WHO INTENDS TO PLAY EXERGAMES? THE FLOW-THEORETIC PERSPECTIVE

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ABSTRACT

Exergames enable users to utilize computer applications to engage in exercise. The literature on exergames has revealed their effects on users' physical indicators. However, insufficient research has examined the predictors of user intention to play exergames. We examine these predictors through an approach grounded in flow theory. Conducting a longitudinal study, we asked participants to play exergames for a total of 18 hours in 12 weeks. We find that a strong perceived challenge and its interaction with performance-approach goals are positively related to user intention to play exergames. We contribute to the literature by providing a novel predictor of user intention to play exergames that can be exploited to encourage the use of exergames. We also provide exergame providers with insights into designing exergames to induce users' playing behaviour.

Keywords: Exergame; Intention to play; Loyalty; Perceived challenge; Flow

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1. Introduction

Exergames are computer games that require users' body movements to manipulate avatars (user representations) and can thereby provide benefits that resemble exercise [Famkner et al. 2010]. Exergames are among the world's most popular computer applications. More than 44% of American adolescents own an exergame, e.g., Wii [Sheu et al. 2013]. Microsoft sold one million Kinect devices for Xbox 360 in just ten days [Microsoft News Center 2010]. These figures affirm the popularity of exergames. Providing a new means of human-computer interactions, exergames can effectively improve users' body control abilities [Sun & Lee 2013], demonstrating the importance of research on the behaviour of exergame users.

The literature on exergames has examined how to design exergames in terms of user interface and avatars. Specifically, user interface embodiment positively contributes to enjoyment, presence (the feeling of "being there"), energy expenditure, and intention to play exergames [Kim et al. 2014], while normal-weight (when compared with obese) avatars lead users to actively play exergames [Peña & Kim 2014]. Users' perceptions of their avatars contribute to their relationships with such avatars [Jin & Park 2009]. User views and foci interact to impact intention to play exergames [Jin 2010a] and response to gaming performance [Jin 2010b]. Moreover, user-context congruence fuels users' intrinsic motivation to play exergames [Song et al. 2013]. In summary, the literature has adopted the perspectives of immersion [Kim et al. 2014], achievement [Song et al. 2013], and social interactions [Jin 2010a, 2010b; Jin & Park 2009; Peña & Kim 2014].

However, no studies have adopted the perspective of flow theory to explore the antecedents to intention to play exergames, indicating a research gap and the potential of using flow theory to advance exergaming knowledge. Research filling the gap should deepen our understanding of why users intend to play exergames. Moreover, such research can assist exergame providers in effectively encouraging users to repeatedly play their exergames, suggesting the value of research on the predictors of intention to play exergames.

In this study, we take the perspective of flow theory to identify and examine the predictors of user intention to play exergames. Exergames provide gaming experiences that have been well explained by flow theory [Csikszentmihalyi & LeFevre 1989], suggesting the appropriateness of adopting flow theory to underpin our research. Flow theory [Csikszentmihalyi & LeFevre 1989] posits that challenges create flow, which strongly motivates individuals to engage in the associated challenging activities. In applying flow theory to exergame play, it is posited that the challenge content of exergames should motivate individuals to play these games to experience flow, supporting our inclusion of perceived challenge in this research. Moreover, exergames display gaming scores that reflect gaming performance. Users may concentrate more on playing exergames (and thus experience flow and enhanced intention to play) when they implicitly set goals to perform better than their peers, or performance-approach goals, supporting the inclusion of performance-approach goals in our research.

Specifically, we set out to examine the impacts of perceived challenge and performance-approach goals and their interaction on user intention to play exergames. Compared with the existing exergaming literature, we make several contributions in this study. First, Kim et al. [2014] examined how the user-exergame interface determines positive user experience and gaming behaviour. We join in their effort by exploring how gaming behaviour is influenced. However, we take a new approach in including novel determinants (including perceived challenge, performance-approach goals, and their interaction) of gaming behaviour. Our study and that of Kim et al. [2014] give a big picture of the determinants of users' gaming behaviour.

Second, Song et al. [2013] found that users who favour competition are sensitive to challenges in playing exergames, so they are likely to have a positive experience. We also examine the role of challenge in determining exergame users' psychology and behaviour. However, we move the literature a step forward by examining the impact of the interaction between perceived challenge and performance-approach goals on user intention to play exergames. Such a step forward contributes to the promotion of exergame applications.

Third, Sun and Lee [2013] examined how perceived challenge is related to users' balance control ability. Our study agrees with the strong impact of challenge on exergame users and joins in the efforts to further explore the impact of challenge on users. However, our work is new in exploring the impact of perceived challenge on user intention to play exergames, likely reinforcing the impact of exergames on users' behaviour.

2. Literature Review

2.1. Exergames

Exergames provide benefits that resemble exercise [Famkner et al. 2010]. Specifically, users can increase their energy and raise their heart beat rates in playing exergames [Peng et al. 2011], enhancing gamers' vigour and happiness [Huang et al. 2017b]. Exergames require gamers to use their body movements to manipulate gaming avatars to cope with gaming requirements and contexts. Through the intensive use of their body, gamers consume a substantial amount of energy to a degree equivalent to light to moderate real-world exercise [Famkner et al. 2010], thus achieving better physical fitness [Huang et al. 2017a]. When using exergames, the user interface embodiment contributes to user experience and gaming behaviour. Specifically, a high level of user interface embodiment improves users' perceptions of presence (the feeling of being there), enjoyment, energy expenditure (in terms of changes in heart rate), and intention to play exergames [Kim et al. 2014]. The literature supports the notion that user intention to play exergames should be a focus of research on human-computer interactions. Moreover, as a result of exergame playing, enjoyment further contributes to users' balance control ability and the intensity level that the player can tolerate [Sun & Lee 2013].

When interacting with computers, competition from other users positively contributes to the mood and intrinsic motivation for highly competitive users, but it does the contrary for low-competitive users [Song et al. 2013]. Such competition from other users provides challenging goals in terms of winning over other users, indicating that the challenge perceived in playing exergames also can improve users' exergaming experience. Moreover, such competition may indicate that playing exergames can be a means of fulfilling users' need for achievement by performing better than their peers (or having performance-approach goals). Such likelihoods are intriguing, motivating us to include perceived challenge and performance-approach goals in our study.

Researchers have adopted various theories to explain exergaming behaviour, including regulatory focus theory and self-construal theory [as by Jin 2010a]. Specifically, prevention focus interacts with self-construal to impact user perceptions of self-presentation [Jin 2010a]; such an interaction also explains user exercise intention. However, the literature has not adopted flow theory to explain exergaming behaviour, showing the newness of our study in using flow theory within the context of exergaming.

2.2. Intention to Play Exergames

The gaming literature has focused on user intention to play games, partly because such intention fosters the sustainability of game providers. One recent study further indicated that online game providers urgently need loyal customers [Li et al. 2015]. Therefore, the gaming literature has studied a number of predictors of continuance intention, including entertainment [Chang 2013], challenge [Teng et al. 2012], immersion satisfaction [Teng 2010], flow [Choi & Kim 2004], and expectancy disconfirmation [Liao et al. 2016]. Moreover, recent gaming studies have begun to focus on how social aspects contribute to gamer loyalty, including team participation [Teng & Chen 2014] and social networks [Tseng et al. 2015].

In the exergaming context, intention to play exergames has been found to be related to user interface embodiment, gaming experience, and energy expenditure [Kim et al. 2014]. Such intention is also related to prevention regulatory focus, with which users focus on avoiding something bad from happening to them [Jin, 2010a]. Flow theory [Choi & Kim 2004] has been applied to gaming contexts, indicating the potential of their applicability to the exergaming context. Therefore, we provide a concise review of the literature on flow theory.

2.3. Flow Theory

Flow is important to electronic commerce managers, as flow can encourage users' loyalty [Shim et al. 2015] and intention to purchase [Cha 2011]. Flow theory posits that when highly skilled individuals encounter tough challenges, they will concentrate intensely on overcoming such challenges, generating the flow experience [Csikszentmihalyi & LeFevre 1989]. Challenge is strongly connected to flow experience in online shopping and gaming [Hung et al. 2015; Shim et al. 2015]. One explanation is that gamers who successfully overcome gaming challenges should perceive strong enjoyment and flow [Weibel et al. 2008]. Moreover, gaming enjoyment leads to continued participation [Hamari & Keronen 2017]. These studies show the importance of challenge in creating flow, supporting our inclusion of challenge as a potential predictor of user intention to play exergames.

Flow theory has been frequently applied and verified in gaming studies, showing its wide applicability and the strong impact of flow. Flow is related to enjoyment, satisfaction, immersion, and the intention to engage in the activities that create flow [Csikszentmihalyi 1990]. Moreover, flow produces enjoyment, devotion [Procci et al. 2012], motivation, and absorption [Khan & Pearce 2015] among gamers, suggesting the usefulness of flow theory in explaining the impact of flow among gamers.

The recent literature has also investigated how challenge, feedback, and rewards can lead to enjoyment (antecedents to flow) when playing exergames [Lyons 2015]. Moreover, research has studied the effects of various flow dimensions in exergames. In playing exergames, participants acquire higher awareness of clear goals, more concentration on tasks, and higher involvement and transformation of time than traditional balance training [Robinson et al. 2015]. Therefore, flow plays a vital role within the context of exergames.

Flow may come from a balance between skill and challenge [Thin et al. 2011]. However, gaming studies have found that challenge itself can trigger flow [Teng 2013]. Hence, research examining the link between challenge and flow is justified. Moreover, clear goals and concentration are important in playing exergames [Robinson et al. 2015], and they are necessary for creating flow [Csikszentmihalyi & LeFevre 1989]. Gamers with implicit goals to perform better than peers are likely motivated to concentrate on playing games, thus creating flow and intention to play. Such likelihood justifies our adoption of performance-approach goals in our framework.

2.4. Performance-Approach Goals

When striving to attain achievement, individuals tend to set achievement goals or have specific goal orientations. Achievement goals comprise four categories, namely, performance-approach goals (tendency to perform better than the norm or peers), performance-avoidance goals (tendency not to perform worse than the norm or peers), mastery-approach goals (tendency to achieve intrapersonal high performance), and mastery-avoidance goals (tendency not to experience intrapersonal low performance) [Elliot & McGregor 2001]. Among them, performance-approach goals are the most related to need for achievement [Elliot & McGregor 2001, p. 509, Table 5], i.e., performance-approach goals are most connected to strong psychological needs, indicating that performance-approach goals should effectively motivate individuals to concentrate in performing tasks. Because concentration is essential for creating flow experience, performance-approach goals should strongly motivate individuals to experience flow, subsequently enhancing intention to play. Hence, we include performance-approach goals as a potential predictor of intention to play exergames.

The literature on performance-approach goals indicates that the effectiveness of such goals is related to gender and age [Midgley et al. 2001], indicating the necessity of including gender and age in research on these goals. Mixing different kinds of achievement goals may further improve their effectiveness [Linnenbrink 2005]. However, our study is the first to consider achievement goals within the exergaming context, so we choose to maintain a clear focus on performance-approach goals only.

3. Hypotheses

Perceived challenge is the difficulty users encounter when completing tasks [Teng 2013]. An increased challenge, if it is acceptable, should motivate users to expend more effort to deal with or overcome the challenge [Selmer & Lauring 2015]. According to flow theory [Csikszentmihalyi & LeFevre 1989], users fully concentrate and focus on overcoming difficult tasks. After playing exergames, users may feel the enjoyment of overcoming such challenge, which enhances their pleasure with such experience. Such enjoyment and pleasure may motivate users to participate in tasks to overcome other challenges in playing exergames. Therefore, we hypothesize a positive relationship between perceived challenge and user intention to play exergames.

H1: *Perceived challenge is positively related to user intention to play exergames.*

Performance-approach goals refer to the tendency to perform better than the norm or peers [Elliot & McGregor 2001]. Such tendency is closely related to individuals' need for achievement [Elliot & McGregor 2001], which should strongly motivate individuals to concentrate on tasks that lead to outstanding performance. Hence, exergame users having strong performance-approach goals tend to concentrate on playing exergames to achieve outstanding performance. According to flow theory, concentration is key to creating the flow experience [Csikszentmihalyi & LeFevre 1989]. Flow further enhances intention to play the game [Choi & Kim 2004]. Therefore, we hypothesize a positive link between performance-approach goals and user intention to play exergames.

H2: *Performance-approach goals are positively related to user intention to play exergames.*

Individuals who have a strong commitment to achieve performance-approach goals tend to perform better than peers [Elliot & McGregor 2001]. In exergaming contexts, such gamers should be further stimulated by difficult challenges, since overcoming difficult challenges obviously demonstrates their outstanding performance. That is, difficult challenges should boost highly intensified concentration among such gamers. According to flow theory, intensified concentration leads to high levels of flow experience [Csikszentmihalyi & LeFevre 1989]. Flow further leads to strong intention to play the game [Choi & Kim 2004]. Therefore, we hypothesize that performance-approach goals should strengthen the positive link between perceived challenge and intention to play exergames.

H3: *Performance-approach goals strengthen the positive link between perceived challenge and user intention to play exergames.*

4. Methods

4.1. Sample and Data Collection

We recruited students from one university in Taiwan in the period January to May 2014. Ethical approval was obtained prior to recruiting the participants. Participants were excluded if they had heart disease, hypertension, heart failure, high brain pressure, dizziness, and a history of injury to the musculoskeletal system. Each participant was asked to play exergames in the same space in the university, 30 minutes for each time, three times per week, and over a period of 12 weeks. Participants were asked to provide information on seven control variables and performance-approach goals prior to playing exergames in this study. To ensure participants' ability to respond, after the first four weeks, they were asked to rate items on perceived challenge pertaining to exergames and intention to play them. After the 12-week programme, participants were asked to provide information on intention to play exergames, which was used as the dependent variable.

We selected Microsoft Xbox 360 and its software Your Shape: Fitness Evolved. The reason for choosing Microsoft Xbox 360 is that participants must use their body movements to interact with every movement of the avatars on the screen. In addition, the software contains various exercise activities, including aerobics, Tai Chi, floor exercises, and yoga. Each exercise activity sets different degrees of patterns, including simple, medium, difficult, and extremely difficult. Such gaming activities cover most exercise items, which indicates the software is suitable for this study.

The game to be played was randomised, and thus, the participants had no freedom to select the game, nor did participants have the freedom to select the difficulty level. All the participants had to play from the simplest to the most-difficult levels. At the beginning, one researcher was present to ensure that the team of research assistants worked as planned and that the participants appropriately used the exergames.

We recruited 55 participants in total. Among them, four dropped out. One was out of contact for unknown reasons. Three discontinued their participation owing to personal reasons. An interview with these participants revealed that none of them discontinued due to reasons related to this study. Eventually, we enrolled 51 participants, reaching a ratio of 92.7%.

4.2. Measurement

The three items measuring performance-approach goals come from Elliot and McGregor [2001]. The six items measuring perceived challenge come from Novak, Hoffman, and Yung [2000]. The two items measuring user intention to play exergames are adapted from Zeithaml et al. [1996]. We modified the items slightly to fit our research context. For example, we modified “the Web” to “this exergame” and “students” to “peers”. We measured each item using a response option ranging from 1 (very much disagree) to 5 (very much agree). We averaged the scores measuring the same construct to represent the level of the measured construct. A higher score represents a high level of the measured construct. Such an approach is consistent with the pertinent literature.

Table 1 summarizes the item means, standard deviations, and the Cronbach’s α values. The Cronbach’s α values range from .70 to .91, indicating sufficient reliability [Nunnally & Bernstein 1994]. We performed an exploratory factor analysis of the response data to check the factor structure. The results indicate that the items measuring each construct load on the theoretically imposed construct.

Table 1: Means, Standard Deviations, and Reliability of the Measurement Items

Construct-*Item*	*M*	*SD*	*α*
Performance-Approach Goals	3.86	0.60	.70
It is important for me to do better than other peers.	4.36	0.70	
It is important for me to do well when compared with other peers.	3.82	0.72	
My goal is to attain higher achievement than most of my peers.	3.40	0.85	
Perceived Challenge	3.59	0.77	.91
Playing this exergame is challenging to me.	3.67	0.83	
The challenges of this exergame requires me to exhibit all my abilities’ limits.	3.54	0.74	
Playing this exergame is a good test of my ability.	3.85	0.85	
Playing this exergame stretches my physical ability to the limit.	3.56	1.01	
Compared with other computer games, playing this exergame is challenging to me.	3.65	1.04	
Compared with typical outdoor or gym activities, playing this exergame is challenging to me.	3.27	1.03	
User Intention to Play Exergames	3.56	0.87	.85
This exergame is my first priority when I choose an exergame to play.	3.42	0.92	
In the future, I will play this exergame.	3.71	0.94	

Note. *α* represents Cronbach’s α values.

Table 2 lists the correlations among the study constructs in this study.

Table 2: Correlations among the Study Constructs

	1	*2*	*3*
1. Performance-Approach Goals	---		
2. Perceived Challenge	.22	---	
3. Intention to Play Exergames	.12	.54**	---

Note. * denotes $p < .05$; ** denotes $p < .01$.

5. Results

5.1. Sample Profile

Table 3 summarizes the sample profile. Among the retained participants, the majority are female, between 21 and 23 years' old, and are undergraduates.

Table 3: Demographic Distribution of the Study Sample

Variable	Category	Number	%
Gender	Male	19	34.5
	Female	36	65.5
Age	21 – 23	43	78.2
	24 – 26	8	14.6
	27 – 29	4	7.2

5.2. Hypothesis Testing

We adopt hierarchical regressions to test the study hypotheses because hierarchical regressions can inform us whether the R2 change is significant. Before the 12-week programme, we collected information on seven control variables, namely, (1) user's gender, (2) age, (3) whether the user is on a diet, (4) weight, (5) whether the user played any exergame in the recent month prior to this study, (6) whether the user feels energetic, and (7) number of times the user exercises per week. We use two-tailed tests.

The seven control variables may represent the gamer's baseline willingness to play the exergame to a degree. Moreover, we measured intention to play exergames after four weeks and after 12 weeks. We use the latter for the analyses because it provides evidence on the effect of playing exergames for the entire programme. Since perceived challenge is significantly related to the former (i.e., intention to play after four weeks, $\beta = .41$, $t = 2.78$, $p = .01$), including the former in the regression analyses would create the statistical problem of multicollinearity, so we use the responses after 12 weeks.

The results indicate that perceived challenge is positively related to intention to play ($\beta = .43$, $t = 2.34$, $p = .02$), supporting H1. Performance-approach goals are not related to intention to play ($\beta = -.04$, $t = -0.24$, $p > .05$), not supporting H2. The reason may be that the goals may not be set by participants who perceive playing exergames as easy. To form the interaction term for testing H3, we adopt the mean-centring technique before creating the interaction term. The result indicates that performance-approach goals strengthen the positive link between perceived challenge and intention to play ($\beta = .33$, $t = 2.15$, $p = .02$), supporting H3. Table 4 summarizes the results of the regression analysis. All the variance inflation factors (VIFs) are below 2.16.

Table 4: Sources of Intention to Play Exergames

	M1	M2	M3
Gender	-.18	-.16	-.21
Age	-.21	.02	-.08
Whether on diet	-.16	-.15	-.15
Weight	.06	.01	.04
Whether played in prior mo.	.07	-.04	-.01
Feel energetic	-.09	.03	-.04
Times of exercise	.05	.37	.41*
Perceived challenge		.52*	.43*
Performance-approach goals		-.01	-.04
Perceived challenge × Performance-approach goals			.33*
R^2	.09	.26	.34
ΔR^2		.19*	.08*

Note. * denotes $p < .05$.

5.3. Additional Analyses

The relationship between perceived challenge and intention to play may be an inverted U-shape. To test such likelihood, we generate a squared term of perceived challenge (challenge × challenge) and add it to the regressions. This squared term is unrelated to intention to play (β = -.29, t = -1.59, p > .05), which does not support the inverted U-shaped relationship. Such a lack of support may be due to the fact that exergames are designed to encourage gamers to play exergames, placing an upper limit on the difficulty level, thus preventing the occurrence of the inverted U-shaped relationship.

To consider the baseline level of intention to play exergames, we calculate the increase by subtracting the intention measured after the first four weeks of the programme (or the baseline) from the intention measured after the entire programme (or 12 weeks). We additionally analyse whether such an increase in intention to play exergames can be predicted by the study variables. We find that the interaction between perceived challenge and performance-approach goals is still positively related to such an increase (β = .37 t = 2.09, p = .04), further supporting our findings.

6. Discussion

6.1. Main Findings and Contributions

We find that perceived challenge and its interaction with performance-approach goals are two strong correlates of user intention to play exergames. This study contributes to flow theory by being the first to use it within the context of exergames.

6.2. Theoretical Implications

This study contributes to the literature on flow theory. Research based on flow theory has found that perceived challenge impacts presence, enjoyment, and flow in online games [Weibel et al. 2008]. Our work is consistent with that of Weibel et al. [2008] in using flow theory. However, our study is new in examining such impacts in exergames, an emerging and popular computer technology. Such newness shows the applicability of flow theory to explain users' behaviour in playing exergames.

In addition, we contribute to the literature on user adoption of novel technologies. Zhou and Lu [2011] identified the relationship between flow and loyalty in using mobile instant messaging. Our study is in line with their work in examining the antecedents of user adoption. However, our work is unique in using perceived challenge, performance-approach goals, and their interaction to explain the adoption of exergames. Our study is valuable in encouraging future researchers to devote more time and energy to this research stream.

This study also adds to the works by Jin [2010a], Jin [2010b], and Jin and Park [2009]. They examined self-construal (the relationship between the self and others) and its impact. Our study agrees with the importance of exergames and follows their works in examining issues in exergame users. However, we move a step forward by examining a novel antecedent (interaction between perceived challenge and performance-approach goals) to user intention to play exergames.

Nguyen et al. [2016] investigated the impact of using exercise-related exergames on players' attitude and intention to perform other forms of exercise. Specifically, frequent exercisers are motivated to engage other forms of exercise after playing such exergames rather than infrequent exercisers. Our study is in line with Nguyen et al. [2016] in examining players' attitude and intention. However, we emphasize players' intention to play exergames rather than performing other forms of exercise.

Moreover, Huang et al. [2017a] found that regular playing of exergames can improve physical fitness for young adults. Huang et al. [2017b] further found that short-term playing of exergames can enhance vigour and happiness. Our study is consistent with these studies by examining the impact of playing exergames among young adults. However, these studies focused on the impact of playing exergames. We emphasize the antecedents to intention to play exergames, which further promotes the impact of playing exergames on gamers.

6.3. Implications for Managers

We find that perceived challenge is positively related to user intention to play exergames. Therefore, we suggest that exergame providers design challenges that have various levels of difficulty. Users overcoming easy challenges can move on to overcome moderately difficult challenges, and so on. For example, exergame providers can design several difficult tasks in each session. At the beginning of each session, the exergame sets the challenging goal that the user needs to finish such difficult tasks within a specific period of time and consume a certain amount of calories. Therefore, the user often finds playing exergames to be highly challenging. Such a sense of challenge can secure users' concentration, which is essential for creating users' flow experience. According to our findings on the correlation between perceived challenge and intention to play, such means may be related to users' enhanced intention to play exergames.

We find that performance-approach goals may amplify the correlation between perceived challenge and user intention to play exergames. Therefore, we suggest that exergame providers strategically remind their current and potential users of the performance-approach goals. Specifically, exergame providers may display the norm or how peers perform. Such information should be useful for reminding users of their performance-approach goals, amplifying their responses to perceived challenges in exergames.

6.4. Research Limitations and Future Research Directions

In this study, we adopt a three-month study period, which should be sufficient for users to fully experience exergames, justifying the choice of this period. However, the period can be longer, e.g., six months or one year. Therefore, there is uncertainty as to whether our findings are still strong in magnitude of effect after one year. Future studies may replicate our study using a longer period to see whether our findings remain robust over a longer period.

Future studies can consider including the element of user interface embodiment. This element should be relevant to predicting user intention to play [as in Kim et al. 2014]. Therefore, future studies can consider how other antecedents to flow (e.g., feedback, control, and concentration) are related to user intention to play and when and how user intention to play can lead to actual exergaming behaviour. Moreover, future studies should address issues concerning social factors and the virtual community when examining the behaviour of exergame users. Furthermore, future studies can incorporate the popular concept of "Internet of Things" to see whether and how findings on exergames are applicable to devices associated with exercise. Such incorporation should meet the trend of big data analysis, which may provide further useful information for exergame or exercise device providers. Future studies may also explore how prior video game experience, preferences for specific types of exergames, or a high/low level of physical fitness influence users' intention to play exergames.

We randomised the game to be played for each participant. This approach increases the generality of the findings. However, not all participants play the same game, nor do they always experience the same exergaming content, yielding one limitation for our study. Future studies may focus on a single game and incorporate its features to further examine how such features may contribute novel knowledge to the exergaming literature.

We included seven control variables at the beginning of the entire programme and measured the dependent variable at the end of the 12-week programme. Such an approach should help support the influence of the hypothesized predictors on intention to play. However, the causality among the study variables still needs to be confirmed in future studies, including the use of experimental designs to rule out alternative explanations.

Digital games provide abundant business opportunities, including enhanced purchase intention of in-game items [Hamari et al. 2017]. Hence, future studies may examine how to incorporate exergaming elements in improving shoppers' perceived value and contribute to their intention to purchase real or virtual items.

7. Conclusions

We find that perceived challenge and its interaction with performance-approach goals are important for users' intention to play exergames. Such findings are useful for exergame providers to encourage their users' engagement in exergaming. Moreover, we extend the applicability of flow theory to the context of exergames. Future studies are necessary to further explore how exergames impact users, their social life, and society.

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