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The impact of competitive and collaborative exergame play on the intrinsic motivation of undergraduate Physical Education students

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Abstract

The purpose of this study was to examine how exergames, when played in two different approaches (competitive and cooperative), affect the intrinsic motivation of undergraduate Physical Education students. Twenty-eight first-year undergraduate students at the Democritus University of Thrace were randomly divided into Xbox Kinect exercise groups of 14 students each, a competitive (8 males and 6 females) and a cooperative group (7 males and 7 females). In the cooperative setting, participants played on a team against a computer avatar, while the competitive condition had participants playing against each other. Xbox Kinect Sports Table Tennis was chosen for its cooperative and competitive options. After the completion of the 15-minute experimental period, participants completed a questionnaire to assess the psychological aspect of the intrinsic motivation for the two gaming conditions. In addition, they were given the opportunity to continue playing if they wished, in order to evaluate the behavioral aspect of the intrinsic motivation. Mann-Whitney U test analyses for independent samples were conducted to investigate the differences of psychological and behavioral aspects of intrinsic motivation among the exercise context (cooperative, competitive) of the participants. No significant difference was found between the two Xbox Kinect exercise context (cooperative, competitive) in any aspect (psychological, behevioral) of the intrinsic motivation. Conclusively, findings suggest that the use of Xbox Kinect Sports Table Tennis is a valuable, feasible and motivational approach in order to enhance physical activity behaviors of undergraduate Physical Education students, regardless of the game conditions (cooperative, competitive).

Keywords: Exergames; Cooperative; Competitive; Table tennis; Intrinsic motivation.

1 Introduction

By examining the data from the World Health Organization (WHO), it becomes evident that Greece is experiencing elevated levels of childhood obesity. This increase is part of a concerning global trend where, in the last four decades, childhood obesity rates in Greece and other nations have tripled, (Karantza-Charoni, Filippa, and Veletza, 2014). The prevalence of childhood obesity had been on the rise since 1980 and continued to increase well into the 2000s. However, recent data indicates a leveling off in childhood obesity rates, attributed in part to the implementation of public health programs over the last decade or so, as noted by Wabitsch, Moss & Kromeyer-Hautschild (2014). Despite

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these efforts, the overall rates of childhood obesity remain alarmingly high (Wabitsch et al., 2014).

Pediatric obesity is associated with several health risks that often persist into adulthood, including conditions such as hypertension, dyslipidemia, metabolic syndrome, diabetes, cognitive deficits, and psychological impairments. This makes addressing the issue of childhood obesity a matter of utmost importance, as emphasized by studies conducted by Elmaogullari, Tepe, Ucakturk, Kara & Demirel (2015), Haemer et al. (2014), and Kamijo et al. (2014).

Consequently, it remains a top priority in Greece and worldwide to continue researching behavioral strategies that can positively influence the development of childhood obesity.

There are two key factors contributing to pediatric obesity: a sedentary lifestyle characterized by excessive sitting and a lack of physical activity (Biswas et al., 2015). Excessive engagement in screen-based activities is a significant driver of sedentary behavior (Sisson et al., 2009). However, it's important to recognize that not all screen-based activities are inherently sedentary. Physically active screen time, such as playing exergames (e.g., Xbox Kinect®), has been found to increase energy expenditure in comparison to traditional sedentary screen time, like traditional video games and television (Penko & Barkley, 2010). Encouraging the play of exergames as a means to boost physical activity holds potential in the pediatric population, as these games are popular, potentially motivating, and could enhance physical activity behaviors for children (Staiano, Abraham & Calvert, 2012). These potential benefits of exergame participation offer promise in the fight against obesity, and further exploration of their implementation is warranted.

The social environment in which children engage in physical activity can significantly influence their behavior. Research findings suggest that peer influence plays a positive role in encouraging physical activity among children (Barkley et al., 2014; Sanders, et al., 2014). In these settings, children have also demonstrated a reduction in sedentary behavior (Barkley et al., 2014). Therefore, participating with a peer can lead youth to increase their physical activity levels and decrease sedentary behavior. The impact of peer presence on physical activity is even more pronounced when the peer is a friend (Barkley et al., 2014; Sanders, et al., 2014). Children tend to be more active when in the company of friends than when they are alone, possibly because youth physical activity often involves interactive play with partners.

Given the significance of peer presence in influencing physical activity in other contexts, it is important to continue exploring how these same social factors may affect a child's motivation to engage in exergames as opposed to sedentary video games or other alternatives.

Several factors can influence how children engage in physical activity with their peers, and one potentially crucial aspect is the goal structure of the activity. The nature of the goal, whether it's cooperative or competitive, can have varying effects on behavior (Snyder, Anderson-Hanley & Arciero, 2012q; Staino et al., 2012). Studies involving adolescents and adults have suggested that adopting a cooperative exercise context as opposed to a competitive one during exergame play can enhance intrinsic motivation among participants, potentially leading to increased long-term engagement (Marker & Staiano, 2015; Staiano et al., 2012).

Thus, although studies in adolescents and adults have explored participation preferences between competitive and cooperative exercise contexts, there is a gap in research concerning younger adults who may have different attitudes toward competition. Consequently, it is essential to understand the preference for goal structure

in physical activity among young adults, as it can have a significant impact on the reinforcement of a healthy lifestyle.

Therefore, the purpose of this study was to examine how exergames, when played in two different approaches (competitive and cooperative), affect the intrinsic motivation of undergraduate Physical Education students.

2 Method

2.1 Participants

This research involved 28 first-year undergraduate students from the Department of Physical Education & Sport Sciences at the Democritus University of Thrace (DPESS-DUTh). Their ages ranged from 19 to 20 years old, with an average age of 19.54 years and a standard deviation of 0.65. Of the participants, 15 were male (53.57%), and 13 were female (46.43%). The study's population consisted of students enrolled in every class section of the "New Technology in Health" course offered during the spring semester of the academic year 2017-2018.

For participant selection, a self-selected sampling method was employed. Participants were then randomly assigned to one of two different Xbox Kinect exercise groups: the competitive group (8 males and 6 females) and the cooperative group (7 males and 7 females), resulting in two independent groups, each consisting of 14 students. Each participant chose a peer of the same age and gender to join them in the research. While the selected friend was not the subject of the study, they participated in the game conditions alongside the main participant. Before their group assignments, participants received orientation regarding the study's purpose, the Xbox Kinect exercise group they would belong to, and their responsibilities in the experiment. Each student provided consent to participate in the study, and they were informed that participation was voluntary and would have no impact on their grades. Exclusion criteria for this study encompassed individuals with known cardiovascular, pulmonary, orthopedic, metabolic, cognitive, neurological, muscular, or behavioral impairments or any related concerns. Participants meeting these criteria were not included in the study.

2.2 Measurement Instrument

The current study primarily focused on assessing intrinsic motivation, and this was done through two distinct approaches, one using psychological measures and the other using behavioral measures. When it comes to the psychological aspect, intrinsic motivation (with a reliability coefficient of .84) was evaluated by having participants provide descriptions using five adjectives such as "interesting," "enjoyable," "fun," "not boring," and "not a waste of time." This method of assessment was consistent with previous studies conducted by Epstein and Harackiewicz (1992), as well as Harackiewicz and Manderlink (1984). Responses regarding the psychological measurement of intrinsic motivation were collected using a 10-point Likert scale (e.g., 1=Strongly Disagree, 10=Strongly Agree).

On the other hand, the behavioral aspect of intrinsic motivation was determined by observing participants' willingness to continue playing beyond the required 15-minute exercise duration. Participants were informed that they needed to exercise for a specific duration and would be alerted when the mandatory time was up. However, they were also informed that they had the option to continue playing beyond that requirement. The

additional time spent playing voluntarily was considered an indicator of intrinsic motivation, following the framework described by Reeve and Deci (1996).

An extension of up to 9 minutes of extra playing time was permitted, resulting in a range from a minimum of 15 minutes (the mandatory requirement) to a maximum of 24 minutes.

2.3 Procedure

Each participant attended a single laboratory session, which commenced with an introduction to the study and an explanation of the procedures, including the collection of consent and assent documents. Anthropometric measurements, such as height, weight, and BMI, were recorded for each participant. A demonstration of gameplay on Xbox Kinect Sports Table Tennis® (an exergame) was provided in both competitive and cooperative settings. In the cooperative setting, participants played on a team against a computer avatar, while the competitive condition had participants playing against each other. Xbox Kinect Sports Table Tennis® was chosen for its cooperative and competitive options and its known ability to increase energy expenditure, similar to the intensity experienced during a beginner's tennis lesson, as demonstrated in Staiano and Calvert's (2011) study.

Prior to the testing phase, the children were allowed to practice for a 10-minute period in each game mode. The experimental procedure involved measurement and data collection during two 15-minute conditions: cooperative, and competitive. The order of the gaming conditions balanced across participants. After completing all experimental conditions, the participants filled out a questionnaire to assess the psychological aspect of the intrinsic motivation for the two gaming conditions (competitive and cooperative). In order to evaluate intrinsic motivation levels using behavioral measures, all participants were informed that they had the option to cease playing once they had completed the mandatory playing time. However, they were also given the opportunity to continue playing if they so desired. It's important to note that the following variables were assessed during the lab visit and were collected solely from the main subject, not their selected friend, except for anthropometric measurements, which were assessed for both undergraduate students.

2.4 Statistical analysis

Due to practical limitation, a field experiment, instead of a laboratory experiment was conducted to test the hypotheses. The experiment was a factorial design with exergame exercise context (cooperative, competitive) as independent variable, and intrinsic motivation performance (psychological and behavioral aspects) as dependent variables. Mann-Whitney U test analyses for independent samples were conducted to investigate the differences of psychological and behavioral aspects of intrinsic motivation among the exercise context (cooperative, competitive) of the participants. The hypotheses of this study were:

H01. The cooperative exercise context will have more intrinsic motivation (psychological aspect) than competitive exercise context toward the Xbox Kinect game of Table Tennis

H02. The cooperative exercise context will have more intrinsic motivation (behavioral aspect) than competitive exercise context toward the Xbox Kinect game of Table Tennis.

3 Results

At the beginning of this study, it was hypothesized that the cooperative exercise context will have more intrinsic motivation (psychological aspect) than competitive exercise context toward the Xbox Kinect game of Table Tennis (H01). To test this hypothesis, a Mann-Whitney U test for independent samples was applied, given the non-normal distribution of the sample. The independent variable being the exercise context of the exergame (cooperative, competitive) and the dependent variable being the psychological aspect of intrinsic motivation. The homogeneity of variance was checked using the Levene's test, and the normality of the sample was assessed with the Shapiro-Wilk test. The level of significance for measurements was set at ($p < 0.05$). The analysis revealed that the experimental groups do not exert a statistically significant effect on the psychological aspect of intrinsic motivation of the undergraduate students for the Xbox Kinect Table Tennis, $U_{(26)} = 76$, $p = .323$, $r = .224$. Therefore, the exercise context does not influence the students' intrinsic motivation of the game as presented through the Xbox Kinect game of Table Tennis. Table 1 provides a detailed presentation of the mean value (*M*), standard deviation (*SD*), and *U*-value with the corresponding level of significance.

Table 1. Mean scores and standard deviations of intrinsic motivation (psychological aspect) for the cooperative and competitive contexts of the exergame.

Intrinsic motivation	Cooperative (n=14)		Competitive (n=14)			
	M	*S.D.*	*M*	*S.D.*	*U*	*p*
Psychological aspect	8,36	1,21	8,10	1,25	76	.323

According to the results, the H1 null hypothesis, which suggested that the cooperative exercise context will have more intrinsic motivation (psychological aspect) than competitive exercise context toward the Xbox Kinect game of Table Tennis, is not accepted. Therefore, undergraduate students were equally motivated by their participation in the Xbox Kinect Table Tennis game, regardless of whether the game had a cooperative or competitive nature (Figure 1).

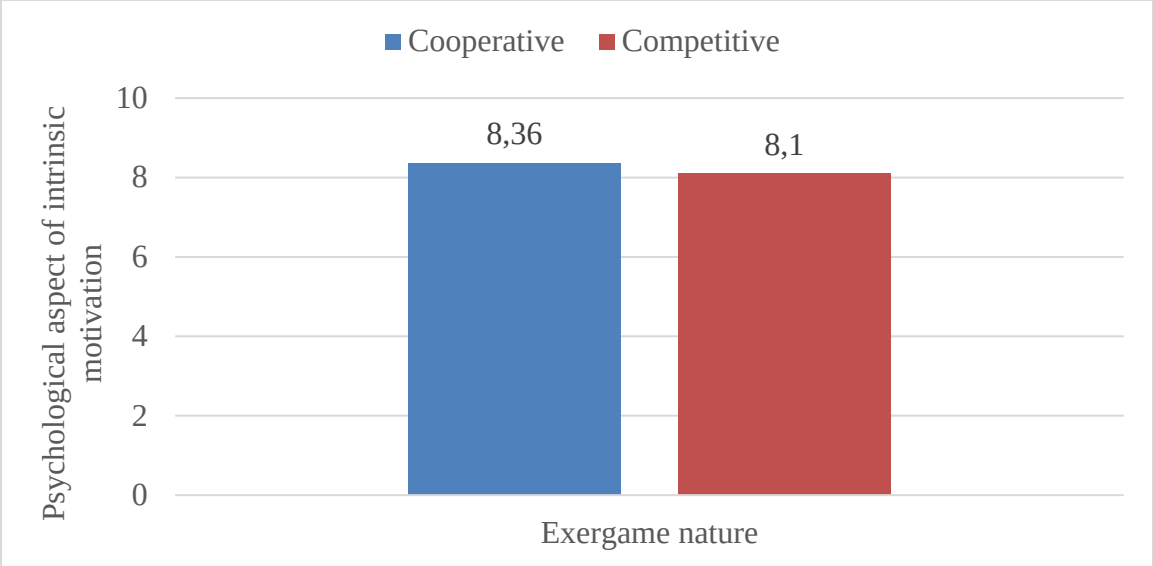

Figure 1. Mean scores of the two experimental groups in psychological aspect of intrinsic motivation.

Furthermore, it had been hypothesized that the cooperative exercise context will have more intrinsic motivation (behavioral aspect) than competitive exercise context toward the Xbox Kinect game of Table Tennis (H02). To test this hypothesis, a Mann-Whitney U test for independent samples was applied, given the non-normal distribution of the sample. The independent variable being the exercise context of the exergame (cooperative, competitive) and the dependent variable being the behavioral aspect of intrinsic motivation. The homogeneity of variance was checked using the Levene's test, and the normality of the sample was assessed with the Shapiro-Wilk test. The level of significance for measurements was set at ($p < 0.05$). Results suggest that participants spent an average of 3.89 min more playing the game after the required 15-min play time. Specifically, the analysis revealed that the experimental groups do not exert a statistically significant effect on the psychological aspect of intrinsic motivation of the undergraduate students for the Xbox Kinect Table Tennis, $U_{(26)} = 86$, $p = .597$, $r = .122$. Therefore, the exercise context does not influence the students' intrinsic motivation of the game as presented through the Xbox Kinect game of Table Tennis. Table 2 provides a detailed presentation of the mean value (*M*), standard deviation (*SD*), and *U*-value with the corresponding level of significance.

Table 2. Mean scores and standard deviations of intrinsic motivation (behavioral aspect) for the cooperative and competitive contexts of the exergame.

Intrinsic motivation	Cooperative (n=14)		Competitive (n=14)			
	M	*S.D.*	*M*	*S.D.*	*U*	*p*
Behavioral aspect	3,94	2,48	3,83	2,33	86	.597

According to the results, the H2 null hypothesis, which suggested that the cooperative exercise context will have more intrinsic motivation (behavioral aspect) than competitive exercise context toward the Xbox Kinect game of Table Tennis, is not accepted.

Therefore, undergraduate students were equally motivated by their participation in the Xbox Kinect Table Tennis game, regardless of whether the game had a cooperative or competitive nature (Figure 2).

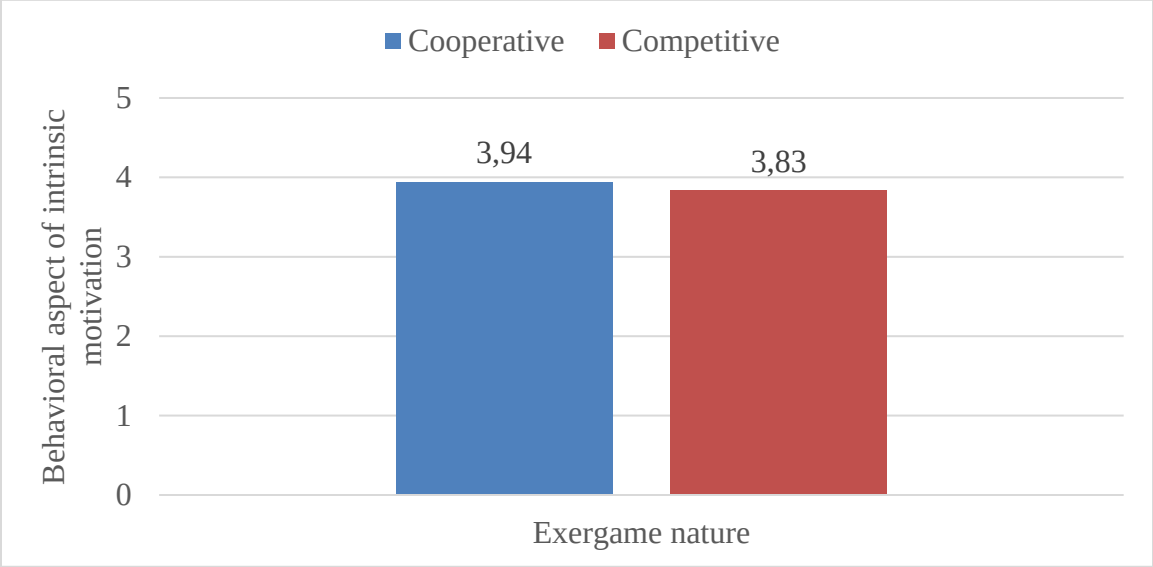

Figure 2. Mean scores of the two experimental groups in behavioral aspect of intrinsic motivation.

4 Discussion

While prior investigations have explored the dynamics of competitive versus cooperative play among older age groups, such as adolescents, or in diverse settings like education and sports, this study represents the first, to our knowledge, to examine how exergames, when played in two different approaches (competitive and cooperative), affect the intrinsic motivation of undergraduate Physical Education students (Staino et al., 2012; Weiss & Smith, 2002). The findings regarding psychological aspect of intrinsic motivation did not align with our hypothesis, which posited that young children would express a stronger preference for a cooperative goal structure over a competitive one. Similarly, contrary to our expectations, behavioral values of intrinsic motivation did not exhibit differences between the cooperative and competitive nature of the exergame. We anticipated that the cooperative condition would result in higher motivational values compared to the competitive condition, assuming that young adults would favor cooperative play and perceive it as less physically demanding due to increased enjoyment. The unexpected outcome contradicted our hypotheses, which anticipated that young adults would be inclined to exert more effort to engage in cooperative gameplay compared to the competitive alternative, as indicated by previous studies on adolescents that measured motivation through survey methods (Staino et al., 2012). In summary, our results partially align with our hypotheses, suggesting that young children tend to lean towards preferring cooperative play, although this preference does not necessarily translate into higher motivation to participate in such activities.

These findings are in contrast with Staiano et al. (2012), who concluded that cooperative exergame play produced higher intrinsic motivation to play the exergame than competitive exergame play did, supporting the notion that cooperative exergames

could be integrated into physical education and recreation programs in order to attract adolescents. A reason why students in the cooperative exergame environment were not motivated more than the competitive exergame environment could be that members of the cooperative groups were not satisfied with the gameplay of their teammates, creating a sense of disappointment and then increasing verbal aggression during the game and hostility after the game. Such an outcome might help clarify the subdued findings in game motivation when considering verbal aggression in the current analysis. According to Deutsch (1973), in group situations, a teammate (involved in cooperative play) making errors in gameplay, thereby diminishing the chances of team success, can heighten dissatisfaction or frustration among group members. In such cooperative play scenarios, an escalation in frustration could subsequently contribute to heightened state hostility (Sheese & Graziano, 2005).

Thus, it might be more appropriate to evaluate multiuser game experience, or even better, teamwork or management skills, while also considering gaming experience into analyses to address experience-related differences. Experienced solo players may encounter challenges when collaborating with others during gameplay. If any of these scenarios occurred in the current study, the psychological and behavioral aspects of intrinsic motivation findings may not accurately reflect the effects of genuine cooperative and competitive play among groups of equally skilled and experienced players. This is especially pertinent for players who regularly play together (e.g., clans or guilds) or are selected to play together based on their specific skills (e.g., unknown task group). Consequently, this study opens avenues for future research to delve deeper into intra- and intergroup gameplay dynamics. For instance, future studies should aim to replicate the research with known and unknown groups possessing equivalent skills, and incorporate nonviolent and potentially non-playing control groups.

Evaluating the results of the current research study, it is important to acknowledge several limitations. Our approach to assessing cooperative and competitive goal structures involved a single exergame, chosen to enhance control over variables and laboratory measurements. This methodology might have impacted the outcomes compared to assessments in different settings such as a gym, playground, or with different exergames. Utilizing a more natural setting in future research could yield more widely applicable findings regarding the psychological and behavioral aspects of intrinsic motivation in young adults. Additionally, the sample was primarily composed of first-year undergraduate students at Democritus University of Thrace, limiting the generalization of our findings to other populations.

5 Conclusion

In summary, this study is the first, to the best of our knowledge, to investigate the impact of two different approaches, competitive and cooperative, on the psychological and behavioral variables of intrinsic motivation during exergame play in young adults engaging with a friend. The key findings related to the psychological and behavioral aspects of intrinsic motivation indicate that exergames, when approached from competitive and cooperative perspectives, do not influence the psychological and behavioral facets of intrinsic motivation among undergraduate Physical Education students. These findings contribute to our understanding of young adults' physical activity behavior and extend previous research conducted in various age groups and settings unrelated to physical activity. This information can inform physical activity programming to potentially enhance participation and improve health benefits. Further exploration into goal structures that are both motivating and well-liked by young adults is necessary to optimize engagement in physical activity.

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