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The Effect of a Cycling Partner on Intensity Selection and Enjoyment Ratings in Sedentary Adults

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Abstract BACKGROUND/OBJECTIVE: Physical inactivity remains prevalent, underscoring the need for accessible exercise strategies that reduce barriers while enhancing motivation, enjoyment, and adherence through virtual group fitness. Therefore, the purpose of this study was to examine the effects of an exercise partner on intensity selection, rating of perceived exertion (RPE), exercise enjoyment, and perceived duration during a 30-min virtual cycling class. METHODS: Twenty-four sedentary adults completed a VO_2 peak test, and two identical 30-min virtual cycling classes: one individually (PAA) and one with an exercise partner (PAP). VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$), wattage (W), and HR (bpm) were assessed every min, while differential RPE for overall (RPE-O), legs (RPE-L), and breathing (RPE-B) as well as lactate ($mmol \cdot dL^{-1}$) were assessed every 5 min. Additionally, perceived duration (min) and exercise enjoyment using the PACES questionnaire were assessed 15-min post exercise. RESULTS: Perceived duration was ~3 min lower ($p = 0.06$) for the PAP trial. Furthermore, participants selected significantly higher ($p \leq 0.05$) wattage at min 10 and 20 for the PAA trial. RPE-L was significantly higher for PAA at min 5, 10, and 30 and approached significance at min 15 and 20. Additionally, participants reported greater levels of invigoration and gratification following the PAA trial. CONCLUSION: Findings suggest participating in a virtually led cycling class with a partner (vs. individually) results in similar overall self-selection of intensity, lower RPE, lower levels of gratification and invigoration, as well as a decreased perceived duration. Collectively these results may systematically alter parameters of exercise bouts adopted during cycling exercise.

Keywords: *Exercise Partner, Identifiability, Kohler Effect, Peloton, Scalar Expectancy Theory*

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1. Introduction

Physical inactivity has been identified as the fourth leading cause of mortality, contributing to more than 3 million deaths annually worldwide [1]. Despite the well-established benefits of physical activity (PA) reducing disease risk and all-cause mortality [2,3,4,5], only 46.9% of Americans meet the American College of Sports Medicine's (ACSM) recommendation of 75-150 minutes of moderate-vigorous PA per week [6]. Plausible explanations for this lack of PA are common barriers such as: perceived lack of time, knowledge, social support, motivation, enjoyment of activity [7,8,9], or access to resources and facilities [10,11].

A feasible approach to overcome PA barriers would be to utilize a personal trainer [12], which has been shown not only to improve the knowledge and social support of exercisers [13], but also to increase exercise adherence [14]. Despite potential advantages, many may find it costly or intimidating to work one-on-one with a fitness professional. An alternative could be participating in a group exercise class, which allows for many of the same benefits of a personal trainer [13] at a reduced cost with potentially enhanced social support from other class members. Additionally, group exercise offers a unique environment providing subconscious motivation for less experienced participants as they may exert more effort in a group setting than exercising alone [15,16], in a phenomenon known as the Kohler effect [16]. Previous research suggests that when exercising with a partner of superior fitness levels (vs independently), individuals increased time spent cycling [15,17] and holding a plank [18]. Specifically, when cycling at 65% heart rate reserve, cycling duration was significantly longer when participants were instructed that their team's overall performance depended on which cyclist stopped first (1,314 ± 605 s) vs. trials where participants cycled with others, but performance was independent of group members (1,186 ± 540 s), and when each participant cycled alone (638 ± 350 s) ($p < 0.001$) [17]. Despite observed positive influences of an exercise partner on performance in traditional exercise, little is known regarding the impact during group exercise.

Spin is a popular low impact, group exercise cycling

class that allows individuals to follow instructor cues while cycling to music at a self-selected intensity [19]. In addition to gym-based Spin classes, home-based Spin classes have grown in popularity with fitness trends of 2022 reporting home gym exercise as the number two trend with online live and on-demand exercise classes as the ninth of the top 20 trends [20]. Specifically, fitness apps such as Peloton offer more than 32,000 virtual fitness classes among various exercise modalities, allowing individuals to be immersed in an auditory and visual virtual training environment, where one can follow feedback cues from the instructor and track exercise progress in real time. This immersive environment offers the potential for individuals to enter into a "flow state" in which they lose sense of self and become more engaged in a task [21]. By reaching this flow state, it may be possible to increase exercise enjoyment, decrease perceived exertion, and alter ones perceived duration of exercise.

While the use of a virtual Spin class, such as Peloton, offers the instruction of a typical gym-based class with a lower cost and convenience of exercising at home, the impact of a cycling partner during a virtual Spin class is unknown. Although previous research suggests cycling duration is significantly longer when individuals cycle with a partner [15,17], the effects of an exercise partner on intensity selection, enjoyment of activity and perceived duration during a virtually led Spin class is not well understood. Therefore, this study investigated the effect of an exercise partner on intensity selection perceived duration and ratings of enjoyment for a virtual Spin class. It was hypothesized that not only will intensity selection be greater during the partner exercise session, but the partner session would also be perceived as more enjoyable and shorter in duration than the individual session.

2. Methods

2.1. Participants

Twenty-four sedentary individuals between the ages of 18 and 45, who did not currently meet the ACSM recommended 150 minutes of moderate PA, were recruited to participate (Table 1). Using G-Power software (v3.1, Düsseldorf, Germany) and differences between perceived duration as a primary dependent variable, it was determined *a priori* that a minimum of 23 participants would be sufficient to achieve a desired power of 0.8, using a moderate-high effect size, and an alpha level set at 0.05. All procedures were approved by the University institutional review board and each participant signed a written informed consent prior to data collection. A PAR-Q+ [22] was used to ensure participant safety, with participants who were deemed greater than minimal risk excluded from the study. Participants reported to the lab well-rested (no strenuous exercise ≥ 24 hours prior), well-hydrated, and instructed to avoid caffeine for a minimum of 24 hr prior to each session. Anthropometric data (height & mass) were collected using a stadiometer (cm) (Detecto, Webb City, MO, USA) and a digital scale (kg) (BWB-800, Tanita co., Alinton Heights, IL, US). Skinfold measurements (Lange, Cambridge, MD, USA) taken at three sites (males: chest, abdomen, and thigh; females: triceps, suprailiac, and thigh) were used to estimate body fat percentage [23].

Table 1. Descriptive characteristics for participants

Variable	Females (n = 19)	Males (n = 5)	Total (n = 24)
Age (yr)	27.8 ± 9.9	26.6 ± 6.3	27.6 ± 9.1
Height (cm)	161.8 ± 7.5	177.6 ± 6.1	165.0 ± 9.7
Mass (kg)	73.9 ± 18.5	94.8 ± 13.4	78.3 ± 19.3
Body Fat (%)	29.6 ± 7.3	26.5 ± 6.6	28.9 ± 7.1
VO_2 peak ($ml \cdot kg^{-1} \cdot min^{-1}$)	25.7 ± 4.3	29.3 ± 4.0	26.4 ± 4.4

Values are means and standard deviations

2.2. VO_2 Peak Trial

Following anthropometric measurements, participants completed a graded cycling test on a Velotron (Velotron, Racer Mate, Seattle, WA, US). Participants were familiarized with the Velotron bike as it was adjusted to their comfort specifications. Seat and handlebar height were recorded to ensure identical bike comfort for later trials. Participants initiated the protocol by cycling at 60 W for three minutes followed by an increase of 50 W for males and 30 W for females every two minutes until volitional exhaustion was achieved. Throughout the peak test, metabolic data (VO_2, VCO_2, VE, RER) were analyzed using a metabolic system (Parvo Medics TrueOne 2400, Sandy, UT, USA) and integrated software and data was recorded within the last ten-seconds of every minute. Prior to each trial, the metabolic system was calibrated using a gas of known concentrations (16.00% O_2; 4.00% CO_2) and the flowmeter was calibrated using a Hans Rudolph (Series 4900) 3.0 L bi-directional calibration syringe (Kansas City, MO). Additionally, heart rate (HR) was assessed using a Polar monitor (T31 Transmitter, Polar Electro, Kempele, Finland). Ratings of perceived exertion (RPE) using the OMNI pictorial cycle scale [24] was assessed for overall feelings of exertion within the last ten-seconds of every minute during the peak test.

2.3. Cycling Trials

Following the peak trial, participants reported to the lab on two separate occasions to complete two interactive Spin trials using the Peloton app (Peloton Interactive Inc, New York, NY, US) and the Velotron bike for both. One cycling trial was completed with a partner (PAP) and the other without a cycling partner (PAA). PAP and PAA were counterbalanced to control for ordering and all cycling trials were completed within 4—7 days. Furthermore, participants were paired with a cycling partner based on VO_2 peak values (± 4 $ml/kg/min^{-1}$) to ensure that participant fitness levels were similar. The interactive cycling trials consisted of an easy-to-moderate difficulty, advanced beginner thirty-minute cycling class with a difficulty rating of 6.9 out of 10 according to the Peloton app. In conjunction with the virtual instructors' cues, participants were allowed to view and adjust their workload (wattage and cadence) as they deemed necessary based on the intensity of the virtual cycling class for both trials. Prior to the start of each cycling trial, participants were given a demonstration on how to adjust their

workload, which was not only visible to the individual participant. To assess intensity selection, metabolic data (VO_2) (Parvo Medics TrueOne 2400, Sandy, UT, USA) HR (T31 Transmitter, Polar Electro, Kempele, Finland), and wattage were recorded at rest and every min, however, averages of every 5 min was used for analyses. In addition, lactate concentration (Analox GL5, Analox Instruments, Stourbridge, UK) from a capillary blood sample, along with RPE differentiated to feelings of overall (RPE-O), legs (RPE-L), and breathing (RPE-B) exertion were assessed using the OMNI cycle scale [24] at rest and every 5 min. Real time cycling duration was blinded throughout each trial to remove bias regarding perceived duration.

Following each trial, participants remained in the lab for a 15-min seated recovery after which they estimated perceived duration of exercise (min) and reported session RPE (SRPE), using the same pictorial scale as acute measures. Additionally, the Physical Activity Enjoyment Scale Questionnaire (PACES) [25] was completed to assess enjoyment associated with each session. This questionnaire consisted of 18 statements on a 1 - 7-point Likert scale (i.e., I enjoy it – I hate it). For analyses purposes, responses were transposed so that lower numbers reflected more positive feelings and higher numbers reflected less positive feelings. Following the final trial, participants reported which trial (partner vs. no partner) they preferred during exercise.

2.4. Statistical Analysis

Means and standard deviations were calculated for descriptive characteristics of participants. A 2 (condition) x 6 (timepoint) factorial ANOVA was used to compare wattage between trials while separate 2 (condition) x 7 (timepoint) factorial ANOVAs were used to compare HR, VO_2, RPE-L, RPE-B, RPE-O, and lactate between trials. As HR, VO_2, and wattage were recorded every 30 seconds to one minute, an average of measurements were taken every five minutes for analyses. If main effects or interactions were observed, post hoc paired samples t-tests were used to compare values between conditions at each timepoint. Furthermore, paired samples t-tests were used to compare mean wattage between trials as well as perceived duration, responses to the PACES questionnaire, and SRPE. Results were considered significant at $p \leq 0.05$. Statistical Package for the Social Sciences (SPSS v 28) was used to analyze the data.

3. Results

3.1. Intensity Selection

Descriptive characteristics for participants are represented in Table 1. There was no main effect of condition or interaction for both HR and VO_2 ($p \geq 0.3$). There was however a significant main effect for timepoint ($p < 0.001$) for both HR and VO_2. Follow up analyses suggest no significant differences between trials at any timepoint for either variable. Furthermore, in regard to wattage and lactate, there was no reported main effect of condition or the interaction of timepoint and condition ($p \geq 0.3$), however, there was a significant main effect of timepoint ($p < 0.001$) for both lactate and wattage. Post hoc analyses revealed a significantly greater wattage for PAA at timepoint 10 ($p = 0.04$) and 20 ($p = 0.04$) though the magnitude of the differences observed were minimal and therefore lacked meaningful significance (Table 2). Additionally, follow-up analyses suggest significantly higher lactate for PAA at minute 10 ($p = 0.02$). Furthermore, there was no significance difference between trials for mean wattage ($p = 0.14$). Complete intensity data for both trials is presented in Table 2.

3.2. Percepual Responses

When comparing differential RPE-O, RPE-L, and RPE-B between conditions, there was a significant main effect of both timepoint ($p \leq 0.001$) and condition ($p \leq 0.05$) observed for all three variables in addition to the interaction of timepoint and condition ($p = 0.006$) for RPE-L. For the PAP trial, RPE-O was significantly lower at timepoint 10 ($p = 0.01$) and 15 ($p = 0.03$) (Figure 1), while RPE-B was also significantly lower at timepoint 10 ($p = 0.02$) and 15 ($p = 0.04$) (Figure 2) when compared to PAA trials. Furthermore, follow-up analyses revealed RPE-L was significantly lower for PAP at timepoint 5 ($p = 0.03$), 10 ($p = 0.002$), and 30 ($p = 0.01$) while also approaching significance at timepoint 15 ($p = 0.06$) and 20 ($p = 0.06$) (Figure 3). When comparing perceived duration, results approached significance with lower values for PAP (27.7 ± 7.1 min) vs. PAA (30.6 ± 8.9 min); ($p = 0.06$). Additionally, the PACES Questionnaire revealed significantly lower feelings of being invigorated ($p = 0.04$) and gratified ($p = 0.004$) for PAA (Table 3). Furthermore, SRPE were not significantly different between PAP and PAA ($p = 0.87$).

Table 2. Participant intensity selection between trials (n = 24)

Variable	Timepoint	PAA	PAP
VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$)	Rest	3.9 ± 0.7	3.7 ± 0.5
	5 min	13.3 ± 2.2	13.3 ± 2.8
	10 min	17.6 ± 3.7	16.9 ± 3.8
	15 min	18.6 ± 3.7	18.3 ± 4.1
	20 min	18.2 ± 3.7	18.3 ± 3.9
	25 min	18.6 ± 4.1	18.8 ± 4.1
	30 min	19.2 ± 3.8	19.7 ± 4.9
	Average	17.6 ± 4.0	17.5 ± 4.4
HR (bpm)	Rest	85 ± 12	85 ± 13
	5 min	124 ± 21	123 ± 18
	10 min	144 ± 24	140 ± 20

Variable	Timepoint	PAA	PAP
Lactate (mmol·dL^{-1})	15 min	152 ± 21	149 ± 20
	20 min	151 ± 20	150 ± 20
	25 min	155 ± 18	153 ± 18
	30 min	159 ± 17	156 ± 18
	Average	147 ± 23	145 ± 22
	Rest	1.4 ± 0.6	1.4 ± 0.6
	5 min	3.1 ± 1.1	2.8 ± 1.4
	10 min	5.0 ± 2.2	4.2 ± 2.1*
	15 min	5.8 ± 2.6	5.3 ± 2.4
	20 min	5.7 ± 2.5	5.5 ± 2.6
	25 min	5.9 ± 2.7	5.4 ± 2.9
	30 min	6.1 ± 2.5	5.7 ± 3.1
	Average	5.2 ± 2.5	4.8 ± 2.6
Wattage (watts)	5 min	53.6 ± 6.2	52.5 ± 9.7
	10 min	72.1 ± 17.3	67.5 ± 18.9*
	15 min	76.6 ± 19.7	73.4 ± 23.8
	20 min	72.2 ± 19.2	67.4 ± 19.0*
	25 min	69.1 ± 18.7	70.4 ± 20.3
	30 min	71.0 ± 18.1	69.5 ± 22.4
	Average	69.0 ± 18.0	67.0 ± 20.0

Data reported as means and standard deviations; PAA (Peloton App Alone Trial), PAP (Peloton App Partner Trial); * = $p \leq 0.05$.

Table 3. PACES Questionnaire (mean ± SD)

Question	PAA	PAP
Enjoyed	2.48 ± 1.33	2.35 ± 0.90
Liked	1.29 ± 0.98	1.32 ± 0.71
Interested	1.56 ± 1.16	2.07 ± 1.37
Pleasurable	2.91 ± 1.40	3.26 ± 1.20
Absorbed	3.24 ± 1.28	3.41 ± 1.33
Fun	1.46 ± 0.84	1.73 ± 0.78
Energizing	2.46 ± 1.46	2.82 ± 1.36
Made me happy	1.49 ± 1.00	1.54 ± 0.89
Pleasant	2.70 ± 1.29	3.19 ± 1.16
Felt good	2.73 ± 1.50	2.76 ± 1.14
Invigorating	2.52 ± 1.01*	3.26 ± 1.61
Not frustrating	1.09 ± 1.25	1.56 ± 1.18
Gratifying	1.93 ± 0.79*	2.61 ± 1.14
Exhilarating	2.71 ± 0.89	2.93 ± 1.23
Stimulating	1.80 ± 1.33	1.90 ± 1.39
Accomplished	1.94 ± 1.06	2.09 ± 1.10
Refreshing	2.26 ± 1.20	2.74 ± 1.09
Nothing I would rather do	2.33 ± 1.09	2.57 ± 1.15

Scale ranked from 1-7 with lower scores meaning the participants agreed with the statement and the higher scores meaning the participants disagreed with the statement; PAA (Peloton App Alone Trial), PAP (Peloton App Partner Trial); *$p \leq 0.05$.

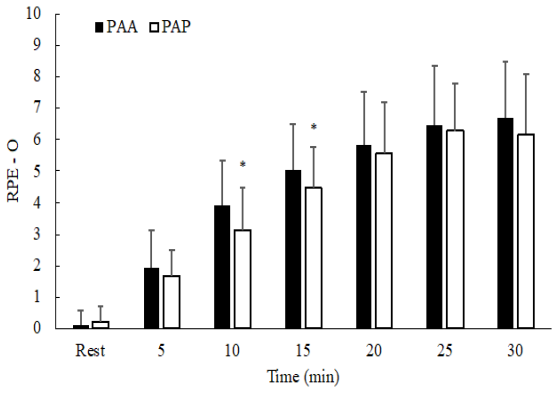

Figure 1. Mean ± SD RPE-O between PAA and PAP Trials. *$p \leq 0.05$

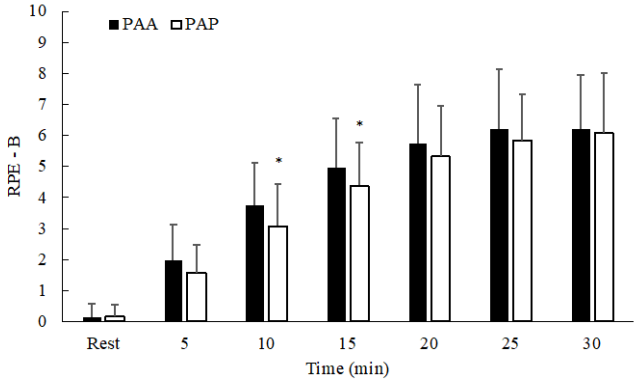

Figure 2. Mean ± SD RPE-B between PAA and PAP Trials. *p ≤ 0.05

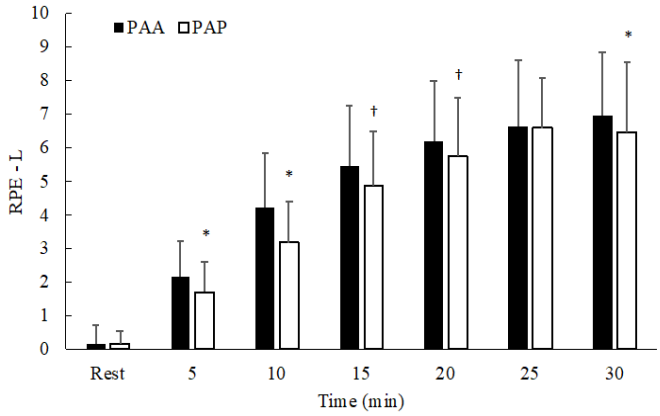

Figure 3. Mean ± SD RPE-L between PAA and PAP Trials. *p ≤ 0.05; † = 0.06

4. Discussion

While the use of personal trainers has shown to improve exercise adherence [14], some may find this method intimidating or costly. An alternative approach is participation in group exercise classes which offer many of the same benefits [13] at a reduced cost and increased level of social support. However, despite the well documented improvements to an individual's performance during an acute exercise bout when exercising in a group setting or with a superior partner [15,16,17,18], little is known about the impact of a partner during a virtual group cycling class. Therefore, this study assessed the impact of a partner on intensity selection, perceived duration of exercise, and enjoyment ratings associated with a virtual cycling class.

Although intensity was significantly higher for the PAA trial at timepoints 10 and 20 for wattage, and timepoint 10 for lactate (Table 2), the differences in wattage were minimal (≤ 4.8 watts), and the difference in lactate (0.8 mmol/dL) was physiologically modest and therefore lack practical clinical significance. When analyzing intensity selection data as a whole (Table 2), it appears that participants selected similar intensities for both PAA and PAP trials. These findings contrast those of previous research who suggest cycling duration [15,17] and time spent holding a plank [18] increased significantly when in a group setting or with a superior partner. Plante et al, [26] suggested that exercising with an individual perceived as being more fit will result in a higher intensity selection and exercising with an individual perceived as less fit will result in a lower intensity selection when cycling. It is possible that because participants were matched with partners of similar aerobic fitness levels, and because participants knew sedentary lifestyle was an inclusion criterion, the Kohler effect [27] may not have been observed, and intensity selections were not increased when exercising with a partner. Furthermore, another potential explanation for these findings was the participants had relatively low identifiability of wattage data. Høigaarda et al, [28] describes identifiability as when an individual's performance metrics in relation to the groups are made public. Research suggest that reduced levels of identifiability may result in social loafing in which individuals will exert less effort when participating in a group activity [29,30,31] possibly due to lack of accountability. In the present study, participant wattage data were displayed on a computer screen directly in front of the individual participant but not projected on a shared screen. Therefore, participants knew their own metrics, though they may have been ignorant of their partners metrics which may have elicited social loafing.

But for minimal exceptions, intensity was not significantly different between trials (Table 2), the present study found significantly lower RPE at timepoints 5 and 10 for RPE-O (Figure 1), timepoints 10 and 15 for RPE-B (Figure 2), and timepoints 5, 10, and 30 for RPE-L (Figure 3) with consistently lower values for PAP for all RPE measures. In addition to the significant differences, values

approached significance at timepoints 15 and 20 for RPE-L ($p = 0.06$), again with lower values for PAP. Hardy [32] suggested the mere presence of another individual may lower one's perception of exertion when cycling at low to moderate intensity. In support of these findings, the present study found similar results when cycling at moderate to vigorous intensity (~66% VO_2 max). To further explain, Hardy [32] uses the saliency of information hypothesis, which states that during physical activity, individuals have access to both internal and external sensory information which is used when making judgments regarding their internal state [33]. It is possible that in the present study, while participants were cycling at moderate to vigorous intensities in the presence of another individual, the external stimulus was heightened while the internal stimulus was weakened, resulting in diminished feelings of exertion. However, another possible explanation is that when individuals are performing in a group setting, they are often concerned about presenting a favorable impression to others present [34]. Specifically, similar to the finding of Hardy [32], individuals in the present study may have viewed PAP as a competitive environment, but due to low fitness levels were unable to increase their intensity, in which case they suppressed self-reported RPE in order to maintain higher levels of self-presentation in comparison to the other rider. Results indicate that the presence of other individuals when exercising may lower perception of exertion therefore potentially increasing exercise duration or intensity to maintain a prescribed RPE.

Current results suggest participants found PAA more gratifying and invigorating vs. PAP (Table 3). Hertel et al, [40] offered a potential explanation into the findings of the present study by suggesting that individuals will adjust intensity based on the performance of other individuals within a group setting. It is possible that in the present study, despite relatively low levels of identifiability, the mechanism of social comparison may have supplied participants with external reinforcement on their performance during PAP. This reinforcement may have led to decreased feelings of invigoration and gratification with their own performance as they compared themselves to their partner. Despite slightly more positive feelings of gratification and invigoration, the results of the present study suggest that the inclusion of an exercise partner during a virtual spin class has minimal influence on positive feelings toward an activity.

In addition to similar enjoyment levels between trials, and significantly lower RPE for PAP, results show perceived duration approached significance ($p = 0.06$) with a 3-minute lower estimation of elapsed time for PAP (PAA 30.6 ± 8.9 min; PAP 27.7 ± 7.1 min). When using the scalar expectancy theory [36,37] as a framework it is possible that including an exercise partner, increased arousal levels due to increased external stimulus (another individual in the room exercising). Additionally, the increases in both invigoration and gratification (Table 3) may have increased the speed of the internal pacemaker within the brain [38,39] which may have led to a distorted perception of time [38]. Furthermore, unlike acute RPE-O, RPE-B, and RPE-L, SRPE was not significantly different between PAA and PAP. A possible explanation is that, unlike acute RPE, which were assessed while exercising, and had high levels of identifiability, SRPE was assessed in a private location where social comparison was no longer a factor and self-presentation was less important.

4.1. Limitations

Limitations of this study include the lack of control for participants familiarity with their exercise partner. Participants were paired based on aerobic fitness level alone. It is possible that if a participant knew their partner, results may be altered if familiarity led to an increase in competitiveness. Further research is needed to investigate the impact of familiarity on intensity selection. Furthermore, to collect data for PAP, the number of researchers were doubled to ensure no cross contamination of blood samples, this increase in researchers may have distracted participants during blood sample collections. Specifically, individuals' assessments of internal fatigue may have been diminished as a result of an increased number of people in the room during the trials. Lastly, a priori power analysis was based on differences between perceived duration as the primary dependent variable however, findings of the present study found no significant differences between estimates of perceived duration and therefore it is plausible that the study was slightly underpowered for this outcome.

5. Conclusion

In conclusion, little is known about the influence of an exercise partner on intensity selection and exercise enjoyment during a virtually led cycling class with and without an exercise partner. Results indicate that the inclusion of an exercise partner during a virtually led cycling class has no impact on intensity selection but has the potential to decrease acute RPE-O, RPE-L, and RPE-B estimations vs. a virtually led cycling class alone. However, cycling alone seemed to improve feelings of gratification and invigoration vs. virtually led cycling classes with a partner. Results suggest inclusion of an exercise partner during a virtually led Spin class may decrease perceived exertion and perceptions of time spent exercising. Based on previous work, [32,33,34] these results could led to increased exercise duration and participation as individuals may feel better about their effort. Future research should investigate the effects and interactions of peer familiarity on intensity selection, perceived duration, and exercise enjoyment.

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