The Effects of Competition on Intrinsic Motivation in Exergames and the Conditional Indirect Effects of Presence

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Abstract

Intrinsic motivation has been reported to be one of the strongest determinants of exercise adherence. The role of competition in exergames was studied to determine the ways to increase intrinsic motivation. We tested the competitive exercise setting as a contextual factor, and competitiveness as individual characteristic, to investigate their effect on intrinsic motivation using psychological, behavioral, and physiological measures. The experiment was a 2 (Competition: Competition versus Non-competition condition) x 2 (Individual competitiveness: High versus Low) between-subjects design. The results showed significant interaction effects of independent variables on intrinsic motivation, mood, and evaluation of the exergame. For highly competitive individuals, competition increased intrinsic motivation, but for those who were lowly competitive, exercising in competitive settings had detrimental effects on the exercise experience. We also found significant moderated mediation effect of presence toward exercise experience in the exergame.

Keywords--**exergame, competition, presence, intrinsic motivation, exercise video game**

1. Introduction

Competition is one of the main elements of video games. Since most games are goal directed, it is not difficult to see competitive situations or competition factors in game play [1]. Communication scholars and media psychologists have argued that competition affects the game-playing experience. Particularly, it has been noted that competition and enjoyment are positively related to one another. In an a field experiment with 349 Tomb Raider players, Vorderer, Hartmann, and Klimmt [2] demonstrated that players tend to have more enjoyment when there are competition factors in game situations, and affirmed the importance of competitive elements as determinants of game enjoyment. Similarly, Williams and Clippinger [3] and Gajadhar, de Kort, and IJsselsteihn [4] also claimed that competition brings more enjoyment to playing games, and even affects players' preferences when they choose games.

It is largely unknown, however, how competition influences the exercise experience in exergames. In this paper, we tested the effect of the competitive exercise setting as a contextual factor and competitiveness as an individual characteristic, using psychological, behavioral, and physiological measures.

2. Literature Review

2.1. Cognitive Evaluation Theory

The effect of competition on intrinsic motivation has been of great interest to many scholars. *Intrinsic motivation* may be defined as participation in an activity without any external pressure, simply for internal rewards, such as interest and enjoyment [5, 6, 7]. Intrinsic motivation has been reported to be related to a higher likelihood of exercise adherence [8] and better psychological well being [9]. Activities begun with intrinsic motivation bring enjoyment, defined as participating in an activity that is fun and stimulating, and aligns with personal interests [10].

Cognitive Evaluation Theory was used to understand how people experience motivation related to exercise. This theory, a sub theory of Self-Determination Theory, explains how external factors (e.g., rewards, competition, and punishment) affect intrinsic motivation [5, 11]. Cognitive Evaluation Theory suggests that competition can affect intrinsic motivation differentially depending on two psychological needs: autonomy and competence [1, 5, 11]. First, autonomy is determined by the perceived locus of causality. For example, exercise with external reasons such as rewards does not meet autonomy needs. In other words, perceiving the locus of causality is more external than internal. The theory predicts that the loss of perceived autonomy undermines intrinsic motivation. The second need, competence, may also influence athletes' motivation. Competence can be defined as one's desire to engage in activity to improve skill, exercise, and be challenged [8]. Vallerand, Gauvin, & Halliwell [12]

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argue that winners reported higher levels of intrinsic motivation than did losers.

A large body of exercise and sports literature has shown that competition has a detrimental effect on intrinsic motivation [6, 13, 14, 15, 16, 17]. Tripathi [16] provides an example supporting previous work by Deci and Ryan [5], in which participants approached tasks and performed with higher levels of commitment and interest with no outside pressure or stresses. Vallerand et al. [17] tested the effect of the competitive exercise setting with children aged 10-12. Participants assigned to competition condition were told to try to beat the other participants in a balancing task (i.e., the stabilometer), whereas those who were in non competition were told nothing about competition. After the task, a five-minute free time was given in which children could do whatever they wanted to do. It was presumed that voluntarily spending more time on the stabilometer would indicate intrinsic motivation. They observed that children in the noncompetition condition spent significantly more time on the balancing task compared to those who were in the competition condition, and thus concluded that competition had a detrimental effect on intrinsic motivation.

Some researchers found individual differences in the relationship between competition and intrinsic motivation. For example, individuals who are more autonomy oriented had a greater interest in intrinsic motivation and higher performance levels [18]. A competitive context did not decrease the level of intrinsic motivation for high achievers [19, 20]. And, it was found that different types of exercises have different motivational appeals depending on personal goals or motives [8].

We propose the following hypotheses to test competition as a contextual factor and competitiveness as an individual factor, respectively, to provide knowledge about how the competitive exercise setting in exergames functions in diverse populations.

H1. There will be a significant interaction effect between competition and competitiveness on intrinsic motivation.

H2. There will be a significant interaction effect between competition and competitiveness on mood.

H3. There will be a significant interaction effect between competition and competitiveness on exercise self-efficacy.

H4. There will be a significant interaction effect between competition and competitiveness on evaluation of the game.

H5. There will be a significant interaction effect between competition and competitiveness on heart rate.

H6. In competition condition, highly competitive individuals will have higher scores on the perceived effects of competition compared to lowly competitive people.

2.2. Presence

Presence is defined as “a psychological state in which virtual objects are experienced as actual objects in either sensory or non-sensory ways” [21]. Presence was found to play a significant role in many different contexts [21-27]. For example, Lee and his colleagues [22] found that when individuals played with robot programmed to manifest incremental cognitive development compared to fully developed robots, the participants enjoyed playing with the social robots more and showed higher bonding with the robots. Importantly, researchers found indirect effects of presence on social responses toward robots. That is, playing with developing robots increased the level of presence, which resulted in enhanced enjoyment and bonding.

Gajadhar, de Kort, and IJsselsteihn [28] tested the concept of presence by looking at players’ social presence in the game experience in different spatial 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 showed that the level of social presence significantly increased from virtual to mediated and to co-located settings. The same pattern was shown in player enjoyment as well.

Ravaja et al. [26] also conducted research on the role of presence in relation to playmates. Results showed that players have different levels of presence depending on who they play against. Individuals feel higher presence when they play against humans, rather than against a computer. Similarly, Gajadhar et al. [28] also found that individuals feel higher presence when they play against friends than strangers.

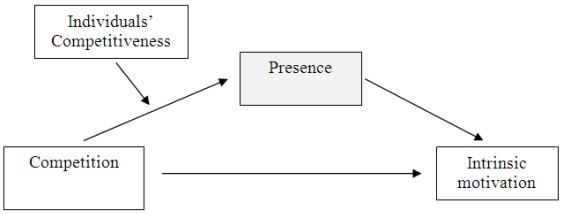

Figure 1. Proposed model: Moderated mediated effect of presence

Still not investigated is how presence works beyond the simple indirect role. It is largely unknown if the magnitude of presence can be changed by certain variables – either contextual or individual related. More sophisticated consideration is needed regarding conditions that might change or affect the pattern of presence. In this regard, we propose to test presence with a four-way analysis by considering both contextual and individual factors. Playing exergames in competitive settings may not affect the feeling of presence, so that enjoyment and other game experiences would result in the same monolithic way. We hypothesize that the mediating role of presence will be moderated by the

level of competitiveness. Thus, a moderated mediated effect of presence was hypothesized (see Figure 1).

H7. There will be a conditional indirect effect of Presence in exergame experience.

3. Methods

3.1. Participants

The experiment was a 2 (Competition: Competition condition versus Non-competition condition) x 2 (Individual competitiveness: High versus Low) between-subjects design. Participants were recruited from a large public Midwestern university in the U.S. totaled 72 undergraduate students: 38 men and 38 women. Individuals were divided into two groups, highly versus lowly competitive groups, based on the median split of competitiveness scores. Half of each group was randomly assigned to either a competition or non-competition condition. As a result, 18 participants were assigned to each of the four conditions.

Most participants (N=63) reported that they had never not played Wii or Wii Fit before, and even those who had played reported that they had only done so a few times. As for the exercise level, participants reported that they usually spent an average of 14.09 hours (*SD* = 12.92) per week. More than half of the participants (56.9%, n=41) fell under the normal weight category, 3% (*n*=3) were underweight, 29.2% (*n*=21) were overweight, and 9.4% (*n*=7) were obese.

3.2. Procedure

Participants were asked to come to the research lab, and were assigned into either a competition or non-competition condition. Upon arrival, they were asked to complete consent forms and to wear heart rate monitors to check their baseline heart rates. In a non-competition condition, participants were told that they would be entered into a random drawing for a $20 gift certificate. On the other hand, participants in a competition condition were told that they were going to compete with three other individuals and only one out of the four would get the gift certificate. Then they were asked to fill out pre-test questionnaires. Then, participants received a short instruction on how to play the game, followed by a 70-second trial session. To test the intrinsic motivation level based on the behavioral measures, all participants were told that they could stop playing after 10 minutes of required playing time, but if they wanted, they would be allowed to keep playing up to 18 minutes. Thus, the playing time ranged from 10 to 18 minutes.

Hula hoop in Nintendo Wii Fit, a moderate level of exercise, was employed for this study. In the game, players are supposed to move their hips as if they were really spinning a hula hoop. This game is designed to be played on the Wii Fit board, which detects the player's movements and translates them into the movements of the avatar. In that way, it seems as though the avatar moves corresponding to the player's movements. While doing virtual hula hooping, players are also required to move their upper bodies to get the hula hoop thrown at them. The game shows total spin numbers of the hula hoop at the end. To avoid a potential avatar effect on the current study, two avatars were pre-set before the experiment: one male and one female avatar, whose gender was matched with that of the participants.

Participants were told that real time performances by one of the other three players in a different lab would be shown on a computer screen through an online video system. It was, in fact, a pre-recorded clip made for the purpose of controlling the performance of the person on the screen. Two people, one male and one female, were asked to help for the program. Their performance was taped in the same laboratory where the actual experiment was conducted. The gender of the actor was matched with that of the participant.

For the non-competition condition, the clip showed the actor playing the Hula hoop game. However, the ranking of the player against the other three participants, including the actor, was also shown in the competition condition. The clip showed a pre-recorded rank ranging from one to four, changing every two minutes. All male participants watched one male's performance, and all female participants watched one female's performance, in an attempt to avoid a potential gender effect.

When participants finished the game play, experimenters checked their playing times and their heart rates again, and asked them to fill out posttest questionnaires.

3.3. Measures

Intrinsic motivation was measured by a self-report of enjoyment item and subsequent free-choice behavior (Reeve & Deci, 1996). Enjoyment of the game (α = .84) was measured by seven adjectives: boring (reverse coded), enjoyable, entertaining, exciting, fun, interesting, and pleasant. Participants used a 10-point scale from "describes very poor" (1) to "describes very well" (10) to rate how well those adjectives described their game-play experiences. Subsequent free-choice behavior was measured based on voluntarily continued playing time. Participants were told that they were required to exercise for 10 minutes but that they could longer. Added playing time on such a voluntary basis was construed as an indicator of intrinsic motivation. The maximum playing time was limited to 18 minutes, including the required 10 minutes.

Mood (α = .84) was measured by five sentences: 1) I feel refreshed after exercising with this game; 2) I feel good after exercising with this game; 3) I feel bad after exercising with this game (reverse coded); 4) I feel happy after exercising with this game; and 5) I feel positive after exercising with this game. Participants indicated their levels of agreement on a 10-point Likert-type scale (1=Strongly Disagree, 10=Strongly Agree).

Exercise self-efficacy of using Wii Fit (α = .85) was measured by a revised version of the general exercise self-efficacy scale [29]. Respondents were asked to indicate their willingness to exercise using this game in seven different situations (e.g., when I am feeling depressed, when I am feeling tired). These items were measured by a 10-point scale (1 = "Will not do", 10 = "Certainly will do").

Evaluation of the exergame (α = .93) was measured by nine adjectives: useful, good, enjoyable, beneficial, fun, interesting, pleasant, worthwhile, and helpful. Participants used a 10-point scale (1 = "Describes very poorly", 10 = "Describes very well") to evaluate their attitudes toward the Wii Fit game.

The perceived effect of competition (α = .85) was measured by seven statements, and these items were only included in the survey for those in a competition condition. The seven statements are: 1) I paid attention to the number of hula hoop spins; 2) I kept checking my ranking on the screen; 3) I tried to be ranked as number 1; 4) Ranking on the screen motivated me to exercise harder; 5) My hula hoop score (number of spins) motivated me to exercise harder; 6) Other people's performance motivated me to exercise harder; and 7) Competition with other people motivated me to exercise harder. Respondents were asked to indicate their levels of agreement on a 10-point Likert-type scale.

Perceived competitiveness in the exergame experience (α = .89) was measured by two sentences. Respondents were asked to indicate their levels of agreement on a 10-point Likert-type scale to the following statements: 1) I felt that this game was competitive; and 2) I think other people would feel that this game is competitive.

Individuals' competitiveness (α = .85) was measured by four statements. Participants were asked to indicate their agreement on a 10-point Likert-type scale to these sentences: 1) I enjoy competition; 2) I like the feeling when my performance is better than others; 3) Competition is fun; and 4) I always do my best to win.

Exercise level (α = .84) was measured by calculating all the time the participants reported spending on strenuous (e.g., biking fast, aerobic dancing), moderate (e.g., walking quickly), and mild (e.g., yoga, easy walking) physical activities every week. These items were created with the revised version of the Godin Leisure-Time Exercise Questionnaire (GLTEQ) [30].

4. Results

First, a manipulation check was conducted. A t-test result showed that participants assigned to the competition condition (M = 8.08, SD = 1.89) reported perceiving significantly higher levels of competition compared to those who were in the non-competition condition (M = 7.17, SD = 2.40), $t(70)=1.78$, $p < .05$. No significant difference in competence in playing the game was observed, either between the competition and non-competition groups, $t(70)=.245$, *ns*, or between the high and low competiveness group, $t(70)=1.67$, *ns*.

To test the proposed hypotheses, ANOVA was conducted. First, H1 address about intrinsic motivation, which was tested in two different ways: psychological and behavioral. Enjoyment was first tested. There was a significant interaction effect of both independent variables on enjoyment, $F(1, 68) = 7.74$, $p < .01$, $\eta^2 = .10$ (see Figure 2-a). In the competition condition, highly competitive individuals (M = 8.53, SD = 1.34) enjoyed the game more than those who were in the low competition level (M = 7.71, SD = 1.37). Conversely, the opposite pattern was observed in the non-competition condition: highly competitive individuals (M = 7.85, SD = 1.14) did not enjoy the activity as much as did the lowly competitive individuals (M = 8.62, SD = .94). The main effects of competition, $F(1, 68) = .153$, *ns*, $\eta^2 = .002$, and competitiveness were not significant, $F(1, 68) = .01$, *ns*, $\eta^2 = .00$.

As a behavioral measure, intrinsic motivation was tested by observing additionally played time. On average, individuals spent 2.86 minutes (SD = 3.32) more (MIN = 0, MAX = 8) playing video games after the required 10-minute play time. H6 was not supported (see Figure 2-f). Neither the interaction effect, $F(1, 68) = 1.16$, *ns*, $\eta^2 = .02$, nor the main effects (for competition, $F(1, 68) = 2.09$, *ns*, $\eta^2 = .03$; for competitiveness, $F(1, 68) = 3.0$, *ns*, $\eta^2 = .04$) were not significant. However, there was a difference, when the two groups were investigated separately. Among lowly competitive individuals, those who played in the non-competition condition played significantly longer than those who were in the competition condition, $t(34)=1.72$, $p < .05$. On average, they voluntarily played 4.45 minutes additionally (SD = 3.47) in the non-competition condition, whereas only 2.55 minutes more (SD = 3.26) in competition condition after finishing the required minimum 10-minute play time. On the other hand, highly competitive individuals played similarly, $t(34)=.27$, *ns*, in both competition (M = 12.05, SD = 3.32) and the non-competition conditions (M = 12.33, SD = 2.94).

H2 was also supported. A significant interaction effect was found, $F(1, 68) = 7.82$, $p < .01$, $\eta^2 = .10$ (see Figure 2-b). Highly competitive individuals (M = 8.88, SD = 1.12) felt better after exercising in the competition condition, when compared to the non-competition condition (M = 8.24, SD = .87), while lowly competitive individuals felt worse (M = 7.71, SD = 1) in the competition condition, when compared to its counterpart (M = 8.5, SD = 1.0). Again, neither of the main effects (for competition, $F(1, 68) = .10$, *ns*, $\eta^2 = .001$; for competitiveness, $F(1, 68) = 3.10$, *ns*, $\eta^2 = .04$) was significant.

For self-efficacy, neither an interaction effect, $F(1, 68) = 2.52$, *ns*, $\eta^2 = .04$, nor the main effects were significant (for competition, $F(1, 68) = .26$, *ns*, $\eta^2 = .004$; for competitiveness, $F(1, 68) = 2.14$, *ns*, $\eta^2 = .03$. Thus, H3 was not supported (see Figure 2-c). Interesting differences

between highly versus lowly competitive groups were found, however. For highly competitive individuals, the exercise self-efficacy level stayed the same regardless of the condition of competition, $t(34)=.09$, ns. The average score of self-efficacy was 6.92 (SD = 2.0) in the competition condition versus 6.97 (SD = 1.35) the non-competition condition. For lowly competitive individuals, on the other hand, exercise self-efficacy between competition and non-competition conditions was in stark contrast, $t(34)=2.15$, $p<.05$. They reported significantly lower exercise self-efficacy when the exercise was competitive (M = 6.13, SD = 1.84), compared to when it was not competitive (M = 7.36, SD = 1.59).

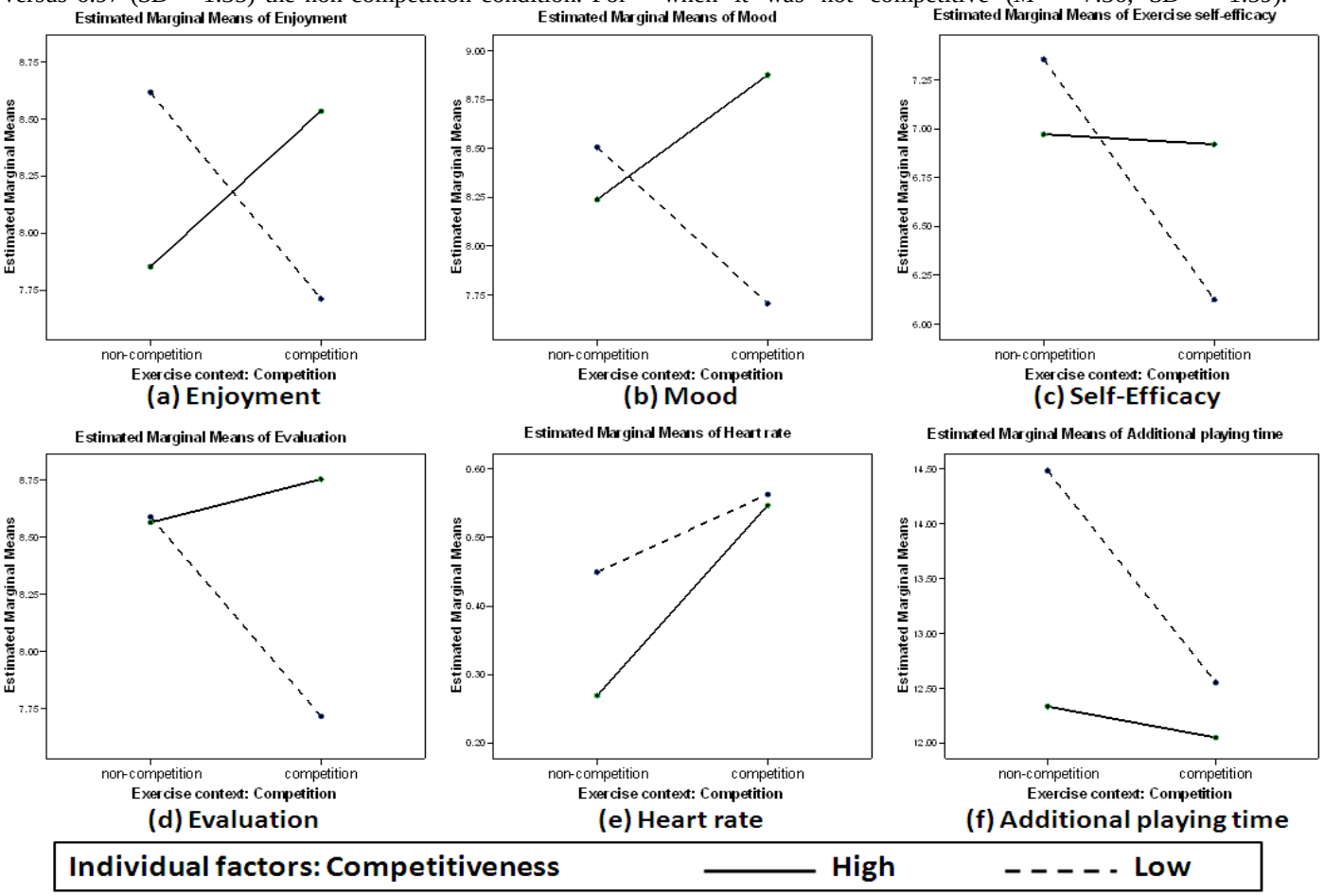

Figure 2. Interaction effects of competitive exercise setting and competiveness on exercise experiences

A significant interaction effect was observed in regard to evaluation of the exergame experience, $F(1, 68) = 4.63$, $p< .05$, $\eta^2 = .06$. Thus, H4 was supported. The main effect of competitiveness was also significant, $F(1, 68) = 4.21$, $p< .05$, $\eta^2 = .06$, whereas the main effect of competition was not, $F(1, 68) = 1.92$, *ns*, $\eta^2 = .03$. As shown in Figure 2-d, there was almost no difference in the non-competition condition between highly (M = 8.57, SD = .94) versus lowly competitive individuals (M = 8.59, SD = .91). On the other hand, when exercise was competitive, the exergame experience was evaluated quite differently by those who were highly competitive (M = 8.75, SD = 1.16) and those who were not (M = 7.72, SD = 1.16).

H5were measured by physiological (i.e., heart rate) and behavioral indicators (i.e., free-choice) respectively. To compare heart rate change before and after, increased heart rate (the discrepancy between before and after playing the game) was divided by baseline heart rate. H5 was not supported (see Figure 2-e). An interaction effect of independent variables was not significant, $F(1, 68) = 1.67$, *ns*, $\eta^2 = .02$ nor was the main effect of competitiveness, $F(1, 68) = 2.391$, *ns*, $\eta^2 = .03$. However, the main effect of competition as a contextual factor was significant, $F(1, 68) = 9.49$, $p < .01$, $\eta^2 = .122$. That is, participants generally experienced more increased heart rate when they exercised in competition rather than in non-competition conditions.

However, the magnitude of heart rate change was different according to individual differences in competitiveness. Highly competitive individuals worked out significantly harder $t(34)=3.10$, $p < .01$, when exercising in a competition condition (M = .55, SD = .33) compared to a non-competition condition (M = .20, SD = .18). On the other

hand, those who were lowly competitive worked out at a similar rate, $t(34)=1.26$, ns, both when exercising with competition (M = .56, SD = .34) and without (M = .45, SD = .17).

H6 was supported. In the competition condition, individuals were asked if they felt that competition made them work harder. Highly competitive individuals agreed more strongly (M = 9.25, SD = 1.14) than did lowly competitive ones (M = 8.33, SD = 1.24), and the difference was significant, $t(70)=2.31$, $p < .05$.

For H7, the moderated mediation effect of presence was tested [31] (see Figure 3). First of all, the competitive exercise setting significantly predicted the mediator, presence (coefficient=1.11, $p < .05$), and the effect of presence on enjoyment depended on the moderator, individual competitiveness (interaction coefficient = .60, $p < .05$). The conditional indirect effect was statistically significant (conditional indirect effect=0.60, $p < .05$) when the value of competition was 8.07.

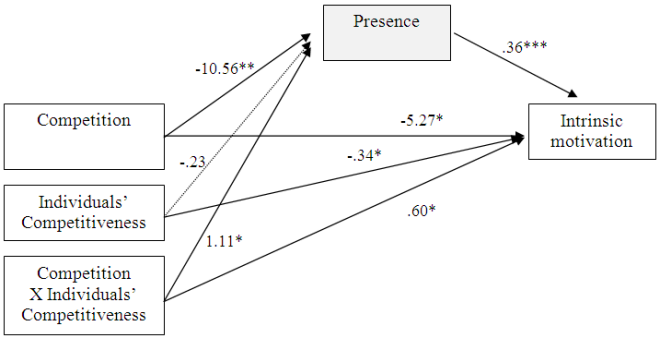

Figure 3. Tested model

5. Discussion

The present study was designed to test the effect of both contextual and individual factors on exergame physiological and behavioral indicators. The heart rate result indicates that participants worked out harder in a competition condition compared to a non-competition condition, regardless of individual differences in competitiveness. That is, competition makes individuals work out harder regardless of their individual characteristics (i.e., competitiveness) or the extent to which they enjoyed the exercise. Does this mean that exercise program based on competition can help individuals work harder when hoping to achieve external rewards? No, the psychological indicators suggest that competition may not work in the same way across all populations. Clearly, significant differences were observed between those who are highly versus those who are lowly competitive, in terms of intrinsic motivation, emotion, and overall evaluation of the exergame.

As heart rate result indicated, lowly competitive individuals who exercised in a competitive setting worked out as hard as highly competitive ones did to achieve the reward. However, it seems as though they pushed themselves only to win a prize. The result definitely showed that they enjoyed the exercise less, felt worse, evaluated the exercise experience more negatively and even exhibited significantly lower exercise self-efficacy compared to those who had exercised without competition. On the other hand, the opposite pattern was observed for highly competitive individuals, who liked to exercise in a competitive setting more. And competition indeed increased their exercise achievement, intrinsic motivation, evaluation of the exergame, and positive mood.

In sum, we have shown that competition does not have a deleterious effect on intrinsic motivation among certain groups of people. For highly competitive individuals, a competitive exercise setting indeed increases intrinsic motivation. It is the lowly competitive individuals who lose intrinsic motivation when the exercise setting is competitive.

This study provides important practical implications. It suggests that exergame designers should be cautious in using the element of competition to motivate people to exercise. We'd like to highlight the results regarding intrinsic motivation and exercise self-efficacy. Those two variables have often been identified as strong determinants of exercise adherence in a long term perspective [8]. Thus, our findings suggest that competition in exergames may affect the exercise experience not only in a short-term way but also in a long-term one. As shown earlier, a competitive exercise setting in exergames has a harmful effect on intrinsic motivation for those who are not competitive. And for exercise self-efficacy, the element of competition has a strong detrimental influence on lowly competitive individuals. On the other hand, no effect was found on highly competitive individuals.

However, this study did not empirically test the long-term effect of competition in exergames. Thus, it is unknown if highly competitive individuals playing competitive exergames (or lowly competitive individuals playing non-competitive exergame) would be more likely to adhere to regular exercise routines compared to exercising in different settings of exergames. Future research should test the long-term effect to broaden knowledge about the effect of competition on intrinsic motivation and provide more in-depth implications to game designers and exercise professionals.

Another limitation of the paper is this research is that we tested only one dimension of presence. According to Lee [21], there are three different types: self, physical, and social. Although only self-presence was tested in this paper, other types of presence should be investigated further. The role of confederates or the way in which one perceives the confederates may be important in a competitive setting. And it would be interesting to test whether social presence also has a moderated mediation effect, as we demonstrated with

self-presence in this paper. Also, the difference between a direct (i.e., against an opponent) and indirect competition setting may be interesting to compare.

We believe that the role of competition should be investigated further in studying exergames. Because competition is so deeply embedded in any sports or exercise activities, it is imperative to find ways to provide the optimal exercise context through strategic use of this key factor in physical activity during exergames.

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