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Virtual and live social facilitation while exergaming: Competitiveness moderates

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ABSTRACT

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This study evaluated the effects of virtual and live social facilitation on exercise behavior using a cybercycle, a virtual reality-enhanced stationary bike, with 3D scenery and interactive races. Research has shown that social presence can enhance performance (Zajonc, 1965). Research with the cybercycle found that more competitive participants increased exercise intensity with the introduction of a virtual competitor (Snyder et al., 2010). The current study extended the prior experimental design by comparing virtual with live social presence. After training to ride the cybercycle, female college students rode in the presence of a virtual rider and live rider (randomly ordered); a gender-matched confederate adjusted performance to keep the level of challenge in both conditions consistent. It was hypothesized that more competitive riders would exhibit greater exercise intensity (watts) in the virtual vs. live condition. Competitiveness, mood and exercise attitudes were measured. Results from 23 female participants indicate that competitiveness moderated exercise effort, such that more competitive riders rode more intensely in the presence of a virtual vs. live competitor ($p=.04$). Implications suggest that for more competitive persons, exercising with a live competitor yields greater exercise effort and may be recommended for maximizing the benefit of workouts.

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INTRODUCTION

Several theories, such as the theory of social facilitation (Allport, 1924), social comparison (Festinger, 1954) and objective self-awareness theory (Duval & Wicklund, 1972), have been developed to explain exercise behavior in the presence of others. These theories hold that the social presence of others causes individuals to evaluate and adjust their exercise performance in response to those individuals within their social environment. Gajadhar et al.(2008) tested the concept of social facilitation by evaluating players in a video game experience in different social settings: virtual play (playing against a computer), mediated play (playing against another human, but in different places), and co-located play setting (playing against another human in the same place). The results found that social presence significantly increased from virtual to mediated and to co-located settings, with the most change in behavior being observed in the co-located condition. It has also been suggested that competitive environments fostered by social facilitation enhance performance on motor tasks (Zajonc, 1965), while other studies have found that competitive environments lead to negative effects on individuals self-efficacy and can hinder exercise performance (Ginis, Jung & Gauvin, 2003). This study will aim to build upon this previous research to see if the alterations in video game behaviors as a function of competing against a live or virtual competitor are also observed when applied to an exercise setting, and will assess how a competitive personality trait can further explain any noticeable changes in behavior.

Theory Background

Over the last century, numerous theories have been proposed to explain how the social presence of another individual in one's personal surroundings can elicit noticeable changes in behavior. Three theories in particular that have undergone a vast amount of research in recent literature are the theories of social facilitation, social comparison, and objective self-awareness. While all of these theories present research to exemplify how social presence can either strengthen or hinder task performance, each theory provides a unique explanation for the underlying factors that result in such behavioral changes.

Dating back to 1898, social facilitation was one of the first theories proposed to describe how behaviors are altered as a result of one's social environment. At the time, researcher Norman Triplett was studying exercise performance on a bicycle riding task and noticed that there was a visible change in participants behaviors when they were riding with another individual compared to when they were riding alone. He observed that participants rode faster by as much as 25% when competing against a pacemaker versus when they were riding alone (Triplett, 1898). This finding allowed him to propose that the social presence of another individual when completing an exercise task sharpens one's competitive instincts, which causes one to alter their behavior in an effort to outperform the other individual. Zajonc (1965) further elaborated on this with his generalized drive hypothesis, which argues that the presence of another individual increases one's innate internal drive and activation level and allows individuals to respond to any actions by others, both expected and unexpected. Other evaluative approaches have been formed to provide possible explanations for how social presence causes changes in behavior, including explanations relating to alertness (Zajonc, 1980), monitoring (Guerin, 1983), and challenge and threat (Blascovich et al., 1999).

While researchers such as Triplett (1898) and Moore (1917) are credited as the first to report findings from studies where individuals had to perform tasks in front of and alongside of other individuals, it wasn't until research conducted by Allport in 1924 that the term social facilitation was first coined. At this time, the formal definition of social facilitation became "an increase in response merely from the sight or sound of others making the same movement (Allport, 1924). Similar to Triplett, Allport studied individuals in coacting situations, where two or more individuals were performing the same exact activity. However, experimental concerns caused researchers in later years to alter the way social facilitation was studied. In coacting settings, it is challenging for the effect of an audience to be studied independently from other social factors, such as competition. Therefore, researchers were looking for a way to measure the 'pure' affect of an audience. From the 60s onward, many researchers instead took the approach of evaluating how people modify their behavior simply due to the presence of others, without having those individuals within one's social environment exhibit any specific behavior (Zajonc, 1980; Strauss, 2002).

Similar to the theory of social facilitation, the theory of social comparison also holds that the presence of others elicits a change in one's behavior, but instead argues that this change results from individuals making personal comparisons between their own abilities and those of the individuals in their social environment. This theory was first proposed by Festinger (1954) and has since undergone many modifications. Instead of solely being influenced by the mere presence of others, social comparison argues that the presence of others causes a chain of reactions whereby an individual appraises and evaluates their own abilities in comparison with individuals in their environment, and

then alters their behavior accordingly. The initial claim presented by Festinger (1954) argued that human organisms exhibit this natural tendency to make comparisons between themselves and others and actively select those who they compare themselves against. Unlike the theory of social facilitation which focuses on the innate biological influences affecting behavior, social comparison relies more on the cognitive influences that shape behavior.

Newer research on social comparison has broken away from the initial restricted focus of Festinger's theory and instead has presented many different paradigms and approaches. Early research following Festinger's study did not unequivocally focus on the comparison of opinion and abilities, but instead focused on individual's responses to stress and uncertainty. Wheeler (1966) was the first to propose the drive upward theory, which states that individuals prefer to compare themselves against others whom they deem as being better than themselves. It was argued that such comparisons can be informative to an individual and can result in goal pursuits and positive effects on behavior. Brickman and Bulman (1977) in response argued that comparisons against superior individuals can also be harmful and threatening, which lead Wills (1981) to propose a downward comparison theory, whereby individuals compare themselves against others who they believe to be worse off in an effort to improve their own well-being. While all of these alterations propose different stances on the theory of social comparison, they all agree with the general point that individuals have a natural tendency to process their cognitive evaluations in a manner whereby they compare and appraise their own abilities against those in their social environment, which as a result leads to changes in behavior to fit the comparisons being made (Festinger, 1954).

The newest of the three theories, objective self-awareness also involves the use of comparisons as a motivating factor for behavioral changes. This theory, first proposed by Duval and Wicklund (1972), involves the orientation of conscious attention inward on the self and promotes self-evaluation against set standards. While the theory of social comparison involves a similar form of comparison against others, the theory of objective self-awareness proposes a greater degree of attention on self-evaluation and one's knowledge of themselves as a person and how their behavior compares to pre-determined standards. In this theory, behavior is altered in an attempt to alleviate any discrepancies that may exist between the self and societal standards (Silvia & Duval, 2001). While individuals can change their behaviors to restore consistency, others can engage in avoidance behavior, which all together terminates the comparison process and any self-evaluation. Though the initial theory of objective self-awareness has undergone modifications since its initial proposal, such as whether focus should be placed on changing the self or the way that particular standards are perceived (Dana et al., 1997), the core of this theory remains largely unchanged.

Presence and Behavioral Changes

As the theories of social facilitation, social comparison, and objective self-awareness all highlight, there are countless explanations for how the presence of others in one's social environment can greatly influence one's behavior. As highlighted by Triplett (1898), the presence of others can increase task performance, which was observed when participants exerted a greater degree of effort on a bicycle riding task when riding with a pacer compared to riding alone. Previous research has suggested that

these changes may be due to increased arousal (Thiessen, 1964) and adrenocortical activity (Mason & Brady, 1964). Rhea et al. (2003) observed similar findings on a weight lifting task that evaluated how performance was influenced by the presence of an audience, where college students were instructed to lift weights in coacting, audience, and competitive settings. Findings indicated that the audience setting, along with the competitive setting, resulted in the greatest degree of change and improvement in participant behavior compared to the coacting setting alone. MacCracken and Stadulis (1985) obtained similar results on a balance motor task, and even found evidence to suggest that the strengthening of performance in response to the presence of an audience even increases as a factor of age. It appears that social presence can lead individuals to alter their performance in an attempt to demonstrate competence (Bond, 1983).

Similarly, the effect of social presence on behavior has also been found to be influenced by the nature of individuals that are within one's social surroundings. As exemplified in a study by Plante et al. (2010), the perceived fitness level of an exercise partner was found to have an influence on the amount of effort that an individual put into an exercise task. Researchers were interested in learning whether participants would be inclined to mimic the behaviors of individuals in their social environment with whom they could make social comparisons with. The researchers hypothesized that the level of effort exerted by participants would match the perceived fitness level of their partner. The testing conditions used included having participants ride a stationary riding bike by themselves, against someone of the same gender who was considered to be "high-fit" (wore athletic clothing and really exerted themselves), and against someone of the same gender who was considered to be "low-fit" (didn't wear athletic clothing or exert

themselves). Results found that participants in the high-fit condition had higher pulse rates and worked out harder than those in the low-fit condition. This showed that there is a tendency of individuals to change their behavior to be more like those around them. By working out against a fitness partner perceived as being high-fit, individuals experienced a greater change in their exercise behavior compared to working out against a low-fit partner, which allowed for a more positive experience where greater exercise benefits were achieved.

While social presence has been found to have influential effects on behavior, it is not always the case that such positive changes in behavior are observed. The affect that an audience and social presence of others has on an individual's task performance has been found to be largely dependent on whether the skill being tested for is a dominant or subordinate response. A dominant response refers to a skill that has already been acquired and practiced by an individual, while a subordinate response refers to a skill that is in the beginning stages of being learned. Zajonc and Sales (1966) found that performance on a verbal learning task was largely dependent on whether the stimulus words being tested for were highly trained or not. In this study, participants went through a training procedure to learn ten stimulus words, which were seven letter nonsense Turkish words. After the training period, the words were then flashed on a screen at high speeds, along with other random words that were not included in the training process, and the participants were asked to identify each word as it appeared. Half of the participants carried out this activity in a room by themselves, while the other half carried out this activity in a room where two confederates acting as students sat in the room. Findings from this study suggested that the stimulus words that were highly trained benefited the

most from the presence of an audience, with participants correctly identifying these words most frequently, while the stimulus words that did not undergo any training suffered in the presence of an audience, with participants incorrectly identifying these words the majority of the time.

In contrast to the previously discussed study, the opposite effect was found in a study conducted by Hollifield (1982), where performance on a well-learned motor task was hindered by the presence of an audience while performance on a novel task was enhanced. While such conflicting findings may be explained by the fact that one study tested verbal skills while the other tested motor skills, further research in this area still needs to be conducted to make more definitive conclusions about the differential affects of social presence on dominant and subordinate responses.

Social Presence and Mood

Whereas the social presence of individuals has been found to have impacts on behavior, social presence has also been found to influence one's mood as well. It has been observed that individuals who do not make comparisons between themselves and those in their social environment are much more positive in the perceptions of their performance compared to individuals who make social comparisons. In many cases, it has been found that social comparisons involve mindless generalizations that do not allow for an accurate understanding of the attribute in question (Langer et al., 2010). Therefore, when engaging in exercise behaviors, individuals need to be realistic about any comparisons that they make between themselves and those in their social environment.

Specifically, social presence in group exercise has been found to elicit different effects on one's mood. Many studies have found that exercising in a group setting improves individual's moods, regardless of the social context of the exercise (McAuley, Talbot, & Martinez, 1999; Plante, Coscarellil, & Ford, 2001; Plante et al., 2001). Other studies, however, have found the opposite effect (Newton & Russell, 2008). A different study conducted by Plante et al. (2007) found that women in particular were more likely to be calm when exercising alone versus tense when exercising in a group setting. Similar findings were found by Ginis et al. (2003) which evaluated women exercising in a mirrored environment versus a nonmirrored environment. When women could visually see themselves exercising they were found to have negative moods and feelings of self-efficacy compared to when they exercised in nonmirrored environments. These observations suggest that social presence in the exercise environment can have both beneficial and deleterious impacts on one's psychological well-being.

Exercise and Competition

Just as social presence has been shown to influence one's behaviors, especially in the realm of exercise behaviors, there are other factors that have a determining role as well, such as competition. As previously exemplified in the study by Rhea et al (2003), where participants conducted a weight lifting task in a coacting setting, an audience setting, and a competitive setting, it was found that being in a competitive environment fostered one of the greatest influences on participant behavior. Similar results were observed by Triplett (1898) when his research team observed that participants rode 25% times faster on a bicycle riding task when competing against a pacemaker compared to

riding alone, and Plante et al. (2010), who noticed that participants were more likely to alter their behavior when exercising alongside someone deemed as posing more of a competitive threat.

While competitive environments elicit changes in behavior, the presence of a competitive personality trait in individuals also impacts one's actions, as such a personality trait results in different kinds of motivational factors for engaging in behaviors. An extensive study by Van Lange et al. (1997) demonstrated that there are many factors that shape whether an individual displays prosocial, individualistic, or competitive orientations. The presence of each type of orientation shapes the behaviors that are displayed throughout one's everyday life, and largely determines how an individual will behave when in the presence of others. In this study, researchers evaluated many different variables and how they relate to the formation of a competitive personality, with the most focused upon being attachment style and the number of siblings a participant had. A variety of decomposed games were enlisted to measure each of these variables, where participants had to make point rankings between themselves and a stranger in different scenarios. It was observed that individuals who had more secure attachment styles and a greater number of siblings displayed prosocial orientations, while the opposite was found for individuals with competitive and individualistic orientations. These findings indicate that the early stages of an individual's life are fundamental in shaping to the degree of a competitive personality that an individual exhibits.

The presence of a competitive personality trait furthermore influences one's intrinsic and extrinsic motivations related to exercise, and determines how likely it is that an individual will engage in exercise behavior and for how long they will adhere to an

exercise routine. There are many different models used in the psychological literature that address the influences of motivation on exercise behavior, with the Self-Determination Theory (SDT) being one of the most studied models. This theory describes how human behavior is motivated by the three primary psychological needs of autonomy, competence, and relatedness, and how these needs combine to produce intrinsic motivation (see Figure 1; Deci & Ryan, 1985). Intrinsic motivation refers to motivation that comes from inside an individual rather than from any external or outside rewards, such as money or grades. SDT argues that individuals are more likely to engage in behaviors that have a high level of self-motivation and evaluates how intrinsic motivation influences exercise behavior. The Cognitive Evaluation Theory, a sub-theory of SDT, in direct contrast, looks at extrinsic motivation and how factors such as reward and competition are incorporated in one's sports behaviors (Ryan & Vallerand, 1984).

A study conducted by Frederick-Recascino and Schuster-Smith (2003) specifically looked at intrinsic motivation and its role in participants physical activity in a competitive environment. In this study, researchers had participants ride a stationary exercise bicycle either in a competitive situation or a non-competitive situation, and then used different scales to measure intrinsic motivation. It was found that those riding in the competitive situation reported lower levels of intrinsic motivation. These results provided evidence to support the cognitive evaluation theory and indicate that certain competitive situation may undermine intrinsic motivation whereby individual do not enjoy the exercise task they are engaging in and are less likely to adhere to the behavior. Similar results were found by Valerand et al. (2001), whose results also illustrated that exercising in competitive situations resulted in lower levels of intrinsic motivation. Such

results exemplify that competitive environments in some cases can be detrimental to individuals who exercise for the sole purpose of enjoyment.

A recent study conducted by Song et al. (2010) further evaluated the effects of a competitive environment on intrinsic motivation, but instead tested a form of exercise called exergaming, which combines traditional exercise measures with video game elements. In this study, participants were placed into either a high or low competitive group based on their individual competitive personality trait (highly competitive vs. lowly competitive) and were each then asked to play a Hula hoop game on the Nintendo Wii Fit in a competitive or non-competitive environment, where they could see the performance of a confederate on a video screen. Results found that participants in the low competitive conditions played the game for a longer duration of time compared to participants in the high competitive conditions. Interestingly though , participants with competitive personality traits enjoyed exercising in the competitive environment, while lowly competitive participants felt worse and enjoyed the activity less. Song et al. (2010) argued that their results challenged the findings observed by researchers such as Frederick-Recascino and Schuster-Smith (2003) and Valerand et al. (2001) regarding intrinsic motivation in competitive settings, and proposed that competition does not always have the deleterious effects on intrinsic motivation as previously found. Such studies exemplify how the presence of a competitive personality trait largely influences the enjoyment that one has when performing an exercise task in a competitive environment. While competitive individuals may thrive in such settings, the same cannot be said for those individuals who do not have competitive natures.

Combining Exercise and Video Gaming: Exergaming

As exemplified by the previously discussed study by Song et al. (2010), there has been a recent trend in the exercise community to combine traditional forms of exercise with video gaming (Lieberman, 2009; van Schaik, Blake, Pernet, Spears, & Fencott, 2008). Research into the combined effects of video gaming and exercise, exergaming, has drastically increased to evaluate whether this pairing can have more beneficial effects on health, both physically and mentally, than traditional exercise alone. In recent years, society has witnessed a drastic increase in the popularity of video games, and in many cases, video games have been blamed for the lack of physical activity among today's younger generation and the rise of obesity.

While some studies have found that the integration of video games into exercise equipment in an effort to produce visually stimulating exercise experiences has resulted in greater improvements in self-efficacy and mood, as well as promoting adherence to exercise behaviors (McAuley et al., 1999), others have not found similar results. Plante et al. (2003) found evidence to suggest that levels of energy and mood were not increased in virtual reality exercise environments, and instead were only increased in traditional exercising environments. In conjunction with these findings, Russell and Newton (2008) were also interested in the psychological effects of interactive video game technology exercise on mood and attention and similarly did not find any immediate effects on participant's moods in the interactive conditions.

This has lead many researchers to ponder what factors can allow video games to be more easily integrated into the exercise experience that will allow them to produce more beneficial effects on physical and mental health. Timpka et al. (2004) employed a

qualitative research method for studying the associations between computer game components and emotional experiences in adolescents to be better understand what makes video games so appealing to today's generation. Participants in the study were asked to play a specific computer game, Max Payne, and were interviewed at key points during their playing experience to answer questions relating to their behavior, knowledge, and attitudes and understandings of the game they were playing. The responses yielded allowed for the researchers to propose a model of four components that are critical to video game enjoyment: gameplay script, narrative, technical spectacle, and narrative space. Within these components, it was found that the amount of challenge and competition within the video game were central motivational factors for enjoyment, with spectacle features adding excitement to the game.

Hartmann and Vorderer (2003) further looked into the role of competition in video game enjoyment in an effort to propose how this variable could be combined with traditional exercise. Through responses from an online survey completed by "gamers", it was found that competitive elements in video games have a considerable affect on the emotional state of players, which can lead to a euphoric experience of enjoyment and an increase in the motivation to continue playing a game. This motivational factor gained from the competitive experience in many cases correlated with the general amount of time that gamers spent playing a particular video game, and highlights the importance of competition in adherence to video game activities, and suggests that this factor is crucial into the successful integration of video games into the exercise experience.

Exergaming and Avatars

When combing video gaming with traditional exercise, competitiveness experienced in this gaming type of exercise often takes the form of onscreen avatars, or virtual competitors, that appear on an individual's computer screen to compete against when carrying out an exercise activity. Avatars are considered to exhibit spatial presence, or a "psychological state in which virtual objects are experienced as actual objects in either sensory or non-sensory ways (Ravja et al., 2005)." However, the question arises as to whether the presence that avatars take, whereby the avatar represents a virtual computer generated individual or represents an actual live human being, influences the effect that avatars have on behavior. Timpka et al. (2004) found that in many cases children and adolescents do not believe that the avatar they are competing against in a video game resembles an individual deemed as being 'alive' and they are easily able to discriminate between live and virtual worlds, with such findings suggesting that the degree of spatial presence is fundamental in determining how an individual responds to the occurrence of an avatar.

The spatial setting of an avatar largely influences the amount of social presence felt by individuals competing against them. Gajadhar et al. (2008) had participants compete against an avatar in three different spatial settings: virtual play, mediated play, and co-located play. Virtual play referred to playing against a computer, mediated play referred to playing another human that was in a different place, and co-located play referred to playing against a human in the same place. It was found that the level of social presence significantly increased from virtual to mediated to co-located, indicating that the greatest effect of social presence was achieved when playing against an actual human versus playing against a computer generated model.

Likewise, the nature of an avatar has been found to elicit different emotional responses in participants. Ravaja et al. (2005) found that the type of spatial presence exhibited by an avatar impacted observed levels of arousal and attention in participants. In this study, participants played the same video against a computer, a friend, and a stranger. Results showed that players felt a higher social presence when they were competing against human competitors compared to when they were playing against a computer generated competitor. Differences in spatial presence were found to elicit different impacts on player's levels of arousal, with a heightened level of arousal being observed when competing against a true individual versus a computerized individual. It was hypothesized that this difference could be attributed to the feeling that a live human presents more of a threat than a computer generated individual. This suggests that the nature of the opponent, or avatar, being competed against influences the degree of spatial presence that is experienced.

Current Study:

In taking all of the present literature into consideration, the current study aims to assess the effects of social presence on exercise behavior, focusing in particular on the role of virtual versus live social facilitation. In particular, the current study is an expansion to a previously conducted study, the Cybercycle Study (Anderson-Hanley et al., 2010), which measured cognitive improvements in older adults after completing an exergaming task over a two year clinical trial. Data from this previous research in our lab has found that highly competitive older adults exhibited greater exercise intensity when competing against a virtual avatar, compared to exercising alone (Snyder et al., 2010).

The current study will expand upon these previous results and further assess the role of personality and its influence on exercise behavior. Specifically, the experimental design of the current study will evaluate the differential effects of completing an exergaming task in the presence of both a virtual and live competitor, and will measure how the amount of effort exerted on the exercise task changes as a function of these different social presence conditions.

Previous research suggests that exercising in the presence of others can produce a profound increase in exercise behaviors exhibited (Triplett, 1898; Rhea et al., 2003; Plante et al., 2010). The literature also suggests that competitive environments foster changes in exercise behavior based on how these environments influence one's intrinsic motivations for engaging in an exercise task (Frederick-Recascino & Schuster-Smith, 2003; Song et al., 2010), and also suggests that the presence of a competitive personality trait plays a large determining factor in this relationship as well (Van Lange et al., 1997; Snyder et al., 2010). The current research aims to expand upon this previous literature and add new insight into this area of research by examining the differential effects of virtual versus live social facilitation on exercise behavior.

Hypotheses:

It is expected that:

1. Participants will exhibit a noticeable increase in exercise intensity when competing against a live human rider compared to a virtual rider (avatar) on a bicycle riding exercise task.

2. The presence of a competitive personality trait may play a factor in the relationship observed between virtual and live social presence and exercise behavior.

METHODS

Participants

To test the hypotheses, a within subjects experimental design was employed. The 23 participants tested were female college students ages 17-22 attending Union College. Participant recruitment was achieved by posting details about the study on an online website (http://freud.union.edu) where students could register to complete the study for either course credit or monetary payment. Prior to collecting data, the study was approved by the Union College HSRB. Informed consent was obtained from each participant stating that they believed themselves to be in the physical condition needed to carry out the exercise activity utilized in the study. All participants were told that they could terminate their participation in the study at any time, especially if the exercise activity began causing them any discomfort.

Measures

3 Month Physical Activity Questionnaire

The 3 Month Physical Activity Questionnaire was used to obtain a baseline measure for the amount of physical activity engaged in by participants on a daily basis over a period of time prior to participating in the study. This measure categorizes 15 different forms of physical activity (e.g. walking, jogging, swimming laps, etc.) and asks participants to indicate how many sessions they engage in per week for each activity and

for what length of time. This questionnaire was used as a means for differentiating between physically active versus inactive participants in an effort to determine whether their baseline physical activity level acted as a confounding variable on their exercise performance in each of the different testing conditions.

The Competitiveness Index (CI)

The Competitiveness Index (Smither, 1992) was used and presented participants with items relating to their interpersonal competiveness in everyday contexts. This measure assesses factors of Emotion, Argument, and Games (Houston, Farese, & De Lu, 1992) and predicts competitive behaviors and task satisfaction in conflict situations. Participant responses were used to determine the presence of a competitive personality trait, classifying participants as either having a low or high competitive personality. 20 different statements, such as "Games with no clear cut winners are boring", "I enjoy competing against an opponent", and "I find competitive situations unpleasant", are presented on this scale. Participants were asked to indicate whether each statement was true or false about their personality. When scoring the questionnaire, all items have equal weighting, with possible scores ranging from 0 to 20. Although no firm cutoff scores have been established, CI scores of 14 or above can be considered high scores for women, with low scores starting at 6.

Exercise-Induced Feeling Inventory (EIFI) Scale

The EIFI was used to determine participant's psychological mood state immediately after completing an exercise task. There are 11 different mood states indicated (e.g. calm, energetic, revived, etc.) and participants were asked to rate each

item on a likert scale ranging from one (1) to five (5) indicating to what extent each word described how they felt at that particular moment. A score of one indicates 'Do not feel' while five indicates 'Feel very strongly.'

Flow State Scale

The Flow State Scale (Jackson & Marsh, 1996) was used to determine whether participants reached a mental state in which they were fully immersed in a feeling of energized focus, full involvement, and success on the exercise activity that they were completing. This likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), has 36 items and asked participants to indicate how each item described how they felt at that particular moment. Some items on the scale included "My attention was focused entirely on what I was doing", "The way time passed seemed to be different from normal", and "I performed automatically." The responses were used to reveal how absorbed participants became in the exercise activity, as the virtual gaming element of the equipment being used is believed to aid riders in reaching such a mental state.

Procedure

As noted above, participants for the study were recruited through the use of an online website that was specific to students of the Union College community. Details about the study, such as the duration of each testing session, were presented on this website so that students could determine whether they wanted to participate, and if they fit the criteria for participation. Only female students were allowed to register for the

study. Participants were given the option to either receive course credit or monetary payment for their participation.

Upon registering for the study, participants were instructed to go to the Neuropsychology Lab at Union College. Once they arrived, participants were asked to read and sign an informed consent, which described the aims and purposes of the study, along with their rights to withdraw from the study at any time. Participants were then asked to fill out the 3 Month Physical Activity Questionnaire and the Competitiveness Index. Once these forms were completed, each participant was then given instructions about how to use the Cybercycle that they would be riding while participating in the study. Details about the images on the computer screen were explained in detail, along with giving demonstrations for how to properly steer the bike and change the gears. The same one (1) mile speedway course was used in all of the different testing conditions described below. Participants were instructed to take water and stretch breaks after each testing session to decrease any discomfort that may result from riding.

Testing was conducted over two (2) 30 minute testing sessions. Participants only filled out the 3PAQ and CI during their first testing sessions. At the beginning of each session participants were given instructions on how to properly ride the bike, after which the participants then completed a training session on the bike. Each session began with the training session. In this condition, the participants were asked to simply ride the Cybercycle without the presence of any virtual riders or confederate riders in the testing room. They were simply becoming familiar with the bike and racing for their own best time on the course selected for the study.

Following the training session, participants were then randomly assigned to what order they would complete one of the two remaining testing conditions. Since the study was divided between two different testing periods, each lasting 30 minutes, whichever course the participants didn't ride in their first session was completed in their second session. The two remaining conditions included virtual presence and real/actual presence. In the virtual presence condition, participants were asked to ride the Cybercycle while in the presence of an avatar that appeared on their computer screen. The presence of the ghost rider on the screen was clearly visible so that participants had a marker for who they were racing against. Participants were told that the avatar was a rider generated by the company that designed the Cybercycle. Participants were unaware that the avatar was actually a confederate rider riding another Cybercycle in a room that was hidden from them. The presence of the confederate rider was not revealed, so that participants mentally allowed themselves to think that they were racing against a computer generated competitor, as opposed to a live person. The confederate used in this condition was also the same confederate used in the live/actual presence condition. This was used as a control measure.

In the real/actual presence condition, participants were asked to ride the Cybercycle while another individual (confederate) rode on a bike set up next to them. The bikes were separated by a two-way mirror, which allowed for the participant and confederate to see one another while riding. The confederate's bike was inter-connected with the participant's bike, allowing the confederate to appear on the participants screen while they were racing. Compared to the virtual presence condition, where the participants were told that they were competing against a computer generated avatar,

participants in this condition knew that the marker they were racing against on their screen was the confederate on the bike next to them. In both the virtual presence and real/actual presence conditions, the same gender matched confederate was used. The confederate rider altered their exercise performance with each participant so that their performance was similar to the participant that they were racing against, in an effort to control for different riding abilities between all participants.

After each riding session, the EIFI and Flow questionnaires were administered to see how each condition influenced participant's moods and mental states. This information was used to determine what factors may affect any differences observed in the intensity with which participants rode in each testing condition. To measure any change in exercise behavior, recordings of the miles, minutes, watts (intensity), heart rate, and miles per hour from each riding session were captured on the internal computer software of the Cybercycle exercise bikes that the participants rode while completing the study. This information was retrieved from the bikes after each testing session and was recorded so that the data could be used in an effort to analyze any behavioral changes of the participants when in each of the different testing conditions. At the close of the study, each participant was debriefed and provided with a brief explanation of the study and invited to ask any questions that they might have had.

RESULTS

High and low competitive samples did not differ significantly on baseline physical activity levels. Repeated measures ANOVA was conducted to test the research hypotheses. Results indicate that there was a significant condition x competitiveness

interaction. It was found that competitiveness moderated exercise effort, such that highly competitive riders rode more intensely in the presence of a live versus a virtual avatar, $F(1,20) = 4.815$, $p=.04$. Participants found to have lower levels of competitiveness exerted slightly more intensity in their riding in the virtual condition compared to highly competitive participants (M=114, SD=30; M=111, SD=27.7). Highly competitive participants exerted much more intensity when riding in the real condition compared to participants with lower levels of competitiveness (M=130, SD=22; M=110, SD=22). Repeated measures ANOVA indicated that there was a significant change in behavior for participants with lower competiveness when riding in the solo condition compared to the virtual condition. Exercise intensity for these participants drastically increased in the virtual condition, such that greater intensity was exerted, $p = .008$. T-test analysis on the EIFI and Flow measures found few significant findings on the tested sub-scales, see tables 3-6. Analysis show no significant differences between the order of condition presentation, $p=.92$. No significant differences in the time between condition presentation were found, $p=.08$.

DISCUSSION

Society today has witnessed a drastic decrease in the number of individuals engaging in daily forms of exercise. Specifically, the younger generation of today has greater instances of obesity and diabetes compared to previous generations (Neumark-Sztainer, Story, Hannan, Perry, & Irving, 2002). One explanation for why individuals are not engaging in a healthy amount of exercise is attributed to the fact that many individuals simply do not find exercising to be enjoyable (Stucky-Ropp & DiLorenzo,

1993; DiLorenzo, Stucky-Ropp, Vander Wal, Gotham, 1998). However, a new movement in exercise is aiming to find ways to make exercising more enjoyable, in an effort to entice individuals to become more physically active. Exergaming, which is the combination of traditional exercise measures with video games, is a novel approach to exercise that is on the rise (Lange et al., 2010; Lieberman, 2009; van Schaik, Blake, Pernet, Spears, & Fencott, 2008). Since video game use has been found to be correlated with weight status, especially in youth, virtual-reality enhanced exercise has been prescribed in an effort to increase exercise interest among those individuals who spend large amounts of time playing video games, instead of engaging in daily forms of physical activity (Vandewater et al., 2004).

Specifically, components of exergaming allow for individuals to introduce different features into their workout, such as competing against a virtual avatar. Previous research on the theory of social facilitation has found that exercising in the presence of others influences observed behaviors (Triplett, 1898; Allport, 1924; Zajonc, 1965) , leading to the question of how a virtual competitor can influence behavior on an exergaming task. Snyder et al. (2010) further found that personality influenced changes in behavior on an exergaming task, such that highly competitive participants exerted more effort into an exergaming task when in the presence of a virtual avatar. The sense of presence between a virtual versus a live competitor is typically found to be strongest for a live competitor (Ravaja et al., 2055), but no studies to date have evaluated the differential effects of virtual and live social facilitation on an exergaming task.

The current research expands upon these previous findings and further explores the combined effects of social facilitation and personality on exercise behavior,

specifically differentiating between virtual and live social facilitation. The hypothesis tested for was that a greater change in exercise intensity would be found when competing against a real competitor, compared to a virtual competitor. It was further hypothesized that a personality factor, namely competitiveness, would also moderate behavioral changes. While the hypothesis that a competitive personality trait would moderate behavioral changes was fully supported, the hypothesis regarding changes in exercise behavior in the presence of a live versus a virtual competitor was only partially supported.

Overall, the findings highlight that there is an effect of social facilitation when completing an exergaming task. As has also been found in previous literature, individuals were found to exert more effort into an exercise task when in the presence of others, albeit a virtual or live competitor, as opposed to exercising alone (Rhea et al., 2003; Plante et al., 2010). Further, the results support previous findings that personality plays a role in this relationship as well (Snyder et al., 2010). The current research expanded upon these previous findings by evaluating the role of personality with respect to different conditions or social facilitation, namely virtual and live.

As evidenced, participants found to be highly competitive exerted the most intensity into their workout in the presence of a real competitor, compared to a virtual competitor. Interestingly, participants who were found to have lower levels of competitiveness exhibited the greatest increase in their riding intensity when changing from riding alone to competing against a virtual rider, with no noticeable increases in their riding intensity when competing against a live rider. While the behavior of the highly competitive participants fully supported our hypothesis that there would be an

increase in riding intensity in the presence of a live rider, the behavior of the lower competitive individuals did not support the hypothesis, as they did not show the greatest increase in the presence of a live rider, but instead a virtual rider. These results suggest that personality influences behavioral changes when in the presence of others, while also suggesting that personality moderates what type of competitor elicits the greatest influence on observed behavior.

The interesting change in exercise behavior for participants with lower levels of competitiveness may indicate that there was another factor that influenced the exercise behavior of these participants when riding against a live competitor. Research on video games has found that a greater level of threat is felt when competing against a live competitor compared to a virtual competitor (Ravaja et al., 2005). When taking our results into consideration, it can be speculated that a competitive personality trait influences how individual perceive threat, thus influencing how they react to such threat. Whereas highly competitive individuals may excel in such situations, the performance of individuals with lower levels of competitiveness may be hindered.

Further, the drastic increase in exercise intensity of the lower competitive participants from the sole riding condition to the virtual condition may suggest that these individuals might not naturally exert a great amount of intensity into their workout unless they have a marker for someone that they should be riding in pace with. As our results suggest, participants exerted more intensity into their workout when they moved from riding in the solo condition to the virtual condition, thus in a way catching up to the avatar, which brought their exercise intensity to a similar level as those participants deemed as being highly competitive. Therefore, while highly competitive individuals

naturally exert a greater amount of intensity into their workout, even when riding alone, it can be suggested that participants with lower levels of competitiveness need to be motivated by the presence of a competitor.

The current study also evaluated the influence of virtual and live social facilitation on mood, though no significant findings were found. Regardless of whether participants rode in a virtual or live condition on an exergaming task, there were no significant changes in mood, as measured by the EIFI. While some studies have demonstrated that virtually enhanced exercise can result in greater improvements in self-efficacy and mood (McAuley, Talbot, & Martinez, 1999; Plante, Coscarellil, & Ford, 2001; van Schaik, Blake, Pernet, Spears, & Fencott, 2008), our results are consistent with previous literature that has suggested that virtual exercise does not result in any short-term psychological effects on mood (Russell & Newton, 2008), and suggest that traditional forms of exercise produce the greatest effects on mood. Interestingly, research has demonstrated that females are less likely to show improvements in mood after completing an exergaming task, as they have been found to be tenser than males in such situations (Plante et al., 2003). Since the current sample was entirely composed of females, this may help to explain why no noticeable changes in mood were observed.

Further, the current study also evaluated whether virtual or live social facilitation influenced participant's abilities to reach a state of FLOW. This state is achieved when participants are fully immersed in a feeling of energized focus, full involvement, and success in the process of completing an activity (Jackson & Marsh, 1996). Specifically, research has demonstrated that individuals engaging in an exergaming task are more likely to experience a state of flow (Thin, Hansen, & McEachen, 2011). However, our

results did not support this finding. Numerous factors could account for this. Firstly, the course selected for our study was short in length, which may have prevented participants from having enough time to research such a state. Secondly, flow is usually achieved when individuals complete a task that they find to be personally enjoyable. Perhaps for the participants in our sample, the exergaming task selected for the study did not provide the necessary amount of personal enjoyment needed to reach such a state.

However, it should be noted that slight differences on the sub-scales of the FLOW measure were observed when participants rode in the virtual condition compared to the live condition, such that slightly higher levels were found in the virtual condition. This may suggest that when participants were in the virtual condition, they were able to be more focused on the exercise task, whereas they were slightly distracted in the live condition by the sight of the confederate rider next to them, which did not allow them to become as focused. As mentioned these noted differences in FLOW between the virtual and live conditions were slight, and should be subjected to further research.

Implications

The major implication of the current research is that personality should be taken into account when prescribing exercise interventions. While some individuals may prefer group exercise, whereby they are exercising in the presence of others, some individuals may prefer to exercise alone. Further, the degree of presence of a competitor may also influence exercise behavior. While our study is in agreement with previous research that suggest that live individuals within our social surroundings influence our behaviors, our results also suggest that virtual competitors are just as likely to elicit behavioral changes as well.

As demonstrated by the current findings, participants found to be highly competitive benefited the most from completing an exercise task in the presence of a live competitor, whereas participants with lower levels of competitiveness displayed the greatest improvement in exercise performance when competing against a virtual competitor. These findings suggest that while all individuals should have the opportunity to perform an exergaming task, attention should be paid to how personality might influence one's overall experience. Since the motivation behind exergaming is to make exercising more enjoyable in an effort to increase adherence to an exercise routine, the influence of personality on enjoyment should be accounted for.

Limitations and Directions for Future Research

One important limitation of the current research is the generalizability of the sample used. Data was solely collected on female students at a private liberal arts college. The vast majority of participants tested were Caucasian (n=19), with only a few African Americans being represented in the sample (n=3). Therefore, an effort to test the current research question on a sample representing a more diverse ethnic group of participants should be carried out. In addition to a more diverse ethnic sample, attempts to evaluate the effect of personality on live and virtual social facilitation in a male population should be subjected to future research. To date, the current research and previous research have only evaluated this topic in female participants. Previous research has suggested that males and females respond differently when completing an exergaming task (Plante et al., 2003). Therefore, it would be interesting to see if there are any gender differences with respect to how the different sexes respond to a virtual versus

and live competitor, in addition to evaluating the role that personality plays in this relationship.

Secondly, another limitation of the current study is the environment in which the study was carried out. While exercise behavior was effectively measured, the study was not conducted in a true exercise setting, such as a gym, but was instead carried out in a controlled lab environment. Therefore, the nature of the environment could have influenced participant behavior since they were aware that there performance was being monitored and may not have acted as they naturally would be inclined to. However, the main difficulty with the experiment setup was due to the use of a two-way mirror in the condition where participants rode with the live, confederate rider. Due to the lighting in the lab it was oftentimes difficult for participants to clearly see the confederate riding in the room next to them. The structure of the bike also influenced the sight that participants had of the confederate rider. Since the exergaming bike used in the study was low to the ground, participants were only able to see the upper torso of the confederate rider, and were not able to see the confederate's legs while they were pedaling. Therefore, an effort should be make to conduct this experiment in an environment whereby the exergaming bikes can be in the same room, which will allow for participants to fully see the confederate's body movements while completing the exercise task.

Thirdly, technological difficulties proved to be another limitation of the study. During the course of the study the exergaming bike that was used to collect riding data malfunctioned, delaying the amount of time between a limited number of participant testing sessions. While most participants only had a week between their two testing

sessions, some participants had a delay of several weeks between their testing sessions (n=5), due to the lengthy time needed to repair the exergaming bike. While analysis was performed to assure that this time gap did not influence the overall research findings, it is worth noting that this significant delay in testing may have influenced the participant's behaviors in ways unknown to the current researchers.

In addition to addressing the limitations previously mentioned, future research should also aim to evaluate the influence of other personality factors on exercise performance. Previous research has found that personality traits, such as neuroticism, extraversion, and conscientiousness, are important sources of performance motivation (Judge & Illies, 2002). Therefore, it can be expected that such personality traits, like competitiveness, would also influence observed exercise performance when comparing virtual and live conditions. Efforts to measure intrinsic and extrinsic motivation should also be carried out, as motivations behind engaging in an exercise activity likely influence exhibited behavior on an exercise task.

Finally, future research should evaluate how the perceived fitness level of a competitor influences exercise performance. Research has suggested that the perceived fitness level of a competitor, such as whether they are perceived as being highly fit or lowly fit, influences behavior (Plante et al., 2010). Competitors who are perceived as being highly fit have been found to cause participants to exert more intensity into their workouts, compared to competitors perceived to be lowly fit. It would be interesting to alter both the appearance of the confederate rider, as well as the appearance of the virtual avatar rider. While the question of competitor perceived fitness level has been evaluated

using traditional forms of exercise, this question, to the best of our knowledge, has never been studied using an exergaming task.

Conclusion

As anyone can imagine, our social surroundings influence our behaviors, many times in ways unknown to us. When looking at exercise behaviors, countless factors influence our performance, such as the type of exercise used and the nature of our competitor. Further, personality traits, such as competiveness, add another layer to the puzzle of how individuals respond to different social stimuli. The current research supports previous findings that behavior noticeably changes when completing an exercise task in the presence of others, compared to when alone. Further, virtual and live competitors were found to elicit different changes in exercise behavior, with this difference being influenced by a competitive personality trait. More research should be conducted on the effects of personality and social facilitation to determine how exercise behaviors can be increased.

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Table 1. Participant Baseline Measures – Overall Sample

Variable	**Mean**	**SD**	
age	19.2	1.7	
educ	14.2	1.1	
ethnicity	78.2% Caucasian	17.4% African American	4.3% Hispanic
phys activity (MET)	49.1	36.7	
CI	12.0	3.9	

Table 2. Participant Baseline Measures – by CI score

		hi CI		**lo CI**		
		M	*SD*	*M*	*SD*	*p*
age		19.5	1.8	19.0	1.6	.52
edu		14.4	1.1	14.1	1.1	.54
MET		38.5	58.8	58.8	47.3	.19
Power	train	105.6	17.9	88.9	12.5	.05
	virt	108.8	28.1	115.9	34.5	.66
	real	124.9	20.7	115.0	21.0	.36
HR	train	138.3	19.1	142.4	15.0	.64
	virt	150.2	27.9	162.0	13.8	.41
	real	162.0	18.2	162.9	14.8	.93
MPH	train	13.9	1.38	12.7	.93	.06
	virt	14.1	1.97	14.5	1.92	.71
	real	15.1	1.3	14.5	1.29	.37

Table 3. EIFI Statistics by Condition

	Virtual		**Real**		
	M	*SD*	*M*	*SD*	*p*
positive energy	7.09	1.70	6.65	2.85	.50
revitalization	7.39	2.04	6.87	2.20	.26
tranquility	5.76	2.70	5.52	2.63	.83
exhaushtion	6.09	3.45	5.83	2.98	.85

Table 4. EIFI statistics by CI groupings

		hi CI		**lo CI**		
		M	*SD*	*M*	*SD*	*p*
Virtual	**positive energy**	6.4	1.6	7.7	2.1	.12
	revitalization	7.3	2.4	7.8	2.4	.63
	tranquility	4.8	2.7	6.0	2.4	.31
	exhaustion	5.9	3.4	5.7	3.4	.91
Real	**positive energy**	6.0	2.9	7.1	3.0	.41
	revitalization	5.8	1.8	7.6	2.3	.06
	tranquility	4.3	2.5	6.1	2.4	.11
	exhaustion	5.5	3.2	5.7	3.0	.87

Table 5. Flow Statistics for Virtual and Real Conditions

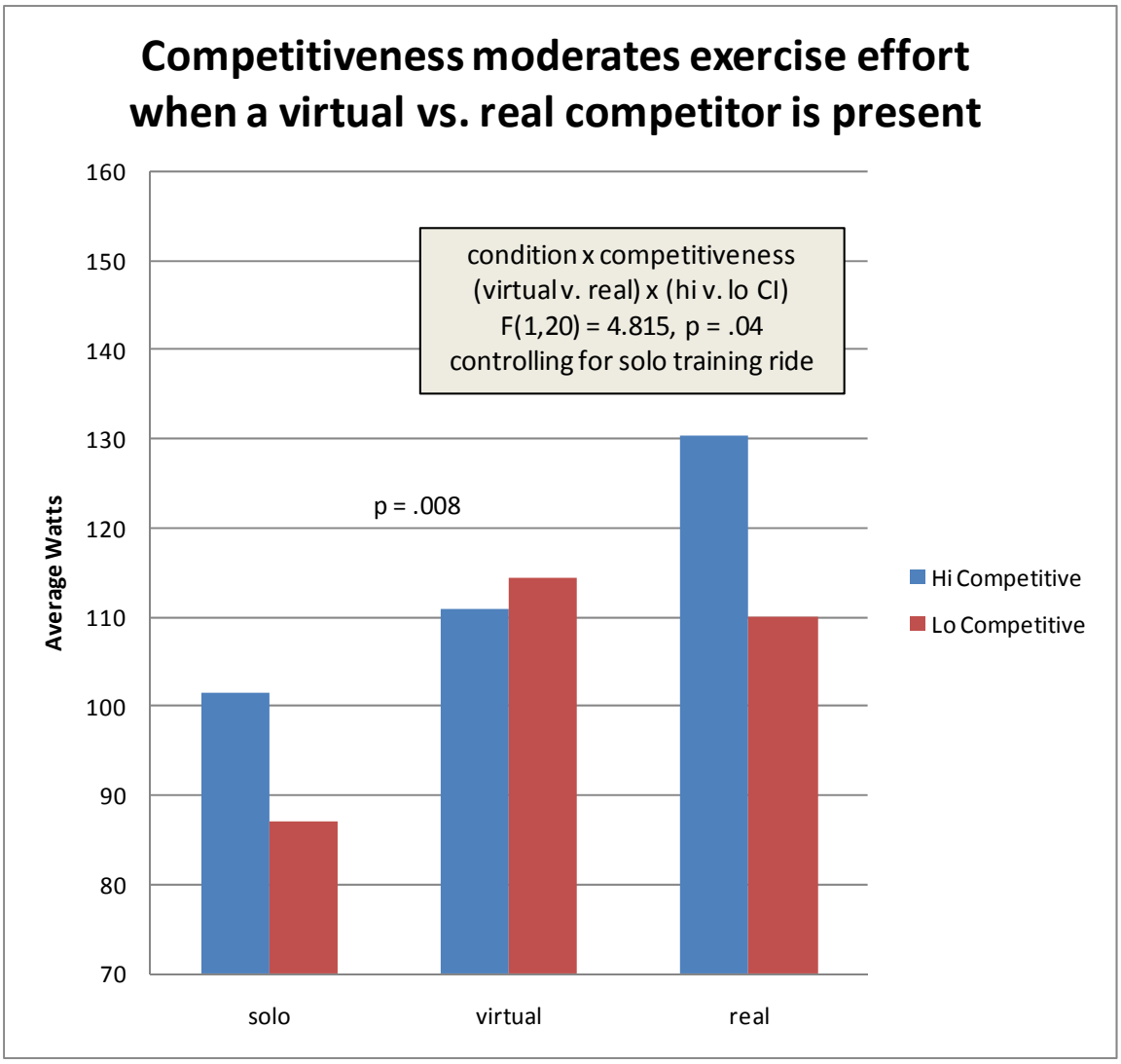
	Virtual		***Real***		
	M	*SD*	*M*	*SD*	*p*
autotelic	14.48	3.19	14.28	3.33	.90
clear goals	15.45	3.50	14.86	3.86	.66
challenge	13.70	3.10	14.13	2.90	.66
concentration	15.43	2.54	15.58	3.12	.78
control	13.35	3.63	13.26	2.93	.96
feedback	15.13	2.83	15.52	2.91	.61
action-awareness	15.99	3.13	15.91	3.37	.95
transformation	14.78	3.23	14.57	3.30	.85
loss self-consciousness	10.26	3.51	10.65	3.61	.71
overall FLOW	128.57	21.32	128.75	20.08	.91

Table 6. Flow statistics by CI grouping

		hi CI		***Lo CI***		
		M	*SD*	*M*	*SD*	*p*
Virtual	**autotelic**	13.5	2.4	14.9	3.8	.34
	clear goals	14.6	2.7	15.4	4.0	.57
	challenge	13.8	2.8	13.5	3.6	.85
	concentration	15.0	1.9	15.8	3.1	.53
	control	13.1	5.0	13.4	2.8	.86
	feedback	15.1	2.6	15.0	3.3	.93
	action-awareness	16.3	2.4	15.7	3.7	.67
	transformation	14.1	2.5	15.2	3.8	.48
	loss self-consciousness	11.0	2.3	9.9	4.4	.52
	overall FLOW	126.4	15.6	128.8	26.5	.82
Real	**autotelic**	14.4	3.4	13.8	3.7	.67
	clear goals	15.3	3.3	13.6	4.6	.32
	challenge	14.2	3.7	13.9	2.0	.84
	concentration	16.4	3.5	14.7	2.8	.24
	control	13.7	3.6	12.7	2.2	.47
	feedback	15.3	3.2	15.8	2.9	.75
	action-awareness	16.1	3.3	15.9	4.0	.90
	transformation	14.6	3.9	14.4	2.6	.93
	loss self-consciousness	11.4	4.0	10.0	3.4	.41
	overall FLOW	131.4	24.4.67	124.7	16.1	.48

Figure 1. Self-Determination Theory variables: autonomy, competence, and relatedness.

Figure 2. Mean changes in riding intensity for all testing conditions.



APPENDIX A. 3 Month Physical Activity Questionnaire

In this section we would like to ask you about your current physical activity and exercise habits that you perform regularly, at least once a week. Please answer as accurately as possible. Circle your answer or supply a specific number when asked.

1. For the last three months, which of the following moderate or vigorous activities have you performed regularly? (*Please circle **YES** for all that apply and **NO** if you do not perform the activity; provide an estimate of the amount of activity for all marked **YES**. Be as complete as possible.)*

Walking

NO YES → How many sessions per week? _____
How many miles (or fractions) per session? _____
Average duration per session? _____ (minutes)

What is your usual pace of walking? (*Please circle one)*

CASUAL or STROLLING (< 2 mph)	AVERAGE or NORMAL (2 to 3 mph)	FAIRLY BRISK (3 to 4 mph)	BRISK or STRIDING (4 mph or faster)

Stair Climbing

NO YES → How many flights of stairs do you climb **UP** each day? _____

Jogging or Running

NO YES → How many sessions per week? _____
How many miles (or fractions) per session? _____
Average duration per session? _____ (minutes)

Treadmill

NO YES → How many sessions per week? _____
Average duration per session? _____ (minutes)
Speed? ____ (mph) Grade? ____ (%)

Cybercycling

NO YES → How many sessions per week? _____
How many miles per session? _____
Average duration per session? _____ (minutes)

Bicycling (outdoor or stationary bike only – not cybercycle)

NO YES → How many sessions per week? _____
How many miles per session? _____
Average duration per session? _____ (minutes)

Swimming Laps

NO YES → How many sessions per week? _____
How many miles per session? (880yds = 0.5miles) _____
Average duration per session? _____ (minutes)

Aerobic Dance/Calisthenics/Floor Exercise

NO YES → How many sessions per week? _____
Average duration per session? _____ (minutes)

Moderate Sports (e.g. Leisure volleyball, golf (not riding), social dancing, doubles tennis)

NO YES → How many sessions per week? _____
Average duration per session? _____ (minutes)

Vigorous Racquet Sports (e.g. Racquetball, singles tennis)

NO YES → How many sessions per week? _____
Average duration per session? _____ (minutes)

Other Vigorous Sports or Exercise Involving Running (e.g. basketball, soccer)

NO YES → Please Specify: _____
How many sessions per week? _____
Average duration per session? _____ (minutes)

Other Activities

NO YES → Please Specify: _____
How many sessions per week? _____
Average duration per session? _____ (minutes)

Weight Training (machines, free weights)

NO YES → How many sessions per week? _____
Average duration per session? _____ (minutes)

Household Activities (sweeping, vacuuming, washing clothes, scrubbing floors)

NO YES → How many hours per week? _____

Lawn Work and Gardening

NO YES → How many hours per week? _____

2. How many times a week do you engage in vigorous physical activity long enough to work up a sweat? _____ (*times per week*)

APPENDIX B. CI Questionnaire (Smither, 1992)

Directions: *Use the following response scale in answering the items below*: T=True F=False

1. I get satisfaction from competing with others. T F

2. It's usually not important to me to be the best. T F

3. Competition destroys friendships. T F

4. Games with no clear cut winners are boring. T F

5. I am a competitive individual. T F

6. I will do almost anything to avoid an argument. T F

7. I try to avoid competing with others. T F

8. I would like to be on a debating team. T F

9. I often remain quiet rather than risk hurting another person. T F

10. I find competitive situations unpleasant. T F

11. I try to avoid arguments. T F

12. In general, I will go along with the group rather than create conflict. T F

13. I don't like competing against other people. T F

14. I don't like games that are winner-take-all. T F

15. I dread competing against other people. T F

16. I enjoy competing against an opponent. T F

17. When I play a game I like to keep scores. T F

18. I often try to out perform others. T F

19. I like competition. T F

20. I don't enjoy challenging others even when I think they are wrong. T F

APPENDIX C. EIFI Questionnaire (Gauvin & Rejeski, 193)

Date: _____ ID: _____

Instructions: After your exercise workout, please use the following scale to indicate the extent to which each word below describes how you feel at this moment in time (right after finishing your exercise). Record your reponses by circling one number next to each word.

	Do Not Feel	Feel Slightly	Feel Moderately	Feel Strongly	Feel Very Strongly
Refreshed	0	1	2	3	4
Calm	0	1	2	3	4
Fatigued	0	1	2	3	4
Enthusiastic	0	1	2	3	4
Relaxed	0	1	2	3	4
Energetic	0	1	2	3	4
Happy	0	1	2	3	4
Tired	0	1	2	3	4
Revived	0	1	2	3	4
Peaceful	0	1	2	3	4
Worn-out	0	1	2	3	4
Upbeat	0	1	2	3	4

Are there any unusual circumstances affecting your rating (feelings above) today?

APPENDIX D. Flow State Scale (Jackson & Marsh, 1995)

Date: _____ ID: _____

Instructions: Immediately after your exercise workout ("after hitting escape" on the computer and writing down your information in the log book), please use the following scale to indicate the extent to which each statement below describes how you feel at this moment in time (right after finishing your exercise). Record your responses by circling one number next to each word.

		Strongly Disagree				Strongly Agree
1	I was challenged, but I believed my skills would allow me to meet the challenge	1	2	3	4	5
2	I knew clearly what I wanted to do	1	2	3	4	5
3	It was really clear to me that I was doing well	1	2	3	4	5
4	My attention was focused entirely on what I was doing	1	2	3	4	5
5	I felt in total control of what I was doing	1	2	3	4	5
6	I was not concerned with what others may have been thinking of me	1	2	3	4	5
7	Time seemed to alter (either slowed down or speeded up)	1	2	3	4	5
8	I really enjoyed the experience	1	2	3	4	5
9	My abilities matched the high challenge of the situation	1	2	3	4	5
10	I made the correct movements without thinking about trying to do so	1	2	3	4	5
11	It was no effort to keep my mind on what was happening	1	2	3	4	5
12	I felt like I could control what I was doing	1	2	3	4	5
13	I was not worried about my performance during the task	1	2	3	4	5
14	The way time passed seemed to be different from normal	1	2	3	4	5
15	I loved the feeling of that performance and want to capture it again	1	2	3	4	5
16	I felt I was competent enough to meet the high demands of the situation	1	2	3	4	5
17	I had total concentration	1	2	3	4	5
18	The experience left me feeling great	1	2	3	4	5
19	The challenge and my skills were at an equally high level	1	2	3	4	5
20	Things just seemed to be happening automatically	1	2	3	4	5
21	I had a strong sense of what I wanted to do	1	2	3	4	5
22	I was aware of how well I was performing	1	2	3	4	5
23	I was completely focused on the task at hand	1	2	3	4	5
24	I felt in total control of my body	1	2	3	4	5
25	I was not concerned with how I was presenting myself	1	2	3	4	5
26	It felt like time stopped while I was performing	1	2	3	4	5
27	I performed automatically	1	2	3	4	5
28	I knew what I wanted to achieve	1	2	3	4	5
29	I had a good idea while I was performing about how well I was doing	1	2	3	4	5
30	I had a feeling of total control	1	2	3	4	5
31	I did things spontaneously and automatically without having to think	1	2	3	4	5
32	My goals were clearly defined	1	2	3	4	5
33	I could tell by the way I was performing how well I was doing	1	2	3	4	5

APPENDIX E. Cycbercycle