercial gym. A 2x2 factorial between within design examined mood changes before and after exercise types (aerobic and anaerobic) and intensities (moderate and high). Total mood disturbance had significantly reduced post-exercise compared to pre-exercise. However, there were no significant differences in mood changes based on exercise type and intensity. Therefore, the public should carry out exercises that they enjoy and are most likely to stick to. A limitation was that scales were self-reported, thus having the risk of human error. Future studies should compare natural-environment outdoor exercise versus artificial-environment indoor exercise on mood benefits.

1. Introduction

1.1 Overview

A substantial body of literature has examined mood and methods to improve it. Exercise's potential to positively influence mood has been a high-interest area of research within sport and health psychology literature (Berger & Motl, 2000; Chan et al., 2019). Exercise can be categorised as aerobic or anaerobic and moderate-intensity or high-intensity. The present literature review will examine gaps in the literature relating to the differences in mood benefits based on exercise type and intensity.

1.2 Mood

Mood is an affective psychological state that has been analysed from different perspectives for centuries. Philosophically, mood is the fundamental way we experience the world and how it discloses itself to us (Freeman, 2014). Psychologically, mood is a human response to and reflection of the outside world (Ronkainen et al., 2021). Zajenkowski et al. (2015) considered mood one of the most significant psychological functions. Ryff (1989) considers it a fundamental facet of wellbeing. It is the culmination of affective states that are transient and constantly fluctuating (Lorr et al., 1971; McNair et al., 1981, 1992), which broadly encapsulates how someone feels at a particular moment in time. Mood is usually more enduring and less intense than emotion. Emotions are often short-term feelings or responses to a stimulus (Ekkekakis, 2013). Mood can be influenced by cognitive flexibility (Betzel et al., 2016) and neurophysiology (Basso & Suzuki, 2017). Exercise's positive influence on mood extends to self-efficacy, self-perception, satisfaction, and an increased sense of control (Berger & Motl, 2000). Glavin et al. (2022) posit that meeting the cardiovascular activity and strength training guidelines may benefit mood and sleep.

1.3 Exercise

According to the American Psychological Association (APA), exercise is a repetitive, planned physical activity aiming to maintain or enhance physical condition ("APA Dictionary of Psychology", 2022a). Examples of exercise are weight training,

cardiovascular training, cycling and resistance training. Most exercise can be categorised into two groups: aerobic and anaerobic. Aerobic exercise is a physical activity that increases heart rate and oxygen intake (Schootemeijer et al., 2020). Examples would be running, rowing, and cycling. By contrast, anaerobic exercises are short, intense bursts of activity with limited oxygen intake ("APA Dictionary of Psychology", 2022b). The energy expenditure in anaerobic exercise is so elevated that the body requires muscles to produce the energy due to insufficient oxygen. Examples of anaerobic exercise would be weight training and resistance training. Acute exercise refers to a single bout of exercise (Chase & Hutchinson, 2015), and chronic exercise is carried out on multiple occasions over an extended period of time (Nieman & Pence, 2020).

1.4 Mood and Exercise

The use of the Profile of Mood States (POMS; McNair et al., 1981) to examine mood changes resulting from exercise has received broad support as the chosen scale when examining mood changes from exercise (Berger & Motl, 2000; Chan et al., 2019; Chase & Hutchinson, 2015; Suganya et al., 2021). The POMS consists of six subscales designed to measure an individual's total mood disturbance (TMD) at a given moment. Berger and Motl (2000) synthesised the literature on the POMS to formulate a taxonomy for maximising mood benefits from exercise. Aerobic exercise has been suggested to have similar benefits to anaerobic (Lox et al., 1995; Sarsan et al., 2006), but when considering other research (Berger & Owen, 1992, 1998; Brown et al., 1995; Liu et al., 2005; Szabo et al., 1998), the efficacy of aerobic exercise towards improving mood becomes uncertain. However, most studies were conducted in laboratory settings and therefore had low ecological validity. Berger and Motl (2000) called for more research, explicitly examining exercise type and intensity. More recent literature on the area of exercise type will be discussed below.

1.5 Exercise Type

Lane et al. (2005) examined if individuals derive more significant mood improvements from their most and least preferred exercise modality. Participants' mood

states were investigated with the Brunel Mood Scale (BRUMS). The BRUMS (Terry et al., 2003) is a shortened version of the aforementioned POMS. Although both groups showed significantly improved mood, results suggested greater enhanced mood when exercises performed were of a more preferred modality (Lane et al., 2005). Netz and Lidor (2003) suggest that rhythmic, low-exertion movements may result in more powerful immediate mood enhancements when comparing the benefits of aerobic dance, swimming, yoga, and Feldenkrais.

Green (2010) examined three different exercise modes (weight training, aerobics, and yoga) on mood. Participants' mood was measured with the Current Mood States Scale (Berman & Turk, 1981). Ten university students participated in each mode on separate days. Results suggested no difference in mood change scores between exercise modes. However, Green's (2010) study was performed on a small sample of participants, who may have produced skewed results due to the participants being university students reportedly experiencing exam-related stress. Future studies should avoid the same limitation and include a larger variety of participants to produce a more diverse sample, thus enhancing ecological validity.

Suganya et al. (2021) analysed 54 male college athletes and examined any mood variance between high-intensity interval training (HIIT) and CrossFit. HIIT could be classified as more anaerobic training, while CrossFit would be described more as aerobic training. The authors used the POMS total mood disturbance (TMD) to assess mood. The HIIT group experienced increased mood disturbance compared to the CrossFit group. Therefore, CrossFit training may be more effective in reducing negative moods than HIIT. Further experiments by Lieberman et al. (2014) support the improved mood effects for participants in a 10-week US army strength, endurance, and combat training course.

Chase and Hutchinson (2015) conducted a study with twenty student participants on how acute aerobic exercise and resistance exercise (a form of anaerobic activity)

affects mood state. The authors used the Profile of Mood States-Short From (POMS-SF), containing six subscales (Shacham, 1983). Chase and Hutchinson (2015) also used the Borg's Category Ratio (CR-10) Rate of Perceived Exertion (RPE) scale to measure intensity (Borg, 1998). Results suggested no significant difference in mood improvement between modes of exercise. It seems both resistance exercise and aerobic exercise can be performed for mood enhancement. Notably, the effect size in tension and depression subscales was slightly more prominent in the resistance training group. As all participants were college students, Chase and Hutchinson (2015) recommend that future studies aim to collect a sample more representative of the general population.

Chan et al. (2019) conducted a systematic review on exercise modality, intensity, and duration on mood. 710 records from the initial search were finally reduced to 38 articles. Regarding exercise mode, both anaerobic and aerobic exercise appeared to improve mood. However, anaerobic was suggested as more reliably efficacious in improving mood than aerobic exercise. Chan et al. (2019) presented inconsistency with findings examining exercise intensity. However, the authors conclude that moderate exercise intensity is likely optimal for more remarkable mood improvement. Thus, the authors suggest that participants carry out moderate intensity anaerobic exercise (Chan et al., 2019).

1.6 Exercise Intensity

Exercise intensity has been defined as the rate of metabolic energy demand during physical activity (MacIntosh et al., 2021). Exercise frequency, duration and volume of work can be easily manipulated when exercising, but exercise intensity is complex and difficult to accurately control (Jamnick et al., 2020). Borg's Rate of Perceived Exertion (RPE) is one of the most used and well-known self-reporting exercise intensity questionnaires (Borg, 1998), enabling the individual to rate the intensity of their recent bout of exercise from 6 to 20. The CR-10 version (Borg, 1998) is similar, but instead, its intensity ranges from 1 to 10. Controlling Exercise intensity is essential for designing effective exercise programs and facilitating the best possible results in athletic

performance, health, and mood (Jamnick et al., 2020). It has been proposed that an inflection point exists as exercise intensity increases, at which further increases results in affective mood decline (Berger & Motl, 2000). Parfitt et al. (2006) attributed this to surpassing the anaerobic threshold, the highest sustainable exercise intensity before significant lactic acid buildup in the muscles. Recent literature on the topic of exercise intensity is discussed further below.

Martínez-Díaz and Carrasco (2021) examined mood changes and neurophysiological stress responses induced by HIIT in a quasi-experimental pilot study of 25 active male college students. The authors used the POMS to assess mood and Borg's RPE (Borg, 1998) to assess intensity. Corticotropin and cortisol plasma increases were observed after exercise. Mood significantly decreased immediately after exercise, but 30 minutes post-exercise, mood returned to baseline. The authors suggest this outcome is due to the significant increases in fatigue and confusion within the POMS scale directly after training. Martínez-Díaz and Carrasco's (2021) results suggest HIIT could have negatively affected young males' mood states. Selmi et al. (2017) reported remarkably similar findings using the POMS with 16 male soccer players in university. Be that as it may, Selmi et al. (2017) had limited participants and did not account for gender-based differences.

Examining the effects of moderate versus high-intensity strength exercise on mood, Znazen et al. (2021) investigated the effects on 46 female physical education students. Exercise intensity was examined with the RPE scale. Mood was examined with the BRUMS (Terry et al., 2003). Results from a repeated-measures ANOVA suggested significantly higher fatigue and confusion subscale scores in the high-intensity group and significantly higher vigour scores in the moderate-intensity group. The authors recommended moderate-intensity resistance exercise for optimal mood improvement. Znazen et al. (2021) only examined female college participants and recommended that future research be conducted in a more ecologically valid setting such as a commercial gym.

Wilson and Yilla (2021) examined maximal intensity aerobic and anaerobic exercise on mood for 55 college student participants. The authors used total mood disturbance (TMD) within the POMS scale (McNair et al., 1981). Results from multiple repeated-measure ANOVAs reported TMD scores as being significantly higher in all exercise tests. This suggests that participants had less stable mood profiles after maximal intensity aerobic and anaerobic exercise. Furthermore, Wilson and Yilla (2021) reported that mood disturbance was almost double in the maximal intensity aerobic exercise group than in the maximal intensity anaerobic group. From Wilson and Yilla's (2021) findings, anaerobic exercise is better for improving mood if exercise intensity is high. The increased mood disturbance in both groups may be due to the anaerobic threshold (Parfitt et al., 2006), where mood begins to decline.

1.7 The Present Study

Despite a plethora of research regarding exercise and mood, many research areas remain to be investigated further. Previous research suggested that future studies should examine mood benefits from exercise using more ecologically valid research designs such as gathering data in a commercial gym with participants performing their usual workout. More representative participant samples, including males and females, are also needed. Finally, much current research appears to rely heavily on university student participant samples, limiting results' validity. Addressing these gaps, the present study explores the impact of acute exercise type and intensity on mood of participants performing their workouts in an Irish commercial gym.

1.8 Research Questions

1)Does self-conducted exercise in a commercial gym influence mood?

2)Does exercise type (aerobic, anaerobic) or exercise intensity (moderate, high) influence mood improvements?

1.9 Hypotheses

H1: There will be a difference for the participants on their total mood disturbance (TMD) before and after their workout.

H2: There will be a difference for the participants on their TMD based on workout type (aerobic, anaerobic).

H3: There will be a difference for the participants on their TMD based on workout intensity (moderate, high).

H4: There will be an interaction between exercise type (aerobic, anaerobic) and time (pre-and post-workout).

H5: There will be an interaction between exercise intensity (moderate, high) and time (pre and post-workout).

H6: There will be an interaction between exercise type (aerobic, anaerobic) and exercise intensity (moderate, high).

2. Method

2.1 Design

This study employed a quantitative 2x2 factorial between within groups experimental design. The dependent variable was (pre and post-exercise) total mood disturbance (TMD). The independent variables were workout type (aerobic, anaerobic) and workout intensity (moderate, high) with two levels each. Participants self-reported their workout type, intensity and TMD in a participation booklet provided.

2.2 Participants

Between the 19th and the 23rd of December 2021, convenience, snowball, and purposive sampling recruited (N=140) participants over 18 and entered the gym for various workouts. The sample had 106 males and 34 females. Twenty-five participants were excluded from the study because they did not fully complete questionnaires or consent forms, were under 18 years of age, or were identified as outliers in the dataset. 95% of participants were recruited in a South Dublin FlyeFit gym. Participants were anonymous and free to withdraw at any time. Figure 1 below displays the percentage of participants within specific age brackets. Figure 2 outlines the number of participants in each occupation category.

Figure 1
Depicting the Age Range of Participants.

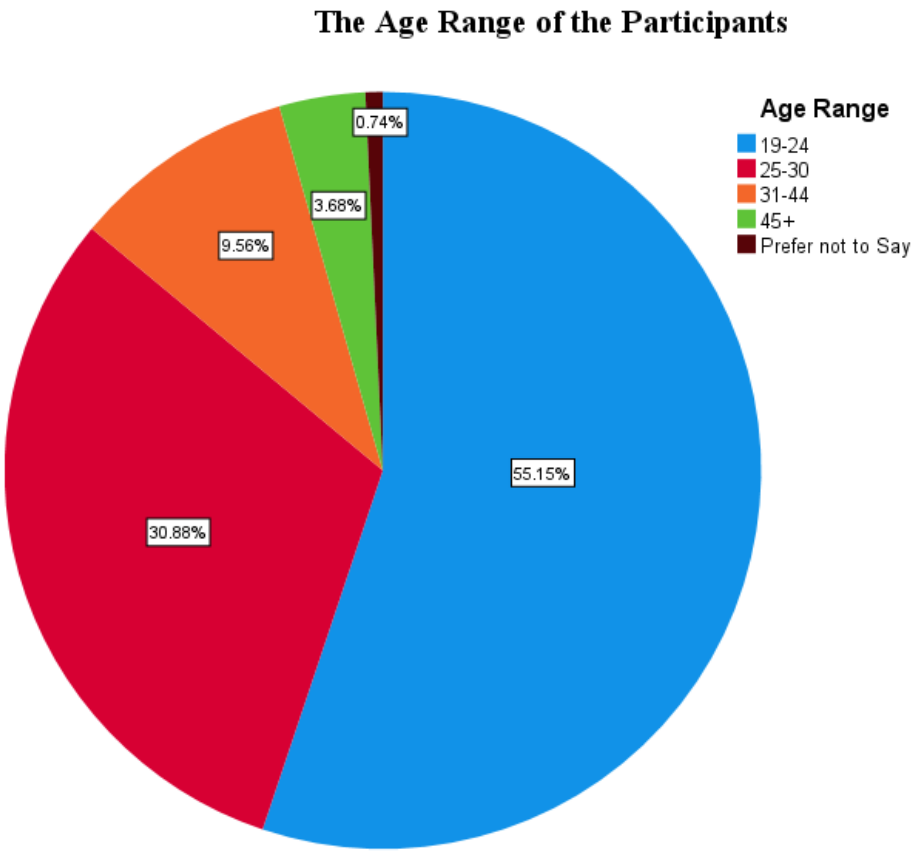
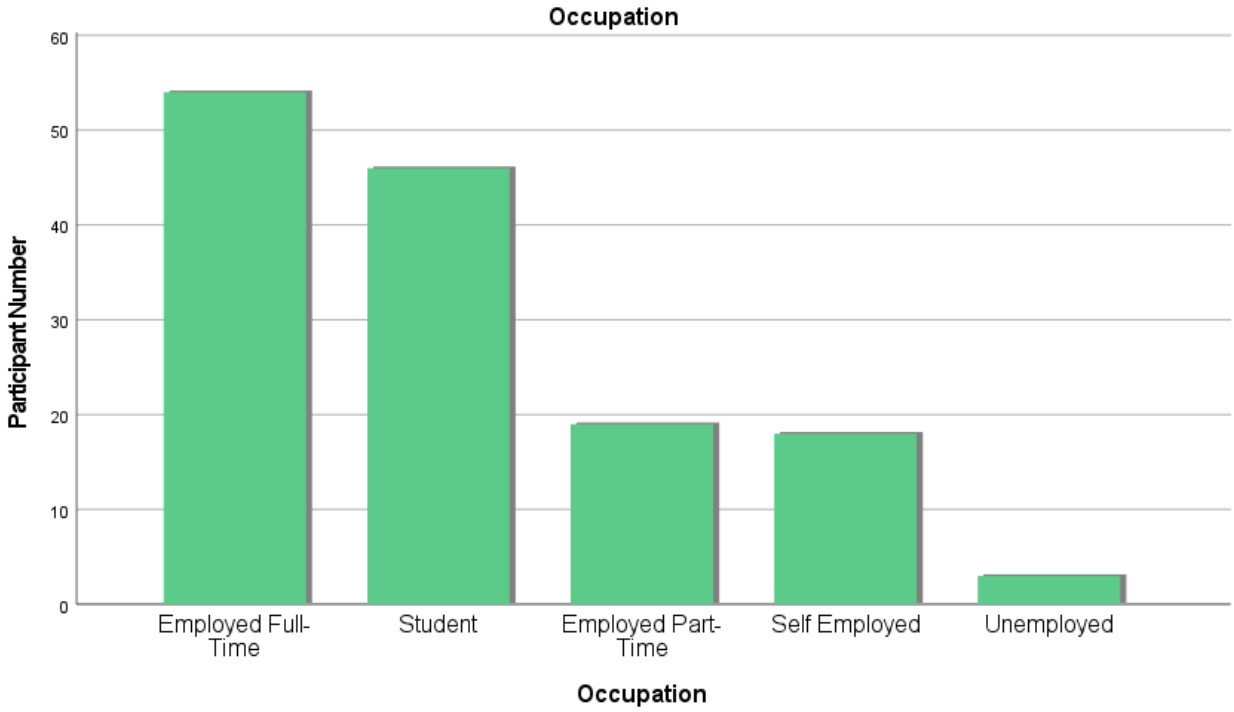


Figure 2

The Number of Participants in Each Occupation.



2.3 Ethics

Participants were treated in accordance with the ethical standards of the Psychological Society of Ireland and approved by the Department of Technology and Psychology Ethics Committee (DTPEC) of IADT (Appendix A). FlyeFit management approved data collection (Appendix B). Participants were fully briefed, debriefed, had to provide informed voluntary consent, were free to not answer any question and were free to withdraw their data at any time up until 30th January 2022. Each participant created a unique identifier code for anonymity and for locating data if participants wished to withdraw from the study.

2.4 Materials

Mood state was measured using the Profile of Mood States (POMS) (McNair et al., 1981), which is a 65-item five-point Likert scale ranging from “not at all” to “extremely”. The items of the POMS are adjectives such as “exhausted” and “lively”

(Appendix C). The adjectives are divided into six subscale items: tension, anger, fatigue, depression, vigour, and confusion. Each participant's total mood disturbance (TMD) was calculated by adding tension, anger, fatigue, depression, and confusion scores and then subtracting the vigour score. There was reverse scoring within some subscales like tension and confusion. McNair et al. (1981) reported Cronbach's alpha level of the POMS scale to be =.84. The reliability of the POMS has been recently confirmed by Ronkainen et al. (2021), with a Cronbach's alpha level of 0.88. The present study recorded the POMS TMD Cronbach's alpha level pre-exercise at .86 and post-exercise at .81 (Appendix D). Independent variables were gathered from the self-reported exercise questionnaire (Appendix E). The exercise questionnaire included questions about workout type, duration, and intensity. Exercise intensity was determined using Borg's (1998) RPE scale, which has two forms. The present study used the CR10 form, which is simpler to understand and self-report (Appendix F). Participants rated their perceived exertion towards their workout from one to 10 on the CR10 scale. According to Borg (1998), the intraclass correlation coefficient (ICC) of the RPE Was =.90. More recently, the ICC was recorded as 0.83 (Znazen et al., 2021). Figure 3 below is an example of a page of the POMS included in the participation booklet. Figure 4 below depicts an explanation of Borg’s RPE scale included in the Participation Booklet.

Figure 3

A Sample Page of the POMS Questionnaire used in the Participation Booklet.

Section 1: Complete Before Exercising

Mood Scale

Please read the words and statements below and circle the number which best equates to how you are currently feeling in relation to those words/statements.

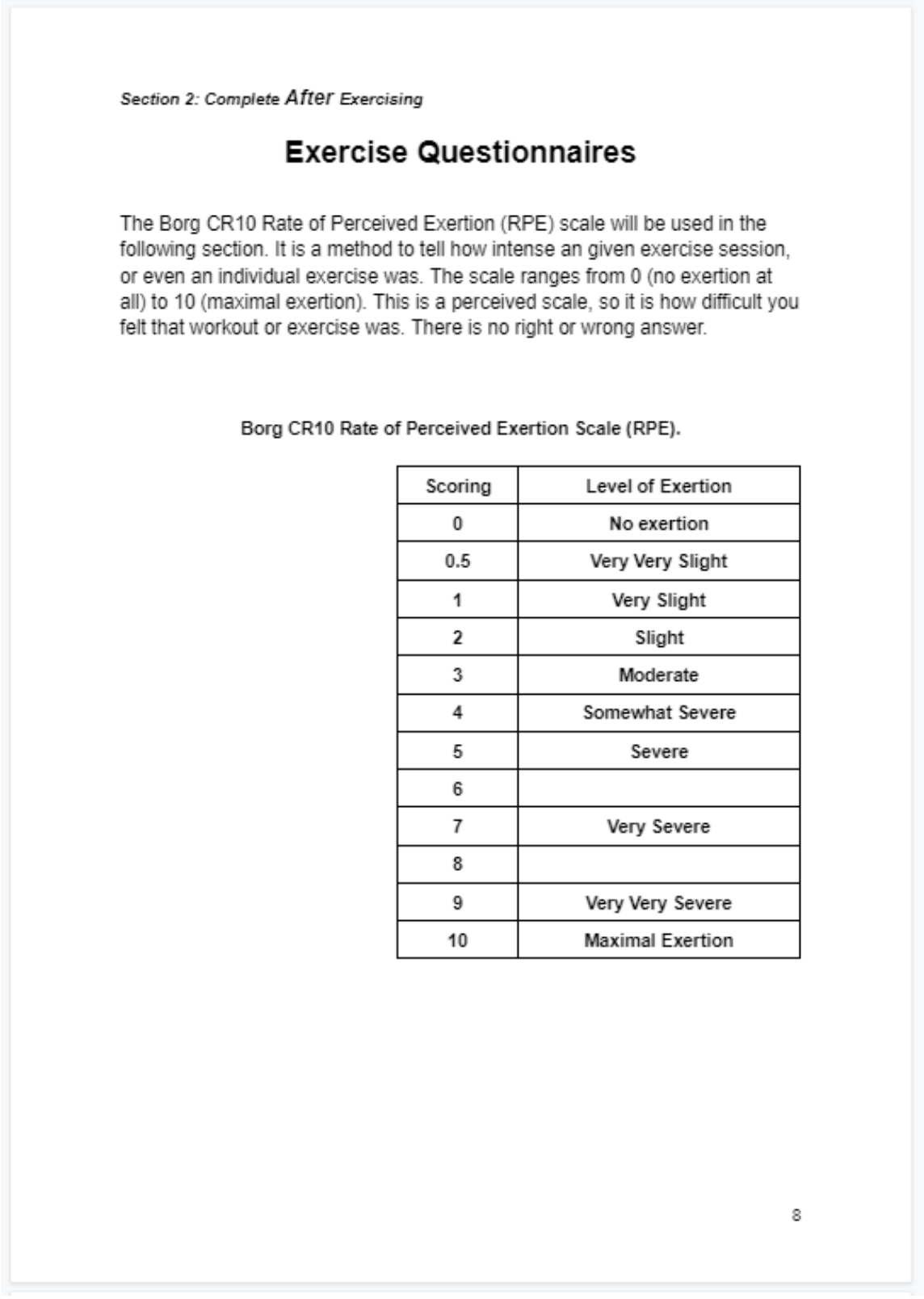
0	1	2	3	4
Not at All	A Little	Moderately	Quite a Bit	Extremely

1	Friendly	0	1	2	3	4
2	Tense	0	1	2	3	4
3	Angry	0	1	2	3	4
4	Worn Out	0	1	2	3	4
5	Unhappy	0	1	2	3	4
6	Clear Headed	0	1	2	3	4
7	Lively	0	1	2	3	4
8	Confused	0	1	2	3	4
9	Sorry for things done	0	1	2	3	4
10	Shaky	0	1	2	3	4
11	Listless (lacking energy)	0	1	2	3	4
12	Peeved	0	1	2	3	4
13	Considerate	0	1	2	3	4
14	Sad	0	1	2	3	4
15	Active	0	1	2	3	4
16	On Edge	0	1	2	3	4
17	Grouchy	0	1	2	3	4
18	Blue	0	1	2	3	4

3

Figure 4

Explanation of the RPE Scale for Participants.



Section 2: Complete After Exercising

Exercise Questionnaires

The Borg CR10 Rate of Perceived Exertion (RPE) scale will be used in the following section. It is a method to tell how intense an given exercise session, or even an individual exercise was. The scale ranges from 0 (no exertion at all) to 10 (maximal exertion). This is a perceived scale, so it is how difficult you felt that workout or exercise was. There is no right or wrong answer.

Borg CR10 Rate of Perceived Exertion Scale (RPE).

Scoring	Level of Exertion
0	No exertion
0.5	Very Very Slight
1	Very Slight
2	Slight
3	Moderate
4	Somewhat Severe
5	Severe
6	
7	Very Severe
8	
9	Very Very Severe
10	Maximal Exertion

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All materials were combined and presented within one participation booklet (Appendix G), provided to participants entering the gym. With this format, the participant sample was easily scalable. The booklet was split into two sections. The first section was completed before exercising, and the second section after exercise. Section one included an information sheet (Appendix H) outlining all the details of the study, a consent form (Appendix I) for collecting informed consent, the POMS scale (Appendix C) to examine mood, and a demographic questionnaire (Appendix J) which consisted of questions about simple demographics such as age and gender and ethnicity. Section two included the POMS scale again and an exercise questionnaire (Appendix F) consisting of questions about their completed workout. Finally, a debrief (Appendix G) to ensure participants had full knowledge about the study, researcher contact details, support resources, and to thank them for participating.

2.5 Pilot Study

A pilot study was carried out with three female and two male (N=5) personal trainers in the gym to identify any problems. A further three male non-personal trainer participants assisted in pilot testing. Minor grammatical and format adjustments were made, along with simplifying specific exercise terminology to ensure participants understood all aspects of the study.

2.6 Procedure

Data collection was conducted in a natural setting as most participants (95%) were entering a south Dublin FlyeFit Gym, complying with the appropriate Covid-19 guidelines. Potential participants entering the gym were provided with the details of the study and invited to participate. Those who chose to participate were given the participation booklet (Appendix H) and were requested to read and fill out the first half (Appendix B, C, D and E) before they exercised, then read and fill out the rest of the booklet (Appendix D, F and G) after exercising. Participants were advised not to change

or adjust the workout they were planning on carrying out. When completed, participants dropped the booklets in the box provided and were allowed to enter a raffle to win protein bars. At any point, participants were aware they could approach the researcher and ask any questions or withdraw from the study.

3. Results

3.1 Overview of results

A two-way mixed analysis of variance (ANOVA) was carried out to investigate the research questions. The independent variables were exercise type (aerobic, anaerobic) and intensity (medium, high). Mood disturbance before and after exercise was the dependent variable. The Statistical Package for Social Sciences (SPSS) IBM version 27 (IBM, 2022) was used for the analysis (Appendix P).

3.2 Assumptions

Preliminary analysis was carried out to examine the assumptions of the two-way ANOVA. Levene's test confirmed the homogeneity of variances for TMD before ($p=.072$) and after ($p=.247$) exercise. All assumptions of normality were according to the Shapiro-Wilk test. The assumption of normality in the pre-exercise aerobic ($p=.056$) group was not violated. The assumption of normality in the pre-anaerobic ($p=.001$), post-aerobic ($p=.008$) and post-anaerobic ($p=<.001$) were violated. The assumption of normality in the pre-exercise moderate intensity ($p=.001$), pre-exercise high intensity ($p=.022$), post-exercise moderate intensity ($p=.034$) and post-exercise high intensity ($p=<.001$) groups were all violated (Appendix T). However, a two-way ANOVA is robust despite violations of normality. Therefore, continuation of inferential statistics is acceptable (Lantz, 2013).

3.3 Descriptive Statistics

Descriptive statistics will be displayed in the tables below, examining participants' average mood disturbance pre- and post-exercise and variables such as type and intensity between participants' different workouts. Table 1 illustrates the overall number, mean, and standard deviation of all participants' moods pre- and post-exercise. Table 2 outlines the N, mean and standard deviation of mood disturbance pre- and post-exercise when separating workouts into two groups (aerobic and anaerobic). Table 3

outlines the N, mean and standard deviation of mood disturbance pre and post-exercise when dividing workouts into the two intensity groups (moderate and high).

Table 1
Mean, Standard Deviation, and Total Participants Pre and Post-exercise for Mood Disturbance.

Descriptive Statistics

	N	Mean	Std. Deviation
TMDBefore	133	38.9248	20.97315
TMDAfter	134	24.8657	15.76986
Valid N (listwise)	129		

Table 2
Summary of Mean, Standard Deviation and Total Participants' Mood Disturbance Scores Pre and Post-exercise for the Exercise Type Variable.

Time	Type	M	SD	N
Pre-exercise	Aerobic	40.78	25.88	32
	Anaerobic	38.34	19.28	101
Post-exercise	Aerobic	22.53	16.1	34
	Anaerobic	25.67	15.66	100

Table 3
Summary of Mean, Standard Deviation and Total Participants' Mood Disturbance Scores Pre and Post-exercise for the Exercise Intensity Variable.

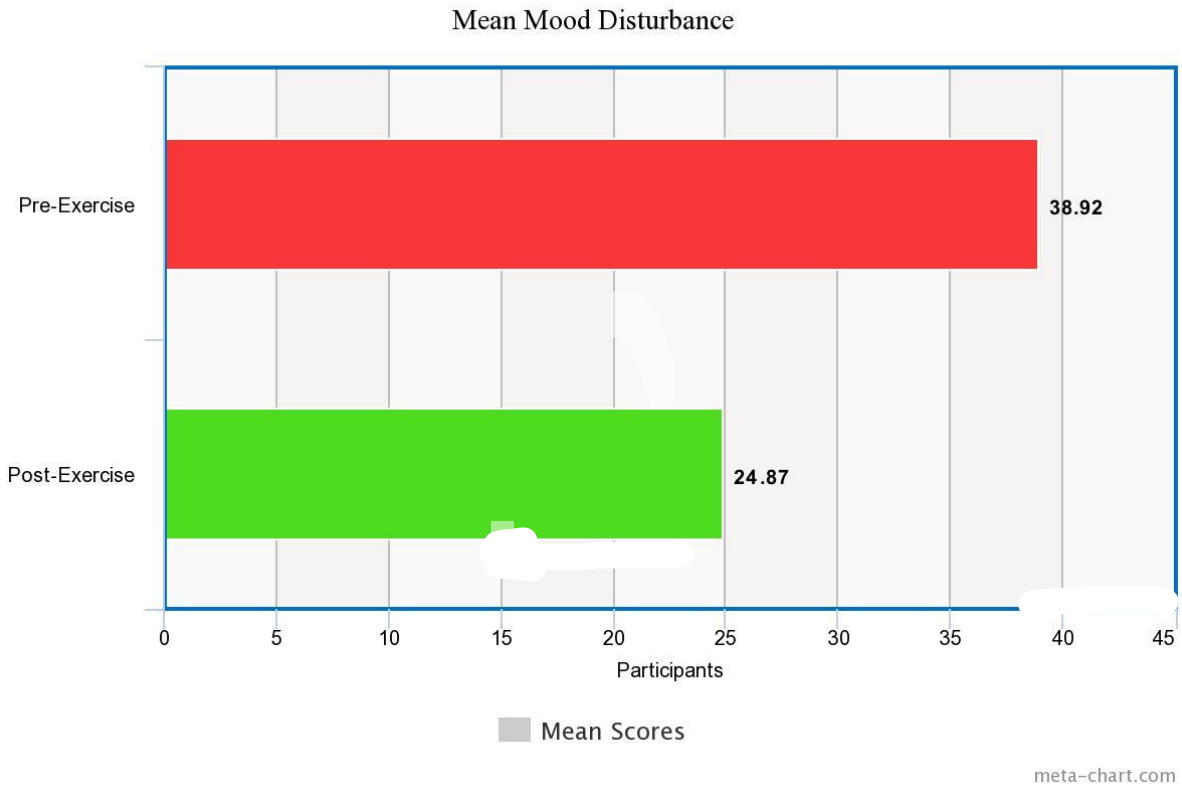
Time	Intensity	M	SD	N
Pre-exercise	Moderate	37.89	19.22	70
	High	40.1	22.86	63
Post-exercise	Moderate	23.88	12.31	72
	High	26.02	19.06	62

3.4 Inferential Statistics

The results of the two-way mixed ANOVA will now be outlined, beginning with the three main effects hypotheses. Hypothesis 1 stated there would be a difference for participants on their mood disturbance based on pre-and post-exercise. This hypothesis was supported F (1,124) = 59.384, p=<.001, partial eta squared = .324, indicating a medium effect size. Post-intervention mood differences can be seen in Figure 4.

Figure 5

The mean reduction in mood disturbance before and after exercise.



Hypothesis 2 stated that there would be a difference in mood based on exercise type (aerobic/anaerobic). This hypothesis was not supported F (1,124) = .003, p= .960, observed power = .050.

Hypothesis 3 stated that there would be a difference in mood based on exercise intensity (medium, high). This hypothesis was not supported F (1,124) = .528, p= .469, observed power = .111.

The results for the three interaction effects hypotheses will now be outlined. Hypothesis 4 stated that there would be an interaction between workout type (aerobic, anaerobic) and time (pre, post-exercise) on TMD. This hypothesis was not accepted, F (1,124) = 3.202, p= .076, observed power = .427.

Hypothesis 5 stated that there would be an interaction between workout intensity (moderate, high) and time (pre, post-exercise) on TMD. This hypothesis was not supported, F (1,124) = .224, p= .637, observed power = .076.

Hypothesis 6 stated that there would be an interaction between workout type (aerobic, anaerobic) and workout intensity (moderate, high) on TMD. This hypothesis was not accepted, F (1,124) = .224, p= .637, observed power = .076. These results will be discussed and analysed in the next section.

4. Discussion

4.1 Overview of the Findings

The present study aimed to examine the effect of exercise, exercise type and exercise intensity on participants' mood. TMD was calculated using the POMS scale (McNair et al., 1981). Lower TMD scores indicated a more stable mood profile, and higher scores indicated less stable mood profiles. Results suggest a significant difference in TMD based on pre- and post-exercise. However, no significant differences or interactions in TMD based on exercise type and intensity.

Hypothesis 1 stated there would be a difference in TMD scores pre and post-exercise. This hypothesis was supported. This corresponds to previous research suggesting exercise can significantly impact mood (Alfini et al., 2020; Liao et al., 2015; Reed & Ones, 2006), including specific research on the POMS and TMD (Berger & Motl, 2000). Martínez-Díaz and Carrasco's (2021) study had opposing findings, suggesting mood state decreased post-exercise but increased back to baseline 30 minutes post-workout. Unlike Martínez-Díaz and Carrasco (2021), the present study had over five times the participants in various levels of education and professions instead of just college student participants.

Hypothesis 2 stated that there would be a difference in mood based on exercise type (aerobic/anaerobic). This hypothesis was not supported. The present findings are congruent with Chase and Hutchinson (2015), suggesting either resistance or aerobic exercise can be performed for mood benefits, congruent with Green (2010) reporting that there was no significant difference in mood across modes of exercise, and congruent with Chan et al. (2019) suggesting aerobic exercise has similar benefits to anaerobic exercise. The present research answers Chase and Hutchinson's (2015) suggestion that future research examines aerobic and resistance exercise with a sample more representative of the general population.

Hypothesis 3 stated that there would be a difference in mood improvements based on exercise intensity (medium, high). This hypothesis was not supported. This does not correspond with previous research on the exercise mood taxonomy (Berger & Motl, 2000), suggesting that exercise intensity reaches a cutoff point where mood declines, otherwise known as the anaerobic threshold (Parfitt et al., 2006). Furthermore, the present findings do not correspond to Znazen et al. (2021), who examined mood differences between moderate and high-intensity acute exercise, suggesting moderate intensity is better for mood improvements. The present study differed from Znazen et al. (2021) in that it had over double the participants, included all genders instead of just females, and allowed participants to carry out their own workouts instead of being assigned a training protocol in a laboratory setting.

The results for the three interaction effects hypotheses will now be outlined.

Hypothesis 4 stated that there would be an interaction between workout type (aerobic, anaerobic) and time (pre, post-exercise) on TMD. This hypothesis was not supported. This finding corresponds with Green (2010) reporting no significant difference in mood improvement between weight training, aerobics, or yoga. Chase and Hutchinson (2015) reported a slightly higher effect size in subgroups for resistance exercise versus aerobic exercise but similar to the present study; both groups had significantly improved TMD.

Hypothesis 5 stating an interaction between workout intensity (moderate, high) and time (pre, and post-exercise) on TMD was not accepted. This is incongruent with Parfitt et al. (2006), suggesting that as exercise intensity increases, it reaches a cutoff point at which it begins to negatively affect mood. Chan et al. (2019) and Znazen et al. (2021) reported moderate-intensity anaerobic exercise producing the most significant mood improvement. Chan et al.’s (2019) finding is dissimilar to the present study's findings as there was no significant interaction between intensity types and mood differences pre and post-exercise.

Hypothesis 6, stating there would be an interaction between exercise intensity and exercise type, was not supported. This finding is incongruent with Wilson and Yilla's (2021) results in their study of 55 college students examining maximal intensity aerobic and anaerobic exercise on mood using the POMS. Wilson and Yilla (2021) reported having TMD almost double in the maximal intensity aerobic exercise group rather than in the maximal intensity anaerobic exercise group. The present findings are dissimilar to Chan et al. (2019), who reported moderate-intensity aerobic exercise eliciting the most significant mood improvements.

4.2 Strengths and Limitations

This study was designed to overcome some commonly identified limitations in recent exercise and mood research while also responding to suggestions for future research. The study had a robust pilot test with personal trainers and gym members who suggested adjustments and improvements to the materials and methodology. The participants were in various professions, such as self-employed and employed full time, and were not limited just to college students (Chase & Hutchinson, 2015; Glavin et al., 2022; Green, 2010; Martínez-Díaz & Carrasco, 2021; Selmi et al., 2017; Suganya et al., 2021; Wilson & Yilla, 2021; Znazen et al., 2021). Participants were not limited to just males (Selmi et al., 2017; Suganya et al., 2021) or just females (Lieberman et al., 2014; Znazen et al., 2021) but represented a mix of genders. Acknowledging previous studies' requests for more ecologically valid research (Martínez-Díaz & Carrasco, 2021; Ronkainen et al., 2021; Znazen et al., 2021), the present study was conducted in a commercial gym where participants already have individual exercise routines, as opposed to actively manipulating individuals' exercise routine in a laboratory setting. Enabling participants to undertake their individual workout routines reinforces the validity of inferences made about the effects of exercise in the real world. Moreover, this is the only study in Ireland to examine mood, exercise types and exercise intensity.

The present study had some limitations. Approximately 15 minutes were required to fill out the booklet. This may have led some participants to rush or may have increased the likelihood of participants leaving questions blank. The anaerobic exercise group was larger than the aerobic exercise group. The present study had more males than females. Finally, Mood, exercise type, and intensity were self-reported; therefore, human error is probable.

4.3 Theoretical implications

The present study addresses gaps referred to in multiple prior researchers' suggestions for future research (including the aforementioned ecological validity) to compare different modes of exercise and their effects on mood (Glavin et al., 2022; Green, 2010; Ronkainen et al., 2021), including suggestions specifically toward RPE, mood disturbance, and aerobic versus anaerobic training (Chase & Hutchinson, 2015; Wilson & Yilla, 2021). The present study built on Berger and Motl's (2000) taxonomy for mood improvement towards exercise. Both the aerobic and anaerobic groups' exercises are rhythmic and predictable activities when in a gymnasium. However, unlike Berger and Motl (2000), exercise intensity had no significant impact on mood improvement. Furthermore, the present study does not concur with Parfitt et al.'s (2006) anaerobic threshold theory, suggesting that high-intensity exercise may result in reduced mood. Finally, the present study was conducted in line with some of Basso and Suzuki's (2017) suggested standardised methods and procedures for examining exercise and mood (including accurately categorising timeframes and the recommended use of the RPE scale) to allow for replicability. This also enhances the comparability of the present findings with the past and future research in the area.

4.4 Practical Implications

Exercise in a gym setting seems to reduce mood disturbance, regardless of whether the exercise is aerobic or anaerobic. Anyone can likely benefit from both types of exercise. The public should be aware that they do not have to perform a particular type of cardio or execute a specific weightlifting movement to enjoy mood improvements;

instead, they should seek out and practice their preferred exercise modalities (Lane et al., 2005). Furthermore, there seems to be no significant difference between moderate and high-intensity exercise. However, whatever exercise and intensity are chosen, the public should be aware of physical activity guidelines (Glavin et al., 2021). The best exercise is the one in which the individual can perform consistently (Wilson & Yilla, 2021).

4.5 Future Research

The present study contributes to the literature on the impact exercise type, and intensity has on mood. Future research should examine longitudinal mood differences between artificial and natural spaces. Three proposed spaces include green space exercises such as trail running and mountain biking, blue space exercises such as rowing and swimming, and artificial space exercises such as training in the gym or indoor basketball court. Selmi et al. (2017) reported less mood disturbance with small-sided games than with HIIT, further suggesting that it may be beneficial for future research to examine group exercise benefits versus individual gym workout benefits for mood.

4.6 Conclusion

Using suggestions from previous research, the present study explored gaps in the research concerning the effects exercise type and intensity has on mood improvement. The present study was conducted in a commercial gym with participants carrying out their usual workouts. The present methodology had robust ecological validity and utilised a representative sample of the South Dublin gym-member population. Findings suggest that although exercise significantly decreased mood disturbance, there was no significant difference in mood between exercise type or intensity. Future research should conduct longitudinal studies on mood benefits from artificial versus natural exercise spaces and team-sport exercise versus individual exercise.

The present thesis will be disseminated in the IADT graduate showcase for 2022.

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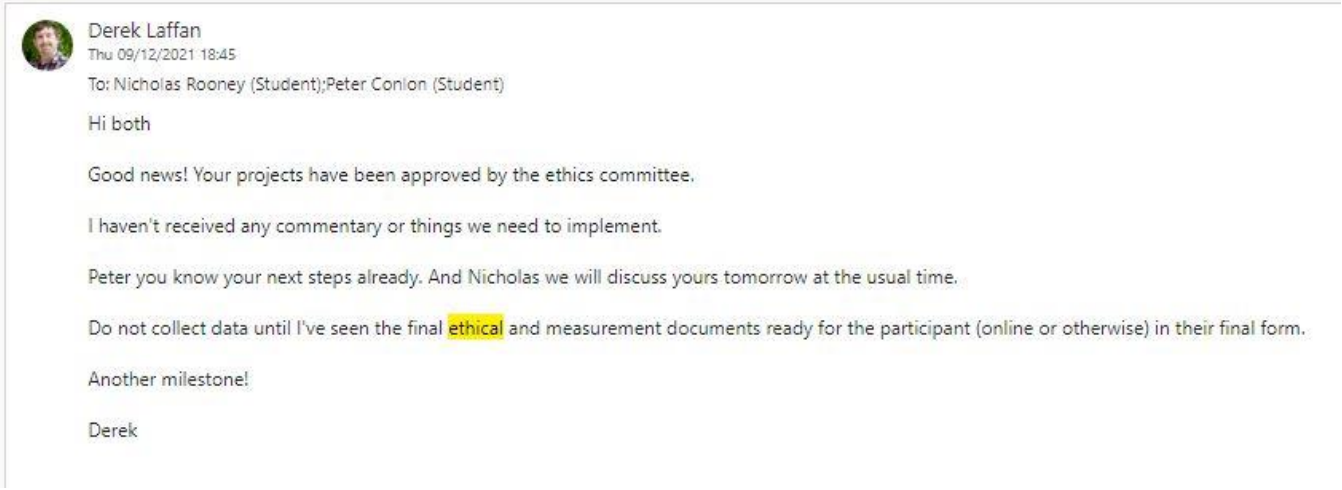
6. Appendices

6.1 Appendix A: Ethical Approval from DTPEC



Derek Laffan
Thu 09/12/2021 18:45
To: Nicholas Rooney (Student);Peter Conlon (Student)

Hi both

Good news! Your projects have been approved by the ethics committee.

I haven't received any commentary or things we need to implement.

Peter you know your next steps already. And Nicholas we will discuss yours tomorrow at the usual time.

Do not collect data until I've seen the final ethical and measurement documents ready for the participant (online or otherwise) in their final form.

Another milestone!

Derek

DL825 Year 4 MRP Green and Amber Ethics Applications December 2021

The following Ethics applications have been approved:

	Nicholas Rooney

If your name is not on this list and you have not yet received Feedback on your Ethics Application please contact your supervisor.

6.2 Appendix B: Ethical Approval from Flyefit Management, Sallynoggin

Flyefit Consent Form

Please Tick the boxes

I have understood the information about this research	
I know how I can contact the researcher for more information if needed	
I had the opportunity to ask more questions about this study	
I am happy to assist as a participant the same way as any other member if such an opportunity arises	
I am happy to consent to the researcher's presence in the gym to undertake this research	

_____	_____	_____
Manager of Flyefit	Date	Signature

_____	_____	_____
Researcher	Date	Signature

Flyefit Consent Form

	Please Tick The boxes
I have understood the information about this research	✓
I know how I can contact the researcher for more information if needed	✓
I had the opportunity to ask more questions about this study	✓
I am happy to assist as a participant the same way as any other member if such an opportunity arises	✓
I am happy to consent to the researcher's presence in the gym to undertake this research	✓

Manager of Flyefit Sallynoggin	Date 1/12/21	Signature
Researcher NICHOLAS ROONEY	Date 1/12/21	Signature

6.3 Appendix C: The Profile of Mood States Scale

Mood Scale

Please read the words and statements below and circle the number which best equates to how you are currently feeling in relation to those words/statements.

0	1	2	3	4
Not at All	A Little	Moderately	Quite a Bit	Extremely

1	Friendly	0	1	2	3	4
2	Tense	0	1	2	3	4
3	Angry	0	1	2	3	4
4	Worn Out	0	1	2	3	4
5	Unhappy	0	1	2	3	4
6	Clear Headed	0	1	2	3	4
7	Lively	0	1	2	3	4
8	Confused	0	1	2	3	4
9	Sorry for things done	0	1	2	3	4
10	Shaky	0	1	2	3	4
11	Listless (lacking energy)	0	1	2	3	4
12	Peeved	0	1	2	3	4
13	Considerate	0	1	2	3	4
14	Sad	0	1	2	3	4
15	Active	0	1	2	3	4
16	On Edge	0	1	2	3	4
17	Grouchy	0	1	2	3	4
18	Blue	0	1	2	3	4
19	Energetic	0	1	2	3	4

20	Panicky	0	1	2	3	4
21	Hopeless	0	1	2	3	4
22	Relaxed	0	1	2	3	4
23	Unworthy	0	1	2	3	4
24	Spiteful	0	1	2	3	4
25	Sympathetic	0	1	2	3	4
26	Uneasy	0	1	2	3	4
27	Restless	0	1	2	3	4
28	Unable to Concentrate	0	1	2	3	4
29	Fatigued	0	1	2	3	4
30	Helpful	0	1	2	3	4
31	Annoyed	0	1	2	3	4
32	Discouraged	0	1	2	3	4
33	Resentful	0	1	2	3	4
34	Nervous	0	1	2	3	4
35	Lonely	0	1	2	3	4
36	Miserable	0	1	2	3	4
37	Muddled	0	1	2	3	4
38	Cheerful	0	1	2	3	4
39	Bitter	0	1	2	3	4
40	Exhausted	0	1	2	3	4
41	Anxious	0	1	2	3	4
42	Ready to Fight	0	1	2	3	4
43	Good Natured	0	1	2	3	4
44	Gloomy	0	1	2	3	4
45	Desperate	0	1	2	3	4
46	Sluggish	0	1	2	3	4

47	Rebellious	0	1	2	3	4
48	Helpless	0	1	2	3	4
49	Weary	0	1	2	3	4
50	Bewildered	0	1	2	3	4
51	Alert	0	1	2	3	4
52	Deceived	0	1	2	3	4
53	Furious	0	1	2	3	4
54	Efficient	0	1	2	3	4
55	Trusting	0	1	2	3	4
56	Full of Pep (Energy)	0	1	2	3	4
57	Bad Tempered	0	1	2	3	4
58	Worthless	0	1	2	3	4
59	Forgetful	0	1	2	3	4
60	Carefree	0	1	2	3	4
61	Terrified	0	1	2	3	4
62	Guilty	0	1	2	3	4
63	Vigorous	0	1	2	3	4
64	Uncertain about things	0	1	2	3	4
65	Bushed (exhausted)	0	1	2	3	4

Scoring for POMS

Each adjective is awarded the score as circled except relaxed and efficient, which should be reversed. You then have a raw score (<60) for each subscale. A Total Mood Disturbance (TMD) can be calculated by adding the raw scores from tension, depression, anger, fatigue and confusion and then subtracting the vigour score. Lower scores are indicative of people with more stable mood profiles.

Subscale items:

Tension:
tense, shaky, on edge, panicky, relaxed, uneasy, restless, nervous, anxious
Add: 2+10+16+20+reverse 22+26+27+34+41

Depression:
unhappy, sorry for things done, sad, blue, hopeless, unworthy, discouraged, lonely, miserable, gloomy, desperate, helpless, worthless, terrified, guilty
Add: 5+9+14+18+21+23+32+35+36+44+45+48+58+61+62

Anger:
anger, peeved, grouchy, spiteful, annoyed, resentful, bitter, ready to fight, rebellious, deceived, furious, bad tempered
Add: 3+12+17+24+31+33+39+42+47+52+53+57

Vigour:
lively, active, energetic, cheerful, alert, full of pep, carefree, vigorous
Add: 7+15+19+38+51+56+60+63

Fatigue:
worn out, listless, fatigued, exhausted, sluggish, weary, bushed
Add: 4+11+29+40+46+49+65

Confusion:
confused, unable to concentrate, muddled, bewildered, efficient, forgetful, uncertain about things
Add: 8+28+37+50+reverse 54+59+64

Others (dummy items):
Ignore: friendly, clear headed, considerate, sympathetic, helpful, good-natured, trusting

6.4 Appendix D: Cronbach's Alpha Level Pre-and Post-exercise

Scale: TMD Before Exercise

Case Processing Summary

		N	%
Cases	Valid	133	95.0
	Excluded[a]	7	5.0
	Total	140	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.859	.882	58

Item Statistics

	Mean	Std. Deviation	N
Mood Before 2	1.58	1.046	133
Mood Before 3	.68	.932	133
Mood Before 4	1.83	1.156	133
Mood Before 5	.77	.794	133
Mood Before 7	1.98	.870	133
Mood Before 8	.47	.822	133
Mood Before 9	.57	.882	133
Mood Before 10	.58	.939	133
Mood Before 11	1.44	1.033	133

Mood Before 12	.68	.884	133
Mood Before 14	.71	.909	133
Mood Before 15	2.29	.989	133
Mood Before 16	1.11	1.005	133
Mood Before 17	.92	.918	133
Mood Before 18	.66	.878	133
Mood Before 19	2.07	.979	133
Mood Before 20	.62	.858	133
Mood Before 21	.39	.777	133
Mood Before 22	2.16	.960	133
Mood Before 23	.49	.876	133
Mood Before 24	.38	.692	133
Mood Before 26	3.15	.957	133
Mood Before 27	2.68	1.144	133
Mood Before 28	1.39	1.192	133
Mood Before 29	1.65	1.122	133
Mood Before 31	.74	.895	133
Mood Before 32	.71	.877	133
Mood Before 33	.50	.876	133
Mood Before 34	3.32	.892	133
Mood Before 35	.66	.887	133
Mood Before 36	.37	.764	133
Mood Before 37	.53	.917	133
Mood Before 38	2.08	.990	133
Mood Before 39	.47	1.145	133
Mood Before 40	1.53	1.197	133
Mood Before 41	2.87	1.040	133
Mood Before 42	.95	1.189	133
Mood Before 44	.67	.814	133
Mood Before 45	.27	.605	133

Mood Before 46	1.23	1.070	133
Mood Before 47	.78	1.054	133
Mood Before 48	.38	.745	133
Mood Before 49	.78	1.075	133
Mood Before 50	.39	.737	133
Mood Before 51	1.95	1.025	133
Mood Before 52	.34	.662	133
Mood Before 53	.37	.773	133
Mood Before 54	2.15	1.062	133
Mood Before 56	1.80	1.055	133
Mood Before 57	.74	1.036	133
Mood Before 58	.29	.683	133
Mood Before 59	2.89	1.071	133
Mood Before 60	1.32	1.125	133
Mood Before 61	.18	.474	133
Mood Before 62	.40	.685	133
Mood Before 63	.85	1.097	133
Mood Before 64	2.53	1.240	133
Mood Before 65	1.26	1.243	133

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Mood Before 2	66.01	322.992	.450	.	.854
Mood Before 3	66.90	324.604	.463	.	.854
Mood Before 4	65.75	321.491	.439	.	.854
Mood Before 5	66.81	328.184	.424	.	.855
Mood Before 7	65.60	340.060	.006	.	.861
Mood Before 8	67.12	322.788	.595	.	.853
Mood Before 9	67.02	324.909	.482	.	.854
Mood Before 10	67.01	325.568	.430	.	.855
Mood Before 11	66.14	323.139	.453	.	.854
Mood Before 12	66.91	319.825	.646	.	.852
Mood Before 14	66.87	321.809	.563	.	.853
Mood Before 15	65.30	337.621	.067	.	.861
Mood Before 16	66.47	323.039	.470	.	.854
Mood Before 17	66.66	323.483	.505	.	.854
Mood Before 18	66.92	322.752	.554	.	.853
Mood Before 19	65.52	343.176	-.086	.	.863
Mood Before 20	66.96	326.233	.453	.	.855
Mood Before 21	67.20	323.249	.614	.	.853
Mood Before 22	65.43	334.823	.150	.	.859
Mood Before 23	67.10	327.149	.414	.	.855
Mood Before 24	67.21	330.137	.414	.	.856
Mood Before 26	64.44	358.930	-.519	.	.870
Mood Before 27	64.90	354.559	-.345	.	.869
Mood Before 28	66.20	321.886	.414	.	.855
Mood Before 29	65.93	322.018	.441	.	.854
Mood Before 31	66.85	322.462	.552	.	.853
Mood Before 32	66.88	322.607	.560	.	.853

Mood Before 33	67.08	322.213	.574	.	.853
Mood Before 34	64.26	354.741	-.432	.	.868
Mood Before 35	66.92	326.146	.440	.	.855
Mood Before 36	67.22	323.581	.614	.	.853
Mood Before 37	67.05	320.990	.584	.	.852
Mood Before 38	65.51	342.706	-.073	.	.863
Mood Before 39	67.11	325.222	.351	.	.856
Mood Before 40	66.05	318.853	.485	.	.853
Mood Before 41	64.71	351.903	-.307	.	.868
Mood Before 42	66.64	323.854	.368	.	.856
Mood Before 44	66.92	323.592	.572	.	.853
Mood Before 45	67.32	325.793	.681	.	.853
Mood Before 46	66.36	323.535	.424	.	.855
Mood Before 47	66.80	329.007	.285	.	.857
Mood Before 48	67.21	324.334	.601	.	.853
Mood Before 49	66.80	315.340	.642	.	.850
Mood Before 50	67.20	323.052	.658	.	.852
Mood Before 51	65.64	341.172	-.032	.	.863
Mood Before 52	67.25	327.264	.556	.	.854
Mood Before 53	67.22	325.475	.536	.	.854
Mood Before 54	65.44	344.536	-.118	.	.865
Mood Before 56	65.78	344.778	-.124	.	.865
Mood Before 57	66.85	321.992	.483	.	.854
Mood Before 58	67.29	330.421	.408	.	.856
Mood Before 59	64.70	362.257	-.549	.	.872
Mood Before 60	66.26	340.044	-.007	.	.863
Mood Before 61	67.41	332.228	.496	.	.856
Mood Before 62	67.19	330.730	.394	.	.856
Mood Before 63	66.74	333.998	.145	.	.860
Mood Before 64	65.05	356.141	-.356	.	.871
Mood Before 65	66.32	314.599	.564	.	.851

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
67.59	341.017	18.467	58

Scale: TMD After Exercise

Case Processing Summary

		N	%
Cases	Valid	134	95.7
	Excluded[a]	6	4.3
	Total	140	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.811	.885	58

Item Statistics

	Mean	Std. Deviation	N
Mood After 2	.66	.858	134
Mood After 3	.26	.600	134
Mood After 4	1.66	1.214	134
Mood After 5	.28	.567	134
Mood After 7	2.64	.913	134
Mood After 8	.27	.651	134
Mood After 9	.29	.744	134
Mood After 10	.67	1.024	134
Mood After 11	.84	.980	134

Mood After 12	.29	.670	134
Mood After 14	.26	.587	134
Mood After 15	2.77	.875	134
Mood After 16	.46	.819	134
Mood After 17	.31	.640	134
Mood After 18	.24	.551	134
Mood After 19	2.45	.954	134
Mood After 20	.33	.635	134
Mood After 21	.17	.483	134
Mood After 22	1.74	1.033	134
Mood After 23	.13	.396	134
Mood After 24	.16	.456	134
Mood After 26	3.68	.570	134
Mood After 27	3.34	.842	134
Mood After 28	.57	.853	134
Mood After 29	1.74	1.163	134
Mood After 31	.28	.580	134
Mood After 32	.22	.553	134
Mood After 33	.18	.488	134
Mood After 34	3.64	.687	134
Mood After 35	.37	.668	134
Mood After 36	.11	.361	134
Mood After 37	.17	.483	134
Mood After 38	2.44	1.044	134
Mood After 39	.18	.473	134
Mood After 40	1.57	1.159	134
Mood After 41	3.44	.809	134
Mood After 42	.68	1.052	134
Mood After 44	.31	.709	134
Mood After 45	.14	.427	134

Mood After 46	.47	.820	134
Mood After 47	.70	1.069	134
Mood After 48	.19	.527	134
Mood After 49	.46	.864	134
Mood After 50	.20	.517	134
Mood After 51	2.40	1.063	134
Mood After 52	.15	.434	134
Mood After 53	.13	.439	134
Mood After 54	1.84	1.132	134
Mood After 56	2.17	1.147	134
Mood After 57	.24	.564	134
Mood After 58	.11	.381	134
Mood After 59	3.48	.801	134
Mood After 60	1.87	1.249	134
Mood After 61	.09	.335	134
Mood After 62	.16	.456	134
Mood After 63	.87	1.100	134
Mood After 64	3.41	.878	134
Mood After 65	1.21	1.177	134

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Mood After 2	59.44	168.775	.494	.	.802
Mood After 3	59.84	172.509	.486	.	.804
Mood After 4	58.44	169.872	.290	.	.808
Mood After 5	59.83	172.910	.489	.	.804
Mood After 7	57.46	181.318	-.066	.	.817
Mood After 8	59.84	171.266	.519	.	.803
Mood After 9	59.81	170.499	.488	.	.803
Mood After 10	59.43	167.781	.441	.	.802
Mood After 11	59.26	167.743	.466	.	.802
Mood After 12	59.81	169.912	.582	.	.801
Mood After 14	59.84	173.035	.463	.	.805
Mood After 15	57.34	178.074	.072	.	.813
Mood After 16	59.64	169.690	.476	.	.802
Mood After 17	59.80	170.944	.548	.	.802
Mood After 18	59.87	174.147	.418	.	.806
Mood After 19	57.66	182.618	-.116	.	.819
Mood After 20	59.78	171.062	.546	.	.803
Mood After 21	59.93	172.123	.645	.	.803
Mood After 22	58.37	179.121	.012	.	.816
Mood After 23	59.98	175.827	.433	.	.807
Mood After 24	59.95	172.486	.654	.	.803
Mood After 26	56.43	189.449	-.589	.	.823
Mood After 27	56.76	192.003	-.522	.	.828
Mood After 28	59.53	168.868	.493	.	.802
Mood After 29	58.37	170.700	.279	.	.808
Mood After 31	59.83	172.264	.521	.	.804
Mood After 32	59.89	171.784	.582	.	.803

Mood After 33	59.93	172.175	.634	.	.803
Mood After 34	56.46	191.453	-.599	.	.826
Mood After 35	59.73	174.830	.297	.	.807
Mood After 36	59.99	175.947	.465	.	.807
Mood After 37	59.93	172.394	.623	.	.803
Mood After 38	57.66	178.766	.024	.	.816
Mood After 39	59.93	173.919	.512	.	.805
Mood After 40	58.53	168.552	.353	.	.805
Mood After 41	56.66	193.022	-.585	.	.828
Mood After 42	59.43	170.006	.343	.	.805
Mood After 44	59.79	170.046	.540	.	.802
Mood After 45	59.96	174.758	.495	.	.806
Mood After 46	59.63	169.783	.472	.	.803
Mood After 47	59.40	170.017	.336	.	.806
Mood After 48	59.91	170.729	.691	.	.801
Mood After 49	59.65	171.147	.382	.	.805
Mood After 50	59.90	171.397	.655	.	.802
Mood After 51	57.70	177.188	.078	.	.814
Mood After 52	59.96	173.366	.611	.	.804
Mood After 53	59.97	172.826	.651	.	.804
Mood After 54	58.27	183.401	-.135	.	.822
Mood After 56	57.93	178.168	.034	.	.816
Mood After 57	59.87	172.042	.552	.	.803
Mood After 58	59.99	175.947	.439	.	.807
Mood After 59	56.63	190.236	-.468	.	.826
Mood After 60	58.24	177.612	.041	.	.817
Mood After 61	60.01	175.669	.535	.	.807
Mood After 62	59.95	173.764	.545	.	.805
Mood After 63	59.23	171.848	.259	.	.808
Mood After 64	56.69	192.394	-.519	.	.828
Mood After 65	58.90	166.094	.430	.	.802

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
60.10	180.530	13.436	58

6.5 Appendix E: Self-Reported Exercise Questionnaire

Section 2: Complete After Exercising

The Workout as A Whole

Please indicate in which category you would say your whole exercise session would fall under. You can circle or tick more than 1 option, but MAXIMUM of 3.

Aerobic Training	Anaerobic Training	Hypertrophy Training
Strength Training	Bodybuilding	Powerlifting
Weight Lifting	Mobility/Flexibility	Cardiovascular Training
High Intensity Interval Training (HIIT)	Other: _____	Other: _____

How long did your workout last (in minutes):

1-19	20-30	31-45	46+

According to the RPE scale explained above, how intense was your workout as a whole:

_____ Out of 10

How repetitive was your workout as a whole in terms of moving your body?

Very Little	Little	So So	Repetitive	Very Repetitive

In terms of that whole exercise session, how comfortable were you with carrying out those movements:

First timer/ Not comfortable at all	uncomfortable	Comfortable	Very Comfortable	So comfortable I could let my mind wander

Did you train at the time of day you would normally train at?

Yes	No

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6.6 Appendix F: Rate of Perceived Exertion Scale

Section 2: Complete After Exercising

Exercise Questionnaires

The Borg CR10 Rate of Perceived Exertion (RPE) scale will be used in the following section. It is a method to tell how intense a given exercise session or even an individual exercise was. The scale ranges from 0 (no exertion at all) to 10 (maximal exertion). This is a perceived scale, so it is how difficult you felt that workout or exercise was. There is no right or wrong answer.

Borg CR10 Rate of Perceived Exertion Scale (RPE).

Scoring	Level of Exertion
0	No exertion
0.5	Very Very Slight
1	Very Slight
2	Slight
3	Moderate
4	Somewhat Severe
5	Severe
6	
7	Very Severe
8	
9	Very Very Severe
10	Maximal Exertion

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6.7 Appendix G: The Complete Participation Booklet

Participation Booklet

The Effects of Different Acute Exercise Sessions on Mood.

Nicholas Rooney's Applied Psychology Thesis

Thank you for your time in reading over/completing this booklet.

Contents

Please complete Section 1 before your workout, and Section 2 after your workout

Section 1: Complete Before Exercising

Information Sheet

The Effects of Different Acute Exercise Sessions on Mood.

You are being invited to take part in the research about the effects of different acute exercise sessions on mood. This project is being undertaken by Nicholas Rooney for his major research project as part of the BSc in Applied Psychology, IADT.

Before you decide whether you wish to take part, it is important that you understand why this research is being done and what it will involve. Please take time to read this information carefully and discuss it with someone you trust. If there is anything that is unclear or if you would like more information please ask. Our contact details are at the end of this information sheet. Thank you for taking the time to read through this fully.

What is the purpose of the project?

The literature is robust regarding the beneficial effects of exercise on improving mood. However, little research has been conducted on exercise type and subsequent changes in mood based. The present research aims to understand which different exercise sessions may affect mood the most.

Who is/Why are you being invited to take part?

You are invited to take part as the present study requires participants who are training in a gym with a variety of exercise equipment, and will be going about their own chosen exercise routine. You are an ideal participant for this study because you are a member of a gym.

What is involved?

If you choose to participate, you will be asked to fill out this participation booklet. Section 1 before your workout, and section 2 after your workout. This includes mood scales, a demographic questionnaire and an exercise questionnaire. This may take roughly 13 minutes per section.

Do I have to take part?

You are free to decide whether you wish to take part or not. If you do decide to take part, you will be asked to sign a consent form that lets us know you have read this information sheet and understand what is involved in the research. Your participation will be greatly appreciated. However, you are free to withdraw from this study at any time and without giving reasons.

What are the disadvantages and risks (if any) of taking part?

A disadvantage for taking part is that time is needed to fill out this document.

What are the possible benefits of taking part?

The benefit from taking part is that you will support the progression of knowledge with sports and health psychology, and you will experience noting down what exercises you did during your session, which is a great way to track progress towards your goals.

How will my information be used?

The questionnaire responses will be combined with all other participants' data and statistically analysed. No individual's data will be identifiable in the final report. The analysis will be reported in Nicholas Rooney's thesis for the BSc in Applied Psychology in the Dun Laoghaire Institute of Art, Design & Technology. Once published, the thesis can be requested through the library at IADT, through my email N00181326@student.iadt.ie or through my supervisor's email Derek.Laffan@iadt.ie. This article may also be published in an academic journal.

How will my data be protected?

A 4 digit number will be the only identifiable data for participants. This will only be for ease of data processing and serve as a way to find the specific data a participant submitted should they decide that they do not want their data in the study. The

research will be conducted in line with the national ethical standards of the Psychological Society of Ireland and will adhere to the EU General Data Protection Regulation (GDPR).

Under the EU General Data Protection Regulation (GDPR) the legal basis for collecting data for scholarly research is that of public interest. The regulations regarding the protection of your data will be followed. Only data which is needed for analysis will be collected. By giving your consent to take part in the study you are consenting to the use of your data as detailed in this information sheet.

The data will be retained by the researcher for at least one year, and may be retained for up to 7 years if the results of the study are published in certain capacities (e.g. in a journal article). There is also a possibility that the fully anonymised dataset may be submitted to a journal and made available to other researchers and academics worldwide for verification purposes, but if this occurs it will be ensured that you are not identifiable from the data.

As the supervisor on this project, I, Derek Laffan, am responsible for ensuring that all datasets will be stored in accordance with GDPR regulations and those which are not submitted to a journal will be fully deleted on or before 1/1/2029.

- The people who have access to the data - Nicholas Rooney (researcher), Derek Laffan (supervisor), and Nicholas Rooney's statistics lecturer.
- The data will be securely stored in a locked filing cabinet and later, in a password protected computer. Once data is transferred online, all paper-copies will be shredded.
- If, in the extremely rare circumstance that there is a data breach, the data protection officer in IADT will be informed immediately.
- The level of identifiability is exceptionally low. Participants will be only asked to provide the last 4 digits of their phone number as a code so in the event that a participant would like to withdraw their data, this can be done. No other identifiable data will be recorded.
- In the long term, the data will only be digital and secured with a password. When the data is not needed anymore, it will be completely erased.

You will find contact information for IADT's Data Protection Officer, Mr Bernard Mullarkey, and more information on your rights concerning your data at https://iadt.ie/about/your-rights-entitlements/gdpr/

Who has reviewed the study?

This study has been approved by the Department of Technology and Psychology Ethics Committee (DTPEC).

What if you have any questions or there is a problem?

If you have a concern about any aspect of this study, you may wish to speak to the researcher who will do their best to answer your questions. You should contact Nicholas Rooney on N00181326@student.iadt.ie or their supervisor Derek.Laffan@iadt.ie.

Thank you

Thank you for your participation. You are aiding in the progression of knowledge in sport psychology.

Date

15/12/2021

Section 1: Complete Before Exercising

Consent Form

Please tick the boxes below.

I have understood the information about this research	
I know how I can contact the researcher for more information if needed	
I had the opportunity to ask more questions about this study	
I am aware participation is voluntary and that I am free to withdraw at any time	
I understand that the data collected about me will not be identifiable	
I am over 18	
I agree to take part in the study	

I'm currently free from psychological and physical health problems	Yes	No

Please Write the Last 4 Digits of your phone number

here:_____

(Please do not write your name anywhere on the booklet)

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*Section 1: Complete **Before** Exercising*

Mood Scale

Please read the words and statements below and circle the number which best equates to how you are currently feeling in relation to those words/statements.

0	1	2	3	4
Not at All	A Little	Moderately	Quite a Bit	Extremely

1	Friendly	0	1	2	3	4
2	Tense	0	1	2	3	4
3	Angry	0	1	2	3	4
4	Worn Out	0	1	2	3	4
5	Unhappy	0	1	2	3	4
6	Clear Headed	0	1	2	3	4
7	Lively	0	1	2	3	4
8	Confused	0	1	2	3	4
9	Sorry for things done	0	1	2	3	4
10	Shaky	0	1	2	3	4
11	Listless (lacking energy)	0	1	2	3	4
12	Peeved	0	1	2	3	4
13	Considerate	0	1	2	3	4
14	Sad	0	1	2	3	4

15	Active	0	1	2	3	4
16	On Edge	0	1	2	3	4
17	Grouchy	0	1	2	3	4
18	Blue	0	1	2	3	4
19	Energetic	0	1	2	3	4
20	Panicky	0	1	2	3	4
21	Hopeless	0	1	2	3	4
22	Relaxed	0	1	2	3	4
23	Unworthy	0	1	2	3	4
24	Spiteful	0	1	2	3	4
25	Sympathetic	0	1	2	3	4
26	Uneasy	0	1	2	3	4
27	Restless	0	1	2	3	4
28	Unable to Concentrate	0	1	2	3	4
29	Fatigued	0	1	2	3	4
30	Helpful	0	1	2	3	4
31	Annoyed	0	1	2	3	4
32	Discouraged	0	1	2	3	4
33	Resentful	0	1	2	3	4
34	Nervous	0	1	2	3	4
35	Lonely	0	1	2	3	4
36	Miserable	0	1	2	3	4
37	Muddled	0	1	2	3	4
38	Cheerful	0	1	2	3	4
39	Bitter	0	1	2	3	4
40	Exhausted	0	1	2	3	4
41	Anxious	0	1	2	3	4
42	Ready to Fight	0	1	2	3	4

43	Good Natured	0	1	2	3	4
44	Gloomy	0	1	2	3	4
45	Desperate	0	1	2	3	4
46	Sluggish	0	1	2	3	4
47	Rebellious	0	1	2	3	4
48	Helpless	0	1	2	3	4
49	Weary	0	1	2	3	4
50	Bewildered	0	1	2	3	4
51	Alert	0	1	2	3	4
52	Deceived	0	1	2	3	4
53	Furious	0	1	2	3	4
54	Efficient	0	1	2	3	4
55	Trusting	0	1	2	3	4
56	Full of Pep (Energy)	0	1	2	3	4
57	Bad Tempered	0	1	2	3	4
58	Worthless	0	1	2	3	4
59	Forgetful	0	1	2	3	4
60	Carefree	0	1	2	3	4
61	Terrified	0	1	2	3	4
62	Guilty	0	1	2	3	4
63	Vigorous	0	1	2	3	4
64	Uncertain about things	0	1	2	3	4
65	Bushed (exhausted)	0	1	2	3	4

Make sure you have answered every item!

Section 1: Complete Before Exercising

Demographic Questionnaire

Please answer the following questions with either a circle or tick on the correct answer, or fill in where space is provided.

I am:

Male	Female	Other	Prefer not to say

I am in this age bracket:

19-24	25-30	31-44	45+	Prefer not to say

Please circle or write in the empty box provided (IN ALL CAPITALS) what ethnicity you are:

I am: _____	Prefer not to say

How many times do you train in the gym per week:

Less Than 1	1-2	3-4	5-6	7+

How many weeks have you been training consistently at the above rate:

Less than 1	1-3	4-6	6-12	More than 12

Do you (do any form of) exercise outside the gym (over 20 minutes) weekly?

Yes	No

If Yes, How many times per week do you exercise outside of the gym:

1-2	3-4	5-6	7+

How would you rate last night's sleep?

Very Bad	Bad	Mediocre	Good	Very Good	Prefer Not to Say

Do you identify as LGBTQI+?

Yes	No	Prefer Not to Say

What is your current occupation?

Unemployed	Student	Employed Part-time
Employed Full-time	Self Employed	Retired

Now, Enjoy your workout!

Please fill in the last 2 sections after you have trained.

*Section 2: Complete **After** Exercising*

Exercise Questionnaires

The Borg CR10 Rate of Perceived Exertion (RPE) scale will be used in the following section. It is a method to tell how intense a given exercise session or even an individual exercise was. The scale ranges from 0 (no exertion at all) to 10 (maximal exertion). This is a perceived scale, so it is how difficult you felt that workout or exercise was. There is no right or wrong answer.

Borg CR10 Rate of Perceived Exertion Scale (RPE).

Scoring	Level of Exertion
0	No exertion
0.5	Very Very Slight
1	Very Slight
2	Slight
3	Moderate
4	Somewhat Severe
5	Severe
6	
7	Very Severe
8	
9	Very Very Severe
10	Maximal Exertion

Section 2: Complete After Exercising

The Workout as A Whole

Please indicate in which category you would say your whole exercise session would fall under. You can circle or tick more than 1 option, but MAXIMUM of 3.

Aerobic Training	Anaerobic Training	Hypertrophy Training
Strength Training	Bodybuilding	Powerlifting
Weight Lifting	Mobility/Flexibility	Cardiovascular Training
High Intensity Interval Training (HIIT)	Other: _____	Other: _____

How long did your workout last (in minutes):

1-19	20-30	31-45	46+

According to the RPE scale explained above, how intense was your workout as a whole:

_____ Out of 10

How repetitive was your workout as a whole in terms of moving your body?

Very Little	Little	So So	Repetitive	Very Repetitive

In terms of that whole exercise session, how comfortable were you with carrying out those movements:

First timer/ Not comfortable at all	uncomfortable	Comfortable	Very Comfortable	So comfortable I could let my mind wander

Did you train at the time of day you would normally train at?

Yes	No

Did you train during the time of day which is your favourite time to train at?

Yes	No

Did you feel like you were competing against anyone in the gym?

Yes	No

Do you think there was a social aspect in the gym that might have affected your mood?

Yes	No	I'm not sure

*Section 2: Complete **After** Exercising*

Mood Scale

Please read the words and statements below and circle the number which best equates to how you are currently feeling in relation to those words/statements.

0	1	2	3	4
Not at All	A Little	Moderately	Quite a Bit	Extremely

1	Friendly	0	1	2	3	4
2	Tense	0	1	2	3	4
3	Angry	0	1	2	3	4
4	Worn Out	0	1	2	3	4
5	Unhappy	0	1	2	3	4
6	Clear Headed	0	1	2	3	4
7	Lively	0	1	2	3	4
8	Confused	0	1	2	3	4
9	Sorry for things done	0	1	2	3	4
10	Shaky	0	1	2	3	4
11	Listless (lacking energy)	0	1	2	3	4
12	Peeved	0	1	2	3	4
13	Considerate	0	1	2	3	4
14	Sad	0	1	2	3	4
15	Active	0	1	2	3	4
16	On Edge	0	1	2	3	4
17	Grouchy	0	1	2	3	4
18	Blue	0	1	2	3	4

19	Energetic	0	1	2	3	4
20	Panicky	0	1	2	3	4
21	Hopeless	0	1	2	3	4
22	Relaxed	0	1	2	3	4
23	Unworthy	0	1	2	3	4
24	Spiteful	0	1	2	3	4
25	Sympathetic	0	1	2	3	4
26	Uneasy	0	1	2	3	4
27	Restless	0	1	2	3	4
28	Unable to Concentrate	0	1	2	3	4
29	Fatigued	0	1	2	3	4
30	Helpful	0	1	2	3	4
31	Annoyed	0	1	2	3	4
32	Discouraged	0	1	2	3	4
33	Resentful	0	1	2	3	4
34	Nervous	0	1	2	3	4
35	Lonely	0	1	2	3	4
36	Miserable	0	1	2	3	4
37	Muddled	0	1	2	3	4
38	Cheerful	0	1	2	3	4
39	Bitter	0	1	2	3	4
40	Exhausted	0	1	2	3	4
41	Anxious	0	1	2	3	4
42	Ready to Fight	0	1	2	3	4
43	Good Natured	0	1	2	3	4
44	Gloomy	0	1	2	3	4
45	Desperate	0	1	2	3	4
46	Sluggish	0	1	2	3	4

47	Rebellious	0	1	2	3	4
48	Helpless	0	1	2	3	4
49	Weary	0	1	2	3	4
50	Bewildered	0	1	2	3	4
51	Alert	0	1	2	3	4
52	Deceived	0	1	2	3	4
53	Furious	0	1	2	3	4
54	Efficient	0	1	2	3	4
55	Trusting	0	1	2	3	4
56	Full of Pep (Energy)	0	1	2	3	4
57	Bad Tempered	0	1	2	3	4
58	Worthless	0	1	2	3	4
59	Forgetful	0	1	2	3	4
60	Carefree	0	1	2	3	4
61	Terrified	0	1	2	3	4
62	Guilty	0	1	2	3	4
63	Vigorous	0	1	2	3	4
64	Uncertain about things	0	1	2	3	4
65	Bushed (exhausted)	0	1	2	3	4

Make sure you have answered every item!

This concludes the study, you may give this booklet back to the researcher, or place it on the pile provided.

Thanks A million.

That was incredibly kind of you to take your time out to help me with my study!

Section 1: Complete Before Exercising

Debrief

You have my deepest thanks for taking part in this research study designed to examine the intersection between mood and exercise. With Covid-19 being this persistent, it's important to find out what we can advise people to do, to bring up their mood during these difficult times.

Withdrawal Information

If you have any extra questions, please ask Nicholas Rooney when giving back this booklet. Additionally, you can email him at N00181326@student.iadt.ie or his supervisor at Derek.Laffan@iadt.ie. Please note that submitting your booklet to the researcher is understood as an indication of your consent for the data given, to be compiled and analysed. If you have changed your mind, and do not want your data to be included, simply refrain from handing the booklet to the researcher and dispose of it securely. If you have already submitted the booklet, and you would like to withdraw your data, email either the researcher or the supervisor with the last 4 digits of your phone number, followed by "I withdraw my data", and you will be emailed back confirmation of when your data had been securely deleted. You will be able to remove your data from the study until 25/1/2021, when the data will be combined and analysed. Data removal will not be possible after that date. Please keep a copy of this information (by carefully pulling it off of the booklet, in case you wish to remove your data after submitting your booklet.

Data Protection

Your data will be treated according to GDPR regulations. You will find contact information for IADT's Data Protection Officer, Mr Bernard Mullarkey, and more information on your rights concerning your data at https://iadt.ie/about/your-rights-entitlements/gdpr/

Support Resources

If you have been affected by the content of this study in any way, the organisations below may be of assistance.

For mental health support during COVID-19, please go online to https://www2.hse.ie/services/mental-health-supports-and-services-during-coronavirus/

For mental health support in general, please go online to

https://www.mentalhealthireland.ie

6.8 Appendix H: Information Sheet

Section 1: Complete Before Exercising

Information Sheet

The Effects of Different Acute Exercise Sessions on Mood.

You are being invited to take part in the research about the effects of different acute exercise sessions on mood. This project is being undertaken by Nicholas Rooney for his major research project as part of the BSc in Applied Psychology, IADT.

Before you decide whether you wish to take part, it is important that you understand why this research is being done and what it will involve. Please take time to read this information carefully and discuss it with someone you trust. If there is anything that is unclear or if you would like more information please ask. Our contact details are at the end of this information sheet. Thank you for taking the time to read through this fully.

What is the purpose of the project?

The literature is robust regarding the beneficial effects of exercise on improving mood. However, little research has been conducted on exercise type and subsequent changes in mood based. The present research aims to understand which different exercise sessions may affect mood the most.

Who is/Why are you being invited to take part?

You are invited to take part as the present study requires participants who are training in a gym with a variety of exercise equipment, and will be going about their own chosen exercise routine. You are an ideal participant for this study because you are a member of a gym.

What is involved?

2

If you choose to participate, you will be asked to fill out this participation booklet. Section 1 before your workout, and section 2 after your workout. This includes mood scales, a demographic questionnaire and an exercise questionnaire. This may take roughly 13 minutes per section.

Do I have to take part?

You are free to decide whether you wish to take part or not. If you do decide to take part, you will be asked to sign a consent form that lets us know you have read this information sheet and understand what is involved in the research. Your participation will be greatly appreciated. However, you are free to withdraw from this study at any time and without giving reasons.

What are the disadvantages and risks (if any) of taking part?

A disadvantage for taking part is that time is needed to fill out this document.

What are the possible benefits of taking part?

The benefit from taking part is that you will support the progression of knowledge with sports and health psychology, and you will experience noting down what exercises you did during your session, which is a great way to track progress towards your goals.

How will my information be used?

The questionnaire responses will be combined with all other participants' data and statistically analysed. No individual's data will be identifiable in the final report. The analysis will be reported in Nicholas Rooney's thesis for the BSc in Applied Psychology in the Dun Laoghaire Institute of Art, Design & Technology. Once published, the thesis can be requested through the library at IADT, through my email N00181326@student.iadt.ie or through my supervisor's email Derek.Laffan@iadt.ie. This article may also be published in an academic journal.

How will my data be protected?

A 4 digit number will be the only identifiable data for participants. This will only be for ease of data processing and serve as a way to find the specific data a participant submitted should they decide that they do not want their data in the study. The

research will be conducted in line with the national ethical standards of the Psychological Society of Ireland and will adhere to the EU General Data Protection Regulation (GDPR).

Under the EU General Data Protection Regulation (GDPR) the legal basis for collecting data for scholarly research is that of public interest. The regulations regarding the protection of your data will be followed. Only data which is needed for analysis will be collected. By giving your consent to take part in the study you are consenting to the use of your data as detailed in this information sheet.

The data will be retained by the researcher for at least one year, and may be retained for up to 7 years if the results of the study are published in certain capacities (e.g. in a journal article). There is also a possibility that the fully anonymised dataset may be submitted to a journal and made available to other researchers and academics worldwide for verification purposes, but if this occurs it will be ensured that you are not identifiable from the data.

As the supervisor on this project, I, Derek Laffan, am responsible for ensuring that all datasets will be stored in accordance with GDPR regulations and those which are not submitted to a journal will be fully deleted on or before 1/1/2029.

- The people who have access to the data - Nicholas Rooney (researcher), Derek Laffan (supervisor), and Nicholas Rooney's statistics lecturer.
- The data will be securely stored in a locked filing cabinet and later, in a password protected computer. Once data is transferred online, all paper-copies will be shredded.
- If, in the extremely rare circumstance that there is a data breach, the data protection officer in IADT will be informed immediately.
- The level of identifiability is exceptionally low. Participants will be only asked to provide the last 4 digits of their phone number as a code so in the event that a participant would like to withdraw their data, this can be done. No other identifiable data will be recorded.
- In the long term, the data will only be digital and secured with a password. When the data is not needed anymore, it will be completely erased.

You will find contact information for IADT's Data Protection Officer, Mr Bernard Mullarkey, and more information on your rights concerning your data at https://iadt.ie/about/your-rights-entitlements/gdpr/

Who has reviewed the study?

This study has been approved by the Department of Technology and Psychology Ethics Committee (DTPEC).

What if you have any questions or there is a problem?

If you have a concern about any aspect of this study, you may wish to speak to the researcher who will do their best to answer your questions. You should contact Nicholas Rooney on N00181326@student.iadt.ie or their supervisor Derek.Laffan@iadt.ie.

Thank you

Thank you for your participation. You are aiding in the progression of knowledge in sport psychology.

Date

15/12/2021

6.9 Appendix I: Consent Form

Section 1: Complete Before Exercising

Consent Form ✓

Please tick the boxes below.

I have understood the information about this research	
I know how I can contact the researcher for more information if needed	
I had the opportunity to ask more questions about this study	
I am aware participation is voluntary and that I am free to withdraw at any time	
I understand that the data collected about me will not be identifiable	
I am over 18	
I agree to take part in the study	

I'm currently free from psychological and physical health problems	Yes	No

Please Write the Last 4 Digits of your phone number

here:_____

(Please do not write your name anywhere on the booklet)

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6.10 Appendix J: Demographic Questionnaire

Section 1: Complete Before Exercising

Demographic Questionnaire

Please answer the following questions with either a circle or tick on the correct answer, or fill in where space is provided.

I am:

Male	Female	Other	Prefer not to say

I am in this age bracket:

19-24	25-30	31-44	45+	Prefer not to say

Please circle or write in the empty box provided (IN ALL CAPITALS) what ethnicity you are:

I am: _____	Prefer not to say

How many times do you train in the gym per week:

Less Than 1	1-2	3-4	5-6	7+

How many weeks have you been training consistently at the above rate:

Less than 1	1-3	4-6	6-12	More than 12

Do you (do any form of) exercise outside the gym (over 20 minutes) weekly?

Yes	No

If Yes, How many times per week do you exercise outside of the gym:

10

6.11 Appendix K: Debrief

Section 1: Complete Before Exercising

Debrief

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For mental health support in general, please go online to

https://www.mentalhealthireland.ie

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6.12 Appendix L: SPSS output for Two-way ANOVA

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

Time	Dependent Variable
1	TMDBefore
2	TMDAfter

Between-Subjects Factors

		Value Label	N
Exercise Groups	1.00	Aerobic Exercise	32
	2.00	Anaerobic Exercise	96
Exercise Intensity	1.00	Moderate Intensity	69
	2.00	High Intensity	59

Box's Test of Equality of Covariance Matrices[a]

Box's M	20.520
F	2.177
df1	9
df2	11089.556
Sig.	.021

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + ExerciseGroup + ExerciseIntensity + ExerciseGroup * ExerciseIntensity
Within Subjects Design: Time

Descriptive Statistics

	Exercise Groups	Exercise Intensity	Mean	Std. Deviation	N
TMDBefore	Aerobic Exercise	Moderate Intensity	38.6667	25.94674	21
		High Intensity	44.8182	26.50592	11
		Total	40.7813	25.88029	32
	Anaerobic Exercise	Moderate Intensity	37.5208	15.98402	48
		High Intensity	38.2292	22.61353	48
		Total	37.8750	19.48130	96
	Total	Moderate Intensity	37.8696	19.36181	69
		High Intensity	39.4576	23.28557	59
		Total	38.6016	21.18919	128
TMDAfter	Aerobic Exercise	Moderate Intensity	21.1429	12.61858	21
		High Intensity	23.0909	15.70640	11
		Total	21.8125	13.53475	32
	Anaerobic Exercise	Moderate Intensity	25.1458	12.42508	48
		High Intensity	26.1458	18.89499	48
		Total	25.6458	15.91423	96
	Total	Moderate Intensity	23.9275	12.52916	69
		High Intensity	25.5763	18.25604	59
		Total	24.6875	15.39289	128

Hypothesis 1, Hypothesis 4 and Hypothesis 5 seen in "Tests of Within-Subjects Effects" table below.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	11262.505	1	11262.505	59.384	.000	.324	59.384	1.000
	Greenhouse-Geisser	11262.505	1.000	11262.505	59.384	.000	.324	59.384	1.000
	Huynh-Feldt	11262.505	1.000	11262.505	59.384	.000	.324	59.384	1.000
	Lower-bound	11262.505	1.000	11262.505	59.384	.000	.324	59.384	1.000
Time * ExerciseGroup	Sphericity Assumed	607.191	1	607.191	3.202	.076	.025	3.202	.427
	Greenhouse-Geisser	607.191	1.000	607.191	3.202	.076	.025	3.202	.427
	Huynh-Feldt	607.191	1.000	607.191	3.202	.076	.025	3.202	.427
	Lower-bound	607.191	1.000	607.191	3.202	.076	.025	3.202	.427
Time * ExerciseIntensity	Sphericity Assumed	42.460	1	42.460	.224	.637	.002	.224	.076
	Greenhouse-Geisser	42.460	1.000	42.460	.224	.637	.002	.224	.076
	Huynh-Feldt	42.460	1.000	42.460	.224	.637	.002	.224	.076
	Lower-bound	42.460	1.000	42.460	.224	.637	.002	.224	.076
Time * ExerciseGroup * ExerciseIntensity	Sphericity Assumed	56.068	1	56.068	.296	.588	.002	.296	.084
	Greenhouse-Geisser	56.068	1.000	56.068	.296	.588	.002	.296	.084
	Huynh-Feldt	56.068	1.000	56.068	.296	.588	.002	.296	.084
	Lower-bound	56.068	1.000	56.068	.296	.588	.002	.296	.084
Error(Time)	Sphericity Assumed	23517.168	124	189.655					
	Greenhouse-Geisser	23517.168	124.000	189.655					
	Huynh-Feldt	23517.168	124.000	189.655					
	Lower-bound	23517.168	124.000	189.655					

a. Computed using alpha = .05

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Time	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Linear	11262.505	1	11262.505	59.384	.000	.324	59.384	1.000
Time * ExerciseGroup	Linear	607.191	1	607.191	3.202	.076	.025	3.202	.427
Time * ExerciseIntensity	Linear	42.460	1	42.460	.224	.637	.002	.224	.076
Time * ExerciseGroup * ExerciseIntensity	Linear	56.068	1	56.068	.296	.588	.002	.296	.084
Error(Time)	Linear	23517.168	124	189.655					

a. Computed using alpha = .05

Levene's Test of Equality of Error Variances[a]

		Levene Statistic	df1	df2	Sig.
TMDBefore	Based on Mean	2.388	3	124	.072
	Based on Median	1.799	3	124	.151
	Based on Median and with adjusted df	1.799	3	103.507	.152
	Based on trimmed mean	2.227	3	124	.088
TMDAfter	Based on Mean	1.398	3	124	.247
	Based on Median	.887	3	124	.450
	Based on Median and with adjusted df	.887	3	95.094	.451
	Based on trimmed mean	1.103	3	124	.351

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + ExerciseGroup + ExerciseIntensity + ExerciseGroup * ExerciseIntensity
Within Subjects Design: Time

Mauchly's Test of Sphericity[a]

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Time	1.000	.000	0	.	1.000	1.000	1.000

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + ExerciseGroup + ExerciseIntensity + ExerciseGroup * ExerciseIntensity
Within Subjects Design: Time

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	Time	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Linear	11262.505	1	11262.505	59.384	.000	.324	59.384	1.000
Time * ExerciseGroup	Linear	607.191	1	607.191	3.202	.076	.025	3.202	.427
Time * ExerciseIntensity	Linear	42.460	1	42.460	.224	.637	.002	.224	.076
Time * ExerciseGroup * ExerciseIntensity	Linear	56.068	1	56.068	.296	.588	.002	.296	.084
Error(Time)	Linear	23517.168	124	189.655					

a. Computed using alpha = .05

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Pillai's trace	.324	59.384[a]	1.000	124.000	.000	.324	59.384	1.000
Wilks' lambda	.676	59.384[a]	1.000	124.000	.000	.324	59.384	1.000
Hotelling's trace	.479	59.384[a]	1.000	124.000	.000	.324	59.384	1.000
Roy's largest root	.479	59.384[a]	1.000	124.000	.000	.324	59.384	1.000

Each F tests the multivariate effect of Time. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

b. Computed using alpha = .05

Hypothesis 2, Hypothesis 3 and Hypothesis 6 seen in table "Tests of Between-Subjects Effects" below.

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Intercept	180090.655	1	180090.655	356.143	.000	.742	356.143	1.000
ExerciseGroup	1.272	1	1.272	.003	.960	.000	.003	.050
ExerciseIntensity	266.919	1	266.919	.528	.469	.004	.528	.111
ExerciseGroup * ExerciseIntensity	113.344	1	113.344	.224	.637	.002	.224	.076
Error	62703.032	124	505.670					

a. Computed using alpha = .05

Estimated Marginal Means

1. Grand Mean

Measure: MEASURE_1

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
31.845	1.687	28.505	35.185

Tests of Normality Follow.

Exercise Groups

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Exercise Groups	Statistic	df	Sig.	Statistic	df	Sig.
TMDBefore	Aerobic Exercise	.121	32	.200*	.936	32	.056
	Anaerobic Exercise	.120	96	.002	.950	96	.001
TMDAfter	Aerobic Exercise	.155	32	.050	.903	32	.008
	Anaerobic Exercise	.127	96	.001	.886	96	.000

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Exercise Intensity

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Exercise Intensity	Statistic	df	Sig.	Statistic	df	Sig.
TMDBefore	Moderate Intensity	.110	69	.038	.935	69	.001
	High Intensity	.118	59	.039	.952	59	.022
TMDAfter	Moderate Intensity	.089	69	.200*	.962	69	.034
	High Intensity	.181	59	.000	.844	59	.000

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction