Only for Casual Players? Investigating Player Differences in Full-body Game Interaction

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ABSTRACT

Full-body motion gestures enable realistic and intuitive input in video games. However, little is known regarding how different kinds of players engage/disengage with full-body game interaction. In this paper, adopting a user-typing approach, we explore player differences and their preferences in full-body gesture interaction (i.e., Kinect). Specifically, we hypothesize three human factors that influence player engagement in full-body game interaction, i.e., the player's *motivation to succeed* (achiever vs. casual player), *motivation to move* (mover vs. non-mover), and *game expertise* (gamer vs. non-gamer). To explore the hypotheses, we conducted an experiment where participants were tasked with playing three different video games supporting full-body game gestures. The results suggest a significant correlation and main effect of the three factors on players' engagement. The results also suggest three important game properties that affect players' preferences: level of cognitive challenge, level of physical challenge and level of realistic interaction.

Author Keywords

Full-body interaction; video games; motion gestures; player differences; Kinect.

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous.

INTRODUCTION

Full-body motion gestures enable realistic and intuitive input into video games. However, despite their intuitiveness, players may not always prefer full-body gestures for gameplay. Indeed, some players have reported that they did not enjoy full-body-based games even though they seem reasonably usable and natural (e.g., [1]). Without a clear understanding of player differences and how each different player envisages to enhance their gaming experience, it is difficult for designers to develop appropriate and effective full-body game interfaces.

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Several studies regarding how body movement influences players during gameplay have been conducted [3, 20, 12, 21, 22]. Yet, the different kinds of players and how they engage/disengage in full-body games remained unexplored. For example, in which context will players engage/disengage full-body games? In full-body game interaction, who are the primary targeted users? If any? Are full-body games reserved for casual players only? How can designers better support the wide variety of players? Understanding the rationale behind players' preferences could enable designers to develop more enjoyable and effective full-body game interactions.

To investigate these questions, adopting a user-typing approach [2, 4], we explore player differences and their preferences in full-body game interaction. Specifically, we hypothesized three human factors that influence player's engagement (Figure 1). To explore the hypotheses, we conducted a formal experiment with 16 participants. The results revealed a significant correlation and main effect of the three factors on different subscales of player engagement. Further analysis also revealed three important game properties that associates with players' preferences: level of cognitive challenge, level of physical challenge, and level of realistic interactions.

RELATED WORK

Past works have investigated how body movement influences player engagement in body game interaction. Bianchi-Berthouze [3] and Isbister et al. [15] found that body movements enhance emotional and social experiences during gameplay. Isbister et al. [16] added that there seems to be a correlation between a high amount of movement and fun. Regarding player motivation, Pasch et al. [22] and Nijhar et al. [21] found that players exhibited two distinct kinds of motivation: the motivation to achieve or to relax and that these players exhibited different level of immersion based on their varying level of motivation to achieve or to relax. Players who are motivated to achieve tend to exhibit more efficient, low movement gestures when compared to players who are motivated to just relax. Regarding heuristics of body movements, Pasch et al. [22] proposed four features of body movements that influence player engagement: *natural control*, *mimicry of movements*, *proprioceptive feedback*, and *physical challenge*. Pasch et al. further linked each features to Ermi and Mäyrä SCI model [10], i.e., *sensory* immersion, *challenged-based* immersion, and *imaginative* immersion.

Freeman et al. [11] and Müller et al. [20] explored full-body game interaction in public places and found that social context is just as important as the interaction itself. On the other hand, Gerling et al. [12] studied suitable full-body gestures for older adults. Some suggested guidelines include fatigue management, individual difference support, and easy gesture recall.

Regarding the user-typing approach [4], Bartle [2] identified four player types in Multi-User Dungeon (MUD) games: Achievers, Killers, Explorers, and Socializers. Yee [23] empirically confirmed the intersection of these four player types and proposed three major components composing player motivation: Achievement, Social, and Immersion . On the other hand, Kallio et al. [17] identified three primary player mentalities in video games: casual; committed; and social.

Past works indicated lifestyle (sedentary/active) may affect how players engage in full-body interaction. Based on Shaw's framework [8], Pasch et al. [22] argued that the engagement of sedentary players may be affected by their perception of the game. When they perceive the game as a serious exercise or as a highly competitive activity, they might prefer to avoid playing it. On the other hand, when they perceive the game as a playful activity, they might engage in the game. This has yet to be proven nevertheless. On a related note, Eastwick et al. [9] indicated that players' behavior in the real-world (e.g., lifestyle) is transferable to the digital world.

There are also some indications that prior experience may affect player engagement in full-body interaction. Based on the mere-exposure theory [24], players may develop an unconscious preference for familiar things (e.g., gamepad controller), resulting in certain expectations. Relating to that, McMahan [19] mentioned that meeting players' expectations is one important condition for reaching immersion. Thus, players who normally play games may not enjoy full-body game interactions when the interaction is limited by comparison with their past gaming experiences using mouse/keyboard or gamepad controller.

Relating to disengagement in video games, Brown and Cairns [5] identified possible immersion barriers, including game control, feedback, task, plot, and atmosphere. This suggested that the way different players engaged in full-body games may depend also upon the type of games.

PRELIMINARY PILOT STUDY

To gain a preliminary understanding of player differences, we conducted an informal pilot study. To further improve the generalizability, we also conducted a survey of player reviews of full-body game experiences in high-traffic gaming sites.

In the informal pilot study, three participants were tasked with playing "*Kinect Adventure*". The participants were asked to play freely for around 30 minutes. We observed them during gameplay and interviewed them on their gaming experience and motivation. The interviews and observations reflected differences in players in three primary ways, i.e., participants differ in i) the amount of motivation they want to move (people who don't like to perform outdoor exercises appear to have low motivation), ii) they differ in their expectations of games (e.g., hardcore gamers expect more), and iii) they differ in their motivation (game purpose) to win or to relax. Crosschecking with players' reviews in high-traffic gaming sites, aside from usability or hardware recognition issues, we found similar player differences as in our pilot study, though the crosschecking may be biased by our initial pilot study.

Figure 1. Three human factors possibly affecting player engagement: player's *motivation to succeed*; player's *motivation to move*; and player's *gaming expertise*. This study investigates how these factors affect players' engagement.

As a result of the two studies, three factors that appear to affect players' engagement were identified: Motivation to succeed, motivation to move, and gaming expertise (Figure 1). First, similar to [21, 22], players showed differences in their levels of motivation to achieve or to relax which may shape how players strategize their play. Second, players differed in their levels of motivation to move. Third, player differences in prior gaming experiences appear to also affect players' behaviors and expectations during gameplay. Based on these observations, we formulated three hypotheses as the followings.

Success Motivation Hypothesis

This hypothesis was formulated based on the findings of [21, 22] and our pilot study. This hypothesis predicts that when players are motivated to win/succeed or to achieve certain things in the games (achievers), they are motivated to search for the most efficient way to accomplish tasks. When a full-body game is competitive and offers efficient ways to interact, achievers will likely engage in the game. Vice versa, the lack of perceived competitiveness or inefficient control will likely hinder the (engagement and) experience of achievers. On the other hand, when players play the game solely to relax or to enjoy it with friends/family (casual players), the players are likely to enjoy and engage in full-body gestures, as they provide high levels of social and affective enjoyment [3] and relaxation. In addition, overly difficult challenges may not be perceived as fun/relaxing for casual players.

Movement Motivation Hypothesis

Player motivation to move refers to the player's general personality to enjoy or avoid moving. Two major groups of players can be classified: movers and non-movers. "Movers" refer to players who enjoy physical activities in real-world (sports or outdoor physical activity) and thus possibly transfer this motivation to digital games as well [9]. On the other hand, "non-movers" refers to players who prefer to avoid unnecessary movements, as they may consider full-body games to be tiring and cumbersome. The hypothesis predicts that movers are likely to engage in full-body interactions while non-movers possess a tendency to avoid full-body interaction when possible. According to [8, 22], the hypothesis also predicts that in full-body games, non-movers are likely to achieve higher engagement in full-body games that they perceive as playful rather than in games that they perceive as serious and competitive.

Expertise Hypothesis
Game expertise refers primarily to experience in the context of gaming frequency and players can be classified as gamers and non-gamers. There are two subconstructs of gaming expertise that may affect player's experience in full-body interaction. First, given high game expertise, gamers may develop an affinity (bias) toward traditional inputs such as a gamepad controller or a mouse/keyboard interface according to the mere-exposure theory [24]. Second, since there is a high tendency for these gamers to exhibit longer sessions of gameplay compared to non-gamers, gamers may tend to avoid full-body interaction as they anticipate that the experience will be tiring over lengthy gameplay. Based on these two subconstructs, the hypothesis predicts that gamers might have some tendency to disengage full-body gestures when the interaction does not meet their expectations. On the other hand, non-gamers may be more easily engaged in full-body game interaction as it is possibly perceived as easy to learn and master, and natural and intuitive [18].

FULL-BODY GAME GESTURES STUDY
To evaluate the three hypotheses, we conducted a study analyzing participant engagement and preferences in three different Kinect games. By analyzing engagement, we were able to explore different kinds of players and investigate their engagement and disengagement patterns when playing full-body games.

Selecting games
Before the study, several full-body games were explored based on several suitability criteria. The games should first be of high quality and thus pose little or no usability issues. Usability issues were generally understood to be possible recognizer issues or requiring awkward combinations of motion gestures. The high quality of games was quantified based on players' review scores from various gaming sites. Second,

Figure 2. Participants play three games using Microsoft Kinect controller. *Virtual Tennis 4* (left), *Forza 4* (mid), *London Olympics 2012* (right).

Games	Perceived Competitiveness	Realistic Interaction	Movement paradigm	Physical challenge	Cognitive Challenge
Virtual tennis 4	High	High (like real-tennis)	Frequent and large axes of movement	High	High (required highly coordinated, frequent movements with the ball, arm, and the torso. Players also need to predict the ball movement from opponents.)
Forza 4	Medium	Low (players only required to steer left/right without having to brake or accel)	Infrequent and small axes of movement	Low	Medium (required eye attention on the road)
London Olympics 2012	Medium	Medium (partially realistic)	Frequent and medium axes of movement	Medium	Medium (required coordinated movements in some intervals)

Table 1. Overview of three games selected for study. They varied in their level of perceived competitiveness, level of realistic interaction, movement paradigm, level of physical challenge and level of cognitive challenge. They all provide a satisfactorily level of usability, i.e., adequate level of mimicry of movements and proprioceptive feedback. Realistic interaction refers generally to level of realism in controls and interactions, but not graphic-wise. Axes of movement refer generally to kinematics displacement. Physical challenges refer generally to the amount of body effort. Cognitive challenges refer to the amount of coordinating processing between perceptual processor, cognitive processor, and motor processor.

in order to keep the whole test setting within a reasonable time-frame, the games should also allow players to experience and enjoy the whole process of the game without necessarily spending overly long sessions of playtime. Third, the selected games should vary in their interaction paradigms thus allowing us to investigate how different kinds of players interact with different kinds of games. Three games were selected based on our criteria-*Virtual Tennis 4*, *Forza 4*, and *London Olympics 2012*. They varied in their relative perceived competitiveness, physical challenge, cognitive challenge, movement paradigm, level of realistic interaction, and hence provided helpful experimental tools to explore the hypotheses from different game types. Table 1 shows the relative differences.

Virtual Tennis 4 (VT)
VT is a tennis-sports game. VT supports full-body input without any reported usability issues. The game is played in the first-person view. The task is to role-play as a professional tennis player and compete with other A.I. controlled players. During the gameplay, players are required to swiftly move left and right by swaying the whole body, and to swing the whole arm to the left or right accurately and with good timing in order to drive the ball back to the opponent.

Forza 4 (FZ)
FZ is a racing game. FZ supports full-body input without any reported usability issues. The game can be played in the first-person or third-person view depending on the players' preference. The task is to complete a certain set of races.

Players are only required to perform a driving-wheel gesture and to steer left and right to finish the race (see Figure 2).

London Olympics (LO)
LO is a party game which is meant to be played at social gatherings. The task is to compete in different series of Olympic activities, e.g., running, hurdling, and javelin throwing. For the task, players were required to perform actual jumps according to timing and accuracy and to swing both their lower arms outward and inward repeatedly as frequently as possible (e.g., hurdle).

Participants
16 university students (3 females, M=21.75 years) were recruited. They were all from Computer Science backgrounds.

Apparatus
Microsoft Xbox 360 and Microsoft Kinect were used connecting with a SHARP Aquos 60-inch flat screen LCD display hung vertically. Other equipment and software included a Panasonic HDC-TM45 1920x1080 video camera, the three Kinect games, and related questionnaire forms.

Design
Participants were tasked with playing three TV games using Kinect full-body gestures in a within-subject design. The sequence of the three games was randomized and counterbalanced using Latin Squares. Participants were instructed to complete a series of tasks for each game. To minimize any possible effect of difficulty factor, we ensured that all games were played at the same difficulty level and with similar game tasks across participants. To also ensure that there was no effect from possible visibility issues, all participants stood/sat approximately 1.8 meters away from the large display. During the gameplay, for our participants to fully enjoy and experience the games, we kept the testing environment away from possible interference, e.g., experimenters did not interrupt or ask any questions during the gameplay. The experiment was video and audio recorded for later analysis. After each game was tested, participants were asked to complete a self-report questionnaire measuring their preference and engagement. To collect qualitative data, we conducted an interview afterward.

Players' contextual info was collected using predefined forms comprising a series of questions. Gaming expertise was rated on a 5-point Likert scale with 5 representing high gaming expertise in a series of three items, i.e., gaming frequency per week, gaming hours per game per time, and gaming years. Gaming expertise was collected prior to the actual experiment session.

Players' general motivation to move was rated on a 5-point Likert scale with 5 as "strongly agree". It was measured using a series of six items, e.g., "I enjoy moving with my body", "I do not mind moving my body during gameplay". This information was collected prior to the experiment.

As for "motivation to succeed", we considered this as dependent upon different games. Thus, after each game was played, prior to the questionnaire session, players were asked a series of five items rated on a 5-point Likert scale with 5 as "strongly agree", e.g., "I put a lot of effort into the game", "I got easily stressed during the gameplay", "I play to relax my body and mind".

Procedure
All participants were first informed about the aim and procedure of the study. They were then asked to sign consent a form regarding possible physical injury and to fill in demographic info (e.g., gaming expertise, general motivation to move). Before the gaming session, the three games were presented for 5-minutes and could be trialed until participants become familiar with the input and game mechanics, and were able to play by themselves. Then participants were assigned to play each game in randomized order. After playing each game, a questionnaire session (measuring players' engagement and motivation to succeed) and semi-structured interviews were conducted. Each experimental session of each game took around 15 minutes with a 5-minute break between. The whole experiment took around 1 hour per participant.

Metrics
The measurement of gaming experience involved largely self-reported measures, namely questionnaires. For our study, we used the Game Experience Questionnaire (GEQ) core questionnaire module [14]. The questionnaire measured seven dimensions: Immersion (Imm), Flow (Flo), Competence (Com), Tension (Ten), Challenge (Cha), Positive Affect (PoA) and Negative Affect (NoA). Each item was measured in a Likert 7-scale response with 7 as strongly agree. To keep the questionnaire within a reasonable timeframe, the social module and post-game module of GEQ were discarded. Three relevant items were added to the questionnaire:"I prefer to use Kinect for this game" (Prf), "I feel difficult when playing Kinect" (Dif), and "I feel fatigued using Kinect" (Fat).

RESULT AND ANALYSIS

Demographic information
User demographic info scores (gaming expertise, motivation to move, motivation to succeed) were aggregated into an average score with high internal reliability of Conbrach α ranging from 0.86 to 0.92. We did not find any significant correlation between player types, e.g., no correlation between gamer participants and achiever participants.

We used cluster analysis to classify possible numbers of player types according to the participants' given demographic info. For each player's dimensions (gaming expertise, motivation to move, motivation to succeed), two primary groups of players can be classified: gamers vs. non-gamers, movers vs. non-movers, and achievers vs. casual players. Non-gamers scored an average of 1-2 in the scale of gaming expertise while the rest are gamers. Non-movers scored an average of 1-2.5 in the scale of motivation to move. Casual players scored an average of 1-2.5 in the scale of motivation to succeed.

For Kinect experiences, seven reported to have no experience in Kinect or full-body game interaction. Another eight reported one to three times, and one reported four times. None had ever experienced any of the three games.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Age	21	21	23	21	21	22	22	20	23	24	19	19	22	22	25	23
Gender	M	M	M	M	M	F	M	M	M	M	F	F	M	M	M	M
Kinect Exposure	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	No	No	Yes	No	Yes	Yes
Movers vs. Non-movers	M	M	M	NM	NM	M	M	NM	M	NM	M	NM	M	NM	M	M
Gamers vs. Non-gamers	G	G	G	G	NG	NG	G	NG	G	NG	NG	NG	G	NG	G	G
Achievers vs. Casual players	V F L	V F L	V F L	V F L	V F L	V F L	V F L	V F L	V F L	V F L	V F L	V F L	V F L	V F L	V F L	V F L
(for each game)	T Z O	T Z O	T Z O	T Z O	T Z O	T Z O	T Z O	T Z O	T Z O	T Z O	T Z O	T Z O	T Z O	T Z O	T Z O	T Z O
	A A C	C C C	A A C	A C A	C C C	A C C	A C C	A A A	A A A	A A A	A A A	C A C	A A C	A A A	A A C	C C C

Figure 3. Distribution of participants' demographic info. VT(Virtual Tennis); FZ(Forza); LO(London Olympics). We did not find any significant correlation between player types (e.g., achievers vs. gamers).

	Imm			**Flo**			**Com**			**Ten**			**Cha**			**PoA**			**NoA**			**Prf**			**Dif**			**Fat**		
Games	VT	FZ	LO	VT	FZ	LO	VT	FZ	LO	VT	FZ	LO	VT	FZ	LO	VT	FZ	LO	VT	FZ	LO	VT	FZ	LO	VT	FZ	LO	VT	FZ	LO
Motivation to move	**0.53***	0.37	0.23	0.37	0.21	0.13	**0.50***	**0.56***	0.24	**0.54***	0.22	0.17	0.40	0.08	0.26	0.44	0.27	0.17	0.36	0.32	0.05	0.39	**0.57***	0.05	0.28	0.05	0.17	0.22	0.16	-0.42
Gaming expertise	0.34	0.10	**0.68****	0.38	0.01	**0.68****	0.43	0.05	0.45	0.11	0.48	0.13	0.31	0.07	0.33	0.45	0.19	**0.56***	0.35	0.005	**0.62****	0.35	0.18	**0.61***	0.31	0.18	0.47	**0.50***	-0.12	0.25
Motivation to succeed	**0.54***	-0.34	0.007	**0.69****	-0.39	0.004	**0.57***	-0.06	0.46	0.30	-0.27	0.38	0.44	0.05	0.35	**0.54***	-0.36	0.04	**0.79*****	-0.03	0.13	0.43	-0.36	-0.04	**0.78*****	-0.28	-0.07	**0.55***	-0.20	0.08

Figure 4. Pearson correlation matrix of Motivation to move, Gaming expertise, Motivation to succeed vs. seven subscales of GEQ. Three additional items are Preference (Prf), Difficulty (Dif), and Fatigue (Fat). (2-tailed Sig.: *=$p<0.05$; **=$p<0.01$; ***=$p<0.001$)

There were three female participants in the study. All female participants were non-gamers. During the study, we did not observe any gender-specific differences between the female participants and the male non-gamer participants.

Figure 3 summarizes the distribution of participant demographic information.

Quantitative Results

Questionnaire scores for each item (Immersion, Flow, Competence, Tension, Challenge, Positive Affect, Negative Affect) were aggregated into average scores since all scales produced high levels of internal reliability with Conbrach α ranging from 0.82 to 0.97. In addition to the three additional items (preference, difficulty, fatigue), total of ten scales were measured.

To analyze any correlation or significant main effects, Pearson correlation analysis and MANOVA were conducted.

Pearson correlation data

To analyze a possible correlation of Motivation to move, Motivation to succeed, Gaming expertise vs. Immersion, Flow, etc., we conducted the Pearson correlation analysis which resulted in the Pearson Correlation Matrix (see Figure 4). There were significant correlations for all three factors in different subscales of engagement suggesting their general association with player engagement.

As shown in Figure 4, across different games, there were significant correlations ($p<0.05$) between Motivation to move and Immersion, Competence, Tension, and Preference; significant correlations between Gaming expertise and Immersion ($p<0.01$), Flow ($p<0.01$), Positive Affect ($p<0.05$), Negative Affect ($p<0.01$), Preference ($p<0.05$), and Fatigue ($p<0.05$); and significant correlations between Motivation to succeed and Immersion ($p<0.05$), Flow ($p<0.01$), Competence ($p<0.05$), Positive Affect ($p<0.05$), Negative Affect ($p<0.001$), Difficulty ($p<0.001$), and Fatigue ($p<0.05$).

MANOVA

To analyze possible effects of the three independent variables (Movers vs. Non-movers, Achievers vs. Casual Players, Gamers vs. Non-gamers) on several dependent variables (e.g., Immersion, Flow), a three-way multivariate analysis of variance (MANOVA) was conducted.

Comparing movers and non-mover participants, there were significant differences in Immersion ($F_{1,14}$=5.052, $p<0.05$), Flow ($F_{1,14}$=4.676, $p<0.05$), and PoA ($F_{1,14}$=6.68, $p<0.05$) (see Figure 5). The differences were found only in VT. Mover participants exhibited generally higher engagement across all games compared to non-movers. This confirmed our hypothesis that movers have higher tendency to prefer full-body interaction compared to non-movers. Comparing the three games, there was no significant interaction effect between the three games and movers/non-movers. The results suggested that the perceived competitiveness of the games does not seem to affect how movers and non-movers choose to engage in full-body games.

Comparing gamer and non-gamer participants, there were significant differences in Immersion ($F_{1,14}$=7.06, $p<0.05$), Competence ($F_{1,14}$=7.619, $p<0.05$), Positive Affect ($F_{1,14}$=8.776, $p<0.05$)and Fatigue ($F_{1,14}$=7.35, $p<0.05$) in VT; a significant difference in Tension ($F_{1,14}$=4.765, $p<0.05$) in FZ; and a significant difference in Immersion ($F_{1,14}$=5.585, $p<0.05$) in LO (see Figure 6). Gamer participants scored generally higher engagement across all games compared to non-gamers. This invalidated our hypothesis, i.e., our gamers achieved higher engagement than non-gamers despite the possible effect of expectations. Non-gamer participants also did not show any higher engagement of full-body gestures compared to gamers. Comparing the three games, there was no significant interaction effect between the three games and gamers/non-gamers.

Comparing achievers and casual player participants, there were significant differences in Flow ($F_{1,14}$=5.116, $p<0.05$),

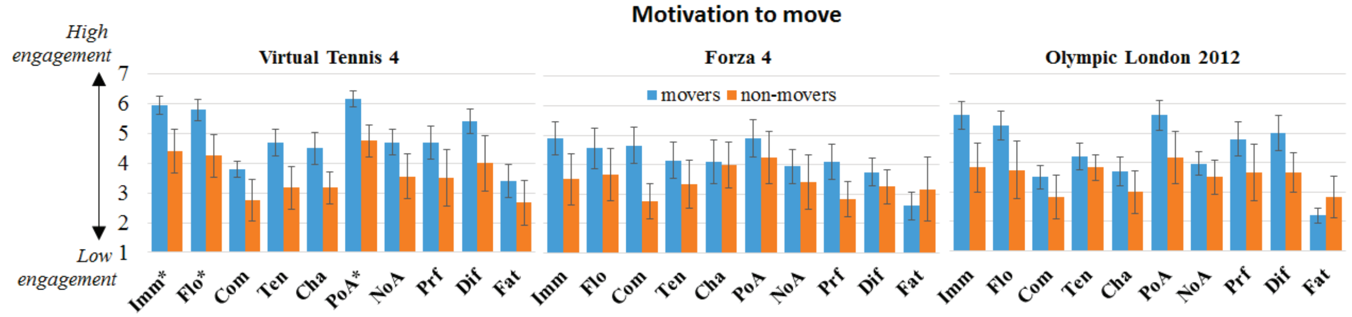

Figure 5. Motivation to move - a significant difference between movers and non-movers in Imm, Flo, and PoA. The difference was only found in Virtual Tennis. 7 represents high engagement; NoA, Dif, and Fat were reversed (e.g., 7 in Fat represents low fatigue). (2-tailed Sig.: *=p<0.05; **=p<0.01; ***=p<0.001)

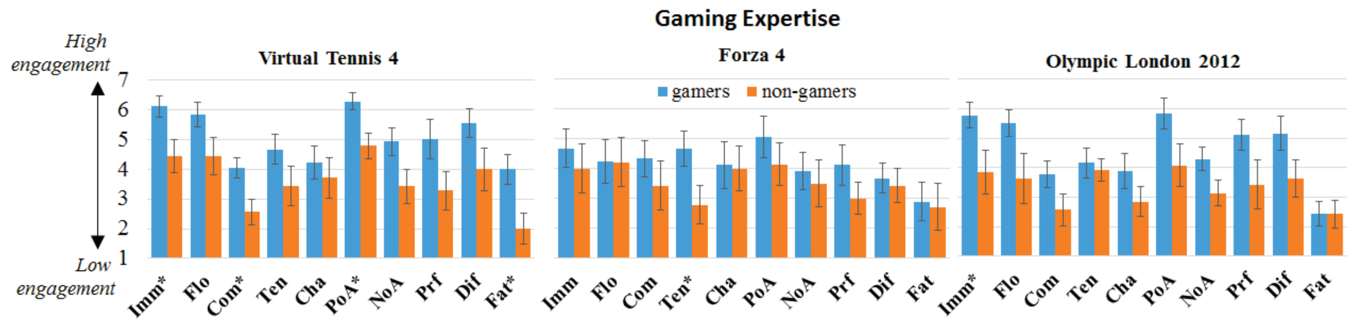

Figure 6. Gaming expertise - a significant difference between gamers and non-gamers in Imm, Com, PoA, and Fat in Virtual Tennis; Ten in Forza 4; and Imm in Olympic London.

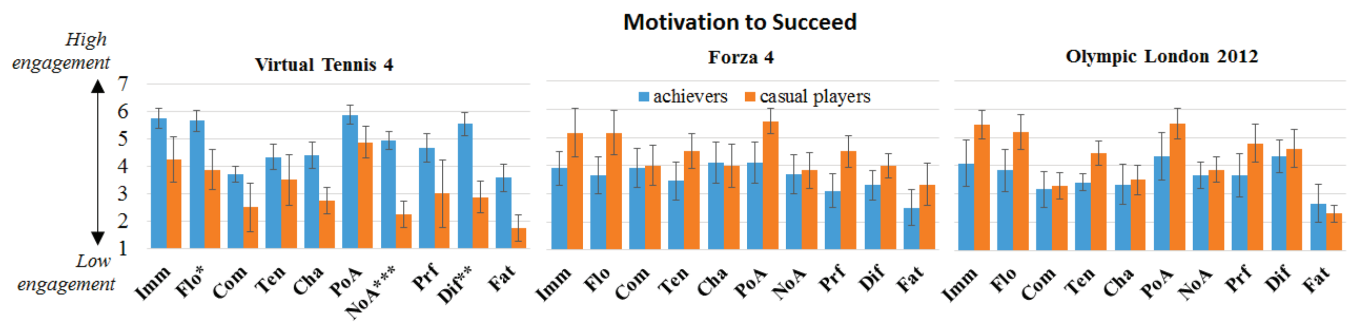

Figure 7. Motivation to succeed - a significant difference between achievers and casual players in Flo, NoA, and Dif. The difference was only found in Virtual Tennis.

Negative Affect ($F_{1,14}$=17.545, $p<0.001$), and Difficulty ($F_{1,14}$=10.894, $p<0.01$) in VT (see Figure 7). Achiever participants scored generally higher engagement in VT, while casual player participants scored higher in FZ and LO. This confirmed our hypothesis as achiever participants achieved significantly higher engagement in VT (competitive with efficient controls), but scored generally lower in FZ (competitive but unrealistic controls) and LO (uncompetitive with medium realistic controls). Comparing the three games, there were significant interaction effects between the three games and achievers/non-achievers in Flow ($F_{2,42}$=3.43, $p<0.05$), Negative Affect ($F_{2,42}$=4.19, $p<0.05$), and Difficulty ($F_{2,42}$=3.83, $p<0.05$). A Posthoc Bonferroni comparison confirmed only the differences ($p<0.05$) of preference for achiever participants between VT and FZ in Immersion, Flow and Difficulty.

The rationales behind these results are explored in the following section regarding qualitative data analysis.

Qualitative Results

Achievers and casual players showed obvious differences in their game preferences. Achievers tend to emphasize their priorities as perceived competitiveness and realistic interaction. On the other hand, casual players tend to prefer less competitive games that are not necessarily highly realistic. For example, achiever participants commented that they enjoy VT when they feel competitive with both high physical challenges and cognitive challenges presented, and when the interaction feels realistic. Meanwhile, our achievers complained at the lack of physical challenges, the lack of realistic interaction in FZ (little movements and unrealistic interaction - players only steer hand left/right) or lack of cognitive challenges in LO (require frequent movements such as shaking hands frequently but pose no high cognitive challenges). LO was sometimes deemed unsatisfactory regarding to' 'realistic interaction" as well, e.g., not eliciting similar movements compared to real world Olympic sports. Two achiever participants quit playing FZ and LO after 5 minutes for this latter reason. Nevertheless, while our achievers complained about FZ and LO, casual players mentioned that FZ and LO are cozy to play due to the simple movements. It also seems that the level of realistic interaction, although there is an impact, has less impact on casual players when compared with achiever needs.

Interviews with movers and non-movers show substantial evidence that their daily lifestyle is transferable to the digital world. Mover participants reported that full-body games are preferable because they can enjoy exercises through game play. On the other hand, non-mover participants tend to disengage full-body games as they feel tired after a few minutes. These non-movers tend to elicit gestures that use minimum physical effort. Through our interviews, we also found that fatigue does not only derive from the amount of movements or axes of movements, but also from performing static gestures over a long period of time. For example, although FZ elicits only a low amount of movement, participants felt tired because they needed to keep their hands up the entire time. We also found that fatigue is not always bad, as some participants mentioned "tiredness is not always negative if I (they) can enjoy the games". Indeed, it seems that game is perceived as highly enjoyable when a high requirement of dynamic movement is required and at the same time, those movements yield some meaningful game output. For example, many participants positively commented that dynamic movements are essential for enjoying full-body games, especially in VT and LO. In any case, all participants mentioned that prolonged fatigue, especially of static gestures, will make them feel tired and disengaged eventually.

Regarding gamers and non-gamers, our interviews show that gamers still tend to enjoy games more, regardless of our previous "expertise" hypothesis. We further discussed this null hypothesis in the discussion section. For gamers, it appears that cognitive challenges are important factors for their enjoyment. For example, gamer participants mentioned that to swing the ball with precise timing was challenging and thus fun.

To further identify important features of full-body game interaction, we used the grounded theory approach [13] where each participants' response was coded and clustered into different categories. Twelve features were identified that affect participants' enjoyment in the game: *Easy-to-understand control*, *ease of learning*, *naturalness*, *amount of fatigue vs. fun levels*, *realistic interaction*, *level of difficulty*, *social opportunities*, *amount of movements*, *opportunities-to-act*, *opportunity to exercise*, *large appropriation of same gesture*, and *mimicry of movements*. In general, participants prefer full-body games that include these following features: easy-to-understand and natural control mechanics; easy to learn gameplay; high fatigue should be rewarded with high level of perceived fun (and in-game accomplishment); interaction that mapped to actions in the real-world; level of game difficulty that is appropriate to their physical capability to move; opportunities to play socially with friends/family members; more frequent and dramatic movements seems more exciting; provide many possible ways to interact with the games; provide opportunities to exercise; allow large appropriation of same gesture; and effectively mimic the actions players want to perform. Table 2 summarizes players' positive and negative comments for each game.

	Positive comments	Negative comments
Virtual Tennis	• Natural to play • Easy-to-understand control • Do not care about fatigue as it is fun • It's like real tennis • No need to learn • Allow large appropriation of the same gesture • Can enjoy exercise	• Difficult to understand the easy way to beat A.I., as they are sometimes quite difficult • Can be very tiring • Sometimes frustrated with the difficulty • Difficult to understand the accurate timing of swing • The game is difficult without experience in real-world tennis
Forza 4	• Natural to play • Easy to play, because no acceleration and no brake	• Tired because of keeping two arms up • Limitation of playing (no acceleration and brake) • Can be too easy, so no fun • Small movements so not so excited • Not challenging
Olympics London 2012	• Easy to understand • Seems fun when my friends play too • Can enjoy exercise • The very frequent movements are very exciting	• Can be too easy, so no fun • Unrealistic interaction (violates physics) • Easy to get tired • Little things players can do (like only jump or swing arms) • The actions I perform don't behave how I want to • The game's difficult without experience in real-world physical activities

Table 2. Positive and negative comments between games.

DISCUSSION AND FUTURE WORK

The study confirmed that full-body game gestures are not always only for casual players but can be equally enjoyable for achievers. In VT, given the high physical challenge and cognitive challenge, these challenges stimulated our achiever participants' drive to compete and succeed. While most challenges in non-body-based games such as FPS or Action games that stimulate players are primarily cognitive [6], challenges in body-based games that stimulate players appear to be necessarily both cognitive and physical. Achiever participants did not enjoy full-body games with relatively lower physical challenge or lower cognitive challenge such as FZ and LO as much as casual player participants as these two games are possibly not as (physically or cognitively) challenging as VT. Based on this, it might imply that challenged-based immersion [10] is more likely to occur in full-body based games when both high physical and high cognitive challenges are presented, as opposed to only cognitive challenges as stated in [6].

The level of realism presented by the interaction also affects achievers and casual players differently. Our achiever participants tend to enjoy more realistic interaction, as there may be a need for them to feel more immersed in their competitive gameplay. On the other hand, our casual participants seems to put less attention on how realistic the interaction is, and more attention on whether they can simply play to relax and enjoy the game. For example, our casual participants commented that FZ is fun and relaxing as they can easily just steer left/right. The perceived competitiveness also seems to interfere with the level of realistic interaction. For example, given that most typical racing games are perceived by achievers to be highly competitive, achievers expected that the game should provide the most efficient way to play the game. Given that our racing game (FZ) does not allow players to break or accelerate but just to steer left/right, our achiever participants quickly lost interest.

It is not surprising that our mover participants achieved generally higher engagement in all three Kinect games, compared to non-movers, especially in high movement games such as VT and LO. We however did not observe a similar prediction to Pasch et al. [22], as Pasch et al. predicted that non-movers may have high engagement in a playful game (i.e., LO) compared to more competitive games (e.g., VT, FZ). But perhaps LO might not be playful enough from the beginning, or maybe the study did not involve playful enough context such as playing the games with friends. In any case, when playing as a single player, it seems rather difficult for non-movers to actually enjoy these full-body games. It would be interesting to study whether other semi-body controllers (e.g., Nintendo Wii Remote) will prove more appealing to non-movers, compared to full-body game gestures, as we feel it is important to encourage these non-movers to exercise or regularly move.

Our gamers showed generally higher engagement in the three games compared to our non-gamers, thus invalidating our hypothesis. This may be because our classification was mainly based only on gaming frequency and thus associated with a generally higher gaming interest. As a result, the findings are not surprising. If we were to prove the expertise hypothesis (expectations effect), it may be perhaps better to investigate the players' game genre preferences against full-body games with the same game genre. In that way we may able to better observe any significant expectations effect. Another possible reason is that, because all our games have substantially few reported usability issues thus the effect of expectations was minimized. In the expertise hypothesis, we also predicted that non-gamers tend to enjoy full-body games as the interaction seems to be easy to learn and intuitive. However, our study suggested that the resistance of non-gamers does not derive only from natural control but also from unsuitable cognitive challenges. For example, some non-gamers found it difficult to swing with precise timing, or to perform simultaneous actions quickly, and they seemed to gradually lose interest.

In summary, of the three factors, the motivation to succeed appears to be the primary predictor of which kind of games players will engage in. The three game properties: physical challenge, cognitive challenge, and realistic interactions, correlate with the motivation to succeed. While all high level (high physical challenge, high cognitive challenge and high realism) will be required to target achievers, casual players may require less of the three components. Indeed, casual players tend to dislike high physical or cognitive challenge. Nevertheless, the choice of games can also be influenced by secondary factors such as motivation to move (level of tolerance to physical challenge) and gaming expertise (suitable cognitive challenge [7] and level of intuitiveness in controls and interactions). In any case, to design enjoyable full-body games for any targeted users, there is a need for designers to consider three game properties: (i) appropriate level of physical and (ii) cognitive challenge, and (iii) realistic controls and interactions.

After the experiment, we also asked our participants to conduct Bartle test [2], which then grouped their playing personality to Killers, Achievers, Explorers, and Socializers. We found most casual player participants scored high as Socializers, while achiever participants scored high in one or more of the following - Killers, Achievers, Explorers. This might imply that social experience is an important feature for most casual players. On the other hand, achievers are motivated to either play to achieve game objectives, explore, or to specifically beat their friends.

To design full-body games that support variety of players remain a big challenge. While our study indicated the three factors are important, better engagement factors for non-movers and non-gamers has yet been answered. Deep analysis of our interviews suggested social factor as the most promising tool to motivate these players. P5 and P8, who are both non-mover and non-gamer, mentioned that they would enjoy full-body games more if those games poses meaningful social enjoyment. How to design meaningful social enjoyment remains to be studied.

Future works includes the investigation of how the social context can influence the experience of different player types in full-body games, the investigation of the effects of the player gaming context (genre) in full-body game interactions, and the investigation of specific video game interactions or paradigms that motivate non-movers to move (e.g., semi-body interactions).

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