Control Your Game-Self: Effects of Controller Type on Enjoyment, Motivation, and Personality in Game

Max Birk and Regan L. Mandryk
Department of Computer Science
University of Saskatchewan
110 Science Place, Saskatoon, SK, S7N 5C9
{firstname.lastname}@usask.ca

ABSTRACT
Whether they are made to entertain you, or to educate you, good video games engage you. Significant research has tried to understand engagement in games by measuring player experience (PX). Traditionally, PX evaluation has focused on the enjoyment of game, or the motivation of players; these factors no doubt contribute to engagement, but do decisions regarding play environment (e.g., the choice of game controller) affect the player more deeply than that? We apply self-determination theory (specifically satisfaction of needs and self-discrepancy represented using the five factors model of personality) to explain PX in an experiment with controller type as the manipulation. Our study shows that there are a number of effects of controller on PX and in-game player personality. These findings provide both a lens with which to view controller effects in games and a guide for controller choice in the design of new games. Our research demonstrates that including self-characteristics assessment in the PX evaluation toolbox is valuable and useful for understanding player experience.

Author Keywords
Personality, motivation, self-discrepancy theory, self-determination theory, games, controller

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Human Factors; Design; Measurement.

INTRODUCTION
Whether they are made to entertain you, or to educate you, good video games engage you. Good games draw the player in and keep them engaged during play, and an engaged player will give the game a better chance of success at its intended purpose, irrespective of whether that be to divulge or divert. Because it is so important for games to be engaging, there has been significant effort from researchers and practitioners in identifying and distilling the essential ingredients for successful and engaging game design. These efforts have taken both a prescriptive approach (i.e., attempting to formulate rules for game design), and an analytic perspective (i.e., measuring play experience).

The analytic approach to understanding player experience (PX) has taken many forms. Significant research has been conducted on operationalizing concepts important to PX (e.g., engagement, flow) [4], and measuring these concepts by instrumenting [16], observing [13], and surveying [11] the player. Although prior research on measuring PX applies various methodological approaches, what previous work has in common is that it all attempts to quantify or qualify the player's experience. However we suggest that to fully understand PX, we must understand both how a player feels about a game and how they feel about themselves during gameplay. For example, consider a role-playing game that rewards players who steal items from their teammates. A player might be engaged and get satisfaction from exercising their stealth inside the boundaries of the game, but quit playing, because succeeding makes them feel sleazy. In this case, the important information is not *how the player feels about the game*, but about *how the game makes them feel about themselves*.

Previous work has introduced the idea of considering a user's experience of themselves during play by investigating a user's in-game trait personality; however, this application of in-game personality has been only in the context of sociological exploration of virtual worlds [39], association with in-game avatars [2] or preference of game genre [23], and not for the purpose of PX evaluation. To investigate the relationship between player experience of a game and a player's in-game personality (how they felt about themselves), we chose to compare the effects of different game controllers. Studying game controllers is a natural choice for this research as the controller acts as the interface between the player and the game – it is the device through which players engage with the game. Previous work comparing input devices in gameplay has focused on measuring performance differences in terms of targeting [20] or steering [1], or player experience differences in terms of spatial presence [34, 36] or immersion [25]. These studies show that controller does affect PX, making

CHI 2013, April 27–May 2, 2013, Paris, France.

controller a good experimental manipulation – we assume that different controllers will elicit different play experiences; however, in this research we ask the question: *could the choice of game controller have an impact on the player's perception of themselves during play*?

We explore how the type of controller used during game play affects the player's game experience in terms of their enjoyment and their motivation. More importantly, we show how controller choice affects a player's perception of themselves and how their perceived personality (using the five factor model [10]) within the game (*game-self*) compares to their idealized version of themselves (*ideal-self*) and their reality (*actual-self*) [8]. To experimentally determine the role of controller on PX, we designed and implemented a custom game that allowed us to compare three controller types (Microsoft Kinect, PlayStation Move, and Xbox GamePad).

Our results show that the choice of controller affects our enjoyment and motivation to play. Further, we show how playing with different types of controllers changes how we satisfy our needs within game play and how we perceive ourselves in a game. Specifically, the choice of controller affects our perceived Agreeableness and Neuroticism. In addition, we show that change in game-self is the biggest predictor of both enjoyment and motivation to play. These findings provide both a lens with which to view controller effects in games and a guide for controller choice in the design of new games. Our research demonstrates that including personality assessment in the PX evaluation toolbox is valuable for understanding player experience.

RELATED WORK

In this section we provide an overview of existing approaches to evaluating PX, the application of cognitive evaluation theory and personality theory to understanding PX, and previous work on how controller affects PX.

Evaluating Player Experience

Early attempts at game experience evaluation appropriated methods from classic usability evaluation, but researchers quickly discovered that games have different goals (e.g., to challenge the user) and constraints (e.g., interrupting players would break the experience) than productivity software [9]. To combat these differences, researchers proposed revising methods of traditional user experience evaluation for use in games, including revised heuristics for playability evaluation [26] and revised questionnaires appropriate for the gaming context [27]. In addition, new methods were created, including new survey instruments (e.g., [11]), psychophysiological methods of evaluation [16], and event log analysis [12] (what has now become known as telemetry, game metrics, or game analytics [33]).

An increasingly active field of research, the goal of game experience evaluation is to understand how the game affects the emotional and cognitive experience of the player to produce the desired outcome of ‘fun’ [5]. Although a few evaluation approaches have been based on theory [37], the grounding of PX evaluation in established theories of human behaviour is lacking. Furthermore, a majority of studies that measure game experience do not leverage the research in validated evaluation approaches and instead apply ad-hoc surveys to gather participant responses.

Self Determination Theory for PX Evaluation

The first psychological theory with validated scales that we explore for understanding PX is Self Determination Theory (SDT) [31]. We first describe the general theory and then provide examples of its use in understanding PX.

Overview of SDT

SDT is comprised of several mini-theories and focuses on factors that influence motivation. One mini theory, Cognitive Evaluation Theory (CET) [31], describes intrinsic motivation in terms of competence and autonomy. To assess the factors that support intrinsic motivation in games, the concept (and evaluation instrument) of Player Experience of Needs Satisfaction (PENS) [32] was developed. We next describe the concepts within PENS.

Intrinsic Motivation. In terms of SDT, intrinsic motivation (IM) is defined by a locus of control inherent in the person, and an outcome attributed to volition and achievement. IM is distinct from external motivation, which is defined by an external locus of control, e.g., deadlines. CET proposes that IM is a function of autonomy, and competence.

Competence. CET proposes that the experience of competence derives from challenge, and the personal effort of mastering challenges. For example, the laddering used in many games provides a structure for players to exert effort to master successively harder challenges.

Autonomy. CET proposes that the experience of autonomy derives from volition and willingness to perform a task. For example, multiple in-game options give players cause to experience autonomy through willing decision-making.

Relatedness. Within SDT, relatedness is defined as the feeling of belonging to a group, and is an important factor for psychological well-being. Social games like FarmVille and massively multiplayer online role-playing games (MMORPGs) make extensive use of this concept.

Presence. PENS defines presence as “the sense that one is within the world”. Presence is fostered by competence and autonomy, and related to the flow concept [4] as the highest state of presence.

Intuitive Controls. PENS defines controls as intuitive, when they do not interfere with one’s sense of presence, are easily mastered, and make sense in context of the game.

Use of SDT in PX Evaluation

SDT has been applied in many psychological studies of motivation (see [31]), but has recently been extended to virtual environments and games. SDT was applied (using PENS) to identify how different game genres satisfy needs differently (e.g., experienced autonomy is highest in roleplaying and strategy games) [11]. In the context of game-based learning, [32] shows that experienced competence, autonomy, and relatedness increase motivation, positive mood, and the recommendation of a game. Finally, in [24], the authors validate the application of SDT (using PENS) to the domain of exergames, showing that SDT-guided game feature choices result in improved game enjoyment, game recommendation and game rating. Specific to the evaluation of input, [17] applied PENS to show that realistic and tangible controller mappings led to higher experienced autonomy and presence.

Self-Discrepancy Theory for Understanding Gameplay

The second psychological theory that we explore for understanding PX is Self-Discrepancy Theory [8]. Although it has not been applied directly to PX evaluation, it has been used to understand play. We first explain the general theory and then give examples of its use in games.

Overview of Self-Discrepancy Theory

Self-discrepancy theory is based on the assumption that people compare themselves to so called *self-guides*, or internalized standards [8], and has been applied in fields such as mental health and work-life balance (see [31]). Self-guides represent three domains of the self, namely the *actual-self* (i.e., the attributes we actually possess), the *ideal-self*, (i.e., the attributes or characteristics we ideally want to possess), and the *ought-self* (i.e., the attributes we – or another person – believe we should have).

A common way to assess self-guides is to use the five factor model of personality, commonly referenced as the Big Five [10]. Usually used to assess personality traits, the instructions are rephrased to use the following five factors to assess different states of self-characterization.

Extraversion (*E*) is a tendency to be energetic, outgoing, and assertive. People who score high on *E* tend to be involved in social activities, rather than spend time alone.

Agreeableness (*A*) is a tendency to be friendly, caring, and conflict avoiding. People who score high on *A* prefer co-operation to competition and are not likely to be aggressive.

Conscientiousness (*C*) is a tendency to show self-discipline, act dutifully, and aim for achievement. People who score high on *C* plan activities rather than engaging in spontaneity, and tend to be organized and dependable.

Neuroticism (*N*) is a tendency to be nervous, sensitive, and emotionally unstable. People who score high on N respond poorly to environmental stress, and are likely to experience stress and frustration in minor situations.

Openness to Experience (*O*) is a tendency to be intellectually curious, think abstractly, and to explore. People who score high on *O* are likely to try something new, rather than sticking to old beliefs and tradition.

Use of Personality Theory in Game Research

The use of personality theory in general – and the five factors in particular – have been useful for understanding play in several contexts. For example, the five factors of personality have been shown to correspond with a player's preferred genre [23] and motivation to play [21]. In the area of player taxonomies, research has shown that player type can be predicted from the personality traits of the player [19], and that considering personality traits in combination with player taxonomies and game design elements can inform the understanding of enjoyment in game play [29]. Additionally, research has shown that personality traits carry into general behavior in virtual worlds [7].

Use of Self-Discrepancy Theory in Game Research

In contrast to the direct application of personality traits (e.g., Big Five factors), self-discrepancy theory considers the difference between self-guides (e.g., the discrepancy between actual-self and ideal-self), and has been applied successfully to understand games. For example, research on character choice in World of Warcraft has shown that players create characters closer to their ideal-selves than to their actual-selves [2], and that this trend was stronger for those with higher depression scores. Additionally, research has shown that the discrepancy between actual-self and ideal-self is related to game enjoyment, especially when convergence between *game-self* (self rated in the context of game play) and ideal-self is high [28]. Finally, self-discrepancy has been used to explain game addiction [14].

Effects of Controller Choice on PX

Previous work comparing input devices in gameplay has focused on measuring performance in terms of targeting [20] or steering [1]. At the level of PX, research has shown that movement-based input enhances engagement and social interaction [15] in collaborative games. Others have shown that controllers differ in terms of spatial presence [36] and immersion [25] within games. It is important to understand the spatial presence of controllers, because research has shown that presence can predict enjoyment in game play [34]. Finally, as noted in the section on the use of SDT in PX evaluation, a realistic mapping between controller and task leads to a higher experience of autonomy and presence, but not competence [17].

EXPERIMENT DESCRIPTION

The goal of our study was to understand how playing a game with different controllers alters our game experience and our view on game-self characteristics. We compared three controller types in a targeting game.

Game, System, and Apparatus

We designed a simple 3D game where the premise was that the user was flying inside of a tornado in a ship and the goal was to collect spinning items (Figure 1). Collection was accomplished using a 'tractor beam' by hovering over the item for 0.8 seconds. The beam changed colour to provide feedback on successful hovering, and feedback on the number of collected items were displayed in a gauge on the ship's console. Items appeared in waves of related items (e.g., vegetables, construction items), and the player was instructed to collect 10 items from each wave of 30 items. Collecting 10 items allowed the player to speed in the ship to the next wave. The number of waves in each game depended on the success of the player and each game ended after five minutes. Our design goal was to create a game that was playable with a variety of controller types, while keeping difficulty constant to allow inexperienced gamers – or gamers inexperienced with a particular controller – the opportunity to succeed in the task. Although complete in terms of the formal elements of game design, our game was specifically designed to be stripped of dramatic elements – such as characters, story, and dramatic arc – to study how controller choice affects self-perception and PX without interference from dramatic effects, (such as an unfolding narrative), or confounding effects, (such as how much the player identifies with their in-game avatar) [2].

Figure 1. Screenshot of TornadoTwister.

The game was built using C# and XNA 4.0. We used the Sony Move CL Eye Platform Driver and the Microsoft Kinect SDK 1.5. The system ran on a Windows 7 PC with a 22” monitor with a resolution of 1680 by 1050. Players stood 1.5 meters from the display in all conditions.

Controller Conditions

Our game required only that the player target objects by manipulating the x- and y-position of the tractor beam; there was no binary input necessary. We compared three popular controller types (traditional, positional, and gestural) represented by the Microsoft XBox GamePad, the Sony PlayStation Move, and the Microsoft Kinect.

GamePad (GP): We used an Xbox360 standard controller. For our study we used the A-Button to start the game and the right analog stick to position the tractor beam.

Move (MO): The PlayStation Move is a position-based controller, using a wand with a coloured light orb on top, which is tracked by the PlayStation “Eye” Camera. The PlayStation Eye was set to capture the scene at 60 Hz with a resolution of 640 x 480, and a 76˚ field of view. The location of the orb can be determined with an accuracy of 1mm and a latency of 22 ms. For our study, we used the PlayStation Move button to start the game and the x- and y-position of the controller to position the tractor beam.

Kinect: The Microsoft Kinect is a gesture-based controller developed for Xbox360. The device uses one camera that detects x- and y-position and another infrared receiver camera that detects depth through the dispersion of dots displayed via an infrared transmitter – for a detailed specification see [34]. In our study the experimenter started the game; the x-position of the tractor beam was controlled by the relative position of the left and right shoulder to the Kinect; the y-position was controlled by the relative position of hip and shoulder to the Kinect.

Training

Players completed a training condition consisting of aiming at 8 targets positioned around the display using the same selection mechanic as in the game (0.8-second dwell) prior to each controller condition.

Participants and Procedure

The experiment was conducted with 78 students from the University of Saskatchewan (38 female, mean age=25.8, SD=6.6). Students were recruited via mailing lists and notices on bulletin boards, and represented a variety of disciplines of study. Most participants played games (94%): 73% played on computers, 44% on consoles, and 45% on mobile devices. In terms of controller expertise, 51% were experienced with the GamePad, 53% with the PlayStation Move or Nintendo Wii, and 9% with Kinect[1].

Participants began by completing an informed consent and a questionnaire about their actual-self, ideal-self, and their current affective state. They then played one game (exactly 5 minutes) with each of the three different controller types. After each controller condition the players completed questionnaires assessing their experience of the game and of themselves within the game (game-self). At the end of the experiment, players completed demographic questions.

The experiment was a within-subject design, with all participants using each of the three controllers. Order of presentation of controller was fully counterbalanced.

Measures

We collected all dependent measures using validated scales. Cronbach’s-α is reported for PANAS, IMI, and PENS in Table 1. For BFI, $\alpha_{actual\text{-}self}$ =.641, and $\alpha_{ideal\text{-}self}$ =.669; $\alpha_{game\text{-}self}$ is not reported because of the use of randomized subscales; imputation would overestimate $\alpha_{game\text{-}self}$.

[1] Note that the novelty of the Kinect among our sample is a potential confound. As such, we replicated our analyses for a subgroup where players were unfamiliar with all devices (N=31; 19 female). Our main results are all confirmed in this subgroup, with two exceptions (flagged in the results), where the trends of the results remain, but $p_{MainEffect}$>.05.

Game Enjoyment

Enjoyment of game was measured using two scales.

PANAS: Positive Affect and Negative Affect were assessed using the Positive Affect Negative Affect Schedule-Expanded (PANAS-X) [38]. In the PANAS-X, participants are asked to agree with 20 emotion adjectives on a Likert-scale ranging from 1 (very slightly or not at all) to 5 (extremely). Half of the adjectives are positive (e.g., 'active') and half are negative (e.g., 'guilty'). Ratings are merged to create a composite score for negative affect and one for positive affect. The PANAS-X has been used to evaluate the enjoyment of video games (e.g., [28]).

IMI: Intrinsic Motivation was assessed using the 18-item Intrinsic Motivation Inventory [30], which has been used to evaluate experience with video games (e.g., [32]). A series of items are rated on 5-point Likert-scale, ranging from 1 (not at all) to 5 (quite a bit). Example items are "I enjoyed this game very much" and "I think I am pretty good at this game". Data is merged to create four scores for each of interest-enjoyment, competence, effort-importance, and tension, and also an overall score of intrinsic motivation.

Need Satisfaction

The Player Experience of Need Satisfaction Scale (PENS) [32], was designed to understand game experience from the perspective of SDT [31], and has been used to evaluate games (e.g., [32]). We used PENS after each condition to assess if the game satisfied the players' needs for Competence, Autonomy, Relatedness, Immersion and Intuitive Controls. A series of statements was agreed with using a 5-point Likert-scale from 1 (not at all) to 5 (quite a bit). Example items include "I feel competent at the game" or "Learning the game controls was easy". Data are merged to create a score for each of the five underlying constructs. Although some have argued for leaving out the subscales on Relatedness if the game is for a single player [11], it is possible that different controller types could differentially satisfy the need for relatedness, so we included it.

Personality

The player's trait personality was assessed using the Big Five Inventory (BFI) [10]. The BFI is a standard instrument to assess personality dimensions and has been used in the context of games [6]. Data are merged to create a score for each of the underlying dimensions and for an overall score. Self-Discrepancy Theory assumes that the distance between self-concepts is predictive for psychological well-being. There are many ways to measure differences between self-concepts, including personality questionnaires, which easily assess personality constructs and get a measure for Self-Discrepancy at the same time. We use the overall score from the BFI to give a simple estimate for Self-Discrepancy by calculating divergence (see [28] for further explanation).

Participants completed the BFI five times. At the beginning of the experiment, participants were asked to reflect on their actual-self and rated their agreement with 44 statements of the form, "The type of person you are…", with answers such as "is talkative" or "likes to cooperate with others". Ratings used a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Participants also reflected on their ideal-self, by completing items of the form "The type of person you wish, desire, or hope to be…", with the same items as used for assessing actual-self. After each game condition, participants were asked to assess their game-self using a short form (15 questions). Participants were asked to answer the questionnaire by completing the sentence "Reflect on the characteristics you see yourself having during the game – the type of person you were playing the game". Items in the short version covered all 5 aspects of personality, the number of items representing the scales E, A, O, N, C per questionnaire were stable, and we fully counterbalanced the presentation. Drawing items from a longer questionnaire is an established approach [39].

Data Analyses

All analyses were conducted using RM-ANOVA in SPSS 20. All parametric tests were performed after validating the data for assumptions of ANOVA use. Degrees of freedom were corrected using the Huynh-Feldt method, if the condition of sphericity was not satisfied. Pairwise comparisons used the Bonferonni method of adjusting the degrees of freedom for multiple comparisons, with the exception of the self-discrepancy measures, which used Tukey's LSD to avoid potential Type II errors resulting from small effect sizes. Significance was set at α=.05.

RESULTS

We first present the results of PX as traditionally measured by positive affect and intrinsic motivation. We extend this traditional analysis of PX by presenting the results of need satisfaction. We then explore how the controller conditions changed how players feel about themselves within the context of the game through presentation of the personality results. Finally, we investigate how the use of personality as a measure of *player experience* compares with the use of measures of *play experience* through a regression analysis.

Affect and Intrinsic Motivation

When evaluating PX, the first question of interest is usually whether or not the experience was fun, often measured as the degree of positive affect (e.g., [28]), mediated by the degree of Intrinsic Motivation (e.g., [32]) – especially the motivational component of interest/enjoyment.

Our results show a significant main effect of controller on positive affect ($F_{2,154}$=29.1, p≈.000, η^2=.27). Pairwise comparisons show that the Kinect produced the highest Positive Affect, then the Move then GamePad (see Figure 2). All differences were significant at p<.006. There was no controller effect on Negative Affect ($F_{1.9,145.5}$=2.4, p=.101).

When considered as a whole, there was no effect of controller on overall Intrinsic Motivation ($F_{2,154}$=1.1, *p*=.352); however, controller did affect the Interest-Enjoyment subscale ($F_{2,154}$=9.4, *p*=.001, η^2=0.10) and the Competence subscale ($F_{1.9,144.2}$=8.9, *p*≈.000, η^2=0.10). Pairwise comparisons show that the GamePad was less enjoyable than the Move (*p*=.031) or Kinect (*p*=.001), which were not different from each other (*p*=.148). For competence, the Move produced greater confidence than the Kinect (*p*≈.000) or the GamePad (*p*=.002), which were not different from each other (*p*=1.0). See Figure 3. There were no main effects of controller on the Effort ($F_{2,154}$=1.7, *p*=.183) or Tension ($F_{2,154}$=1.9, *p*=.147) subscales.

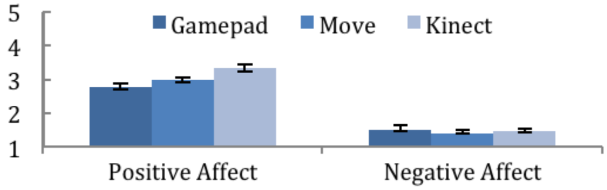

Figure 2. Means (±SE) for positive affect and negative affect on a scale of 1 (low) to 5 (high).

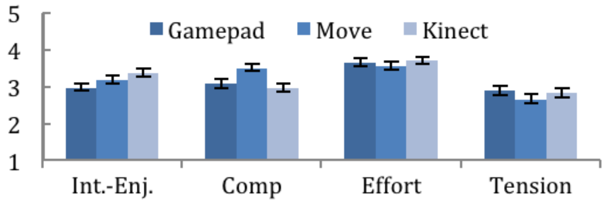

Figure 3. Means (±SE) for subscales of intrinsic motivation on a scale of 1 (low) to 5 (high).

Player Experience of Need Satisfaction

Although the analysis of affect and motivation provide insight into the game experience provided by different controllers, we used PENS, as it has been shown to provide a deeper understanding of game experience [32]. See Table 1 for descriptive statistics, and Figure 4.

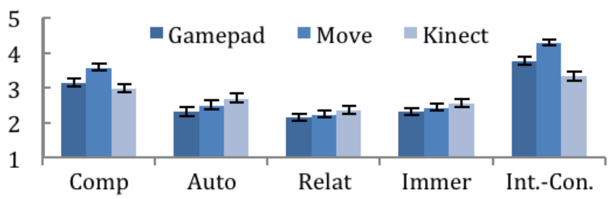

Figure 4. Means (±SE) for subscales of PENS on a scale of 1 (low) to 5 (high).

There was a main effect of controller on Competence ($F_{1.9,145.2}$=11.4, *p*≈.000, η^2=0.13). Pairwise comparisons revealed that the Move provided higher Competence than the GamePad (*p*=.001) or Kinect (*p*≈.000), which were not different from each other (*p*=.702).

There was a main effect of controller on Autonomy ($F_{2,154}$=9.3, *p*≈.000, η^2=0.11). The Kinect provided higher Autonomy than the Move (*p*=.044) and GamePad (*p*=.001), which were not different from each other (*p*=.119).

There was a main effect of controller on Relatedness[1] ($F_{2,154}$=4.3, *p*=.016, η^2=0.05). The Kinect provided higher Relatedness than GamePad (*p*=.014); the other differences were not significant (MO-KI: *p*=.281; MO-GP: *p*=.732).

There was a main effect of controller on Immersion ($F_{2,154}$=5.9, *p*=.003, η^2=0.07). The Kinect provided higher Immersion than GamePad (*p*=.004); the other differences were not significant (MO-KI: *p*=.240; MO-GP: *p*=.272).

There was a main effect of controller on Intuitive Controls ($F_{1.8,137.0}$=25.2, *p*≈.000, η^2=0.25). The Move was most Intuitive, followed by the GamePad, then Kinect. All differences were significant (MO-GP: *p*≈.000; MO-KI: *p*≈.000; GP-KI: *p*=.025).

	GamePad		Move		Kinect		
	M	*SD*	*M*	*SD*	*M*	*SD*	α
IMI							
Combined	3.15	0.52	3.23	0.60	3.22	0.60	
Interest-Enj.	2.96	0.86	3.19	0.93	3.37	1.06	0.82
Competence	3.08	1.05	3.51	0.92	2.97	1.04	0.90
Effort-Imp.	3.66	0.91	3.55	1.00	3.71	0.86	0.83
Tension	2.90	1.12	2.66	1.04	2.83	1.09	0.86
Affect							
Positive	2.76	0.89	2.98	0.93	3.33	0.91	0.90
Negative	1.52	0.67	1.41	0.51	1.46	0.55	0.86
PENS							
Competence	3.15	1.02	3.56	0.91	2.97	1.06	0.83
Autonomy	2.31	1.14	2.49	1.13	2.70	1.22	0.85
Relatedness	2.15	0.93	2.24	0.92	2.36	1.06	0.67
Immersion	2.32	0.91	2.44	0.97	2.56	1.08	0.89
Intuitive Cont.	3.75	1.06	4.29	0.69	3.32	1.11	0.72

Table 1. Means and SD for intrinsic motivation, affect and PENS on a scale from 1 (low) to 5 high. Cronbach's-α shows the consistency of the scale items for each construct.

Perceived in-game Personality

The results for self-characteristics are presented overall and for the five subscales (see Table 2 for descriptive statistics).

	Actual-self		Ideal-self		GamePad		Move		Kinect	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
CS	3.41	0.26	3.80	0.19	3.16	0.37	3.26	0.39	3.14	0.43
E	3.27	0.72	4.16	0.46	2.94	0.82	3.15	0.87	2.97	0.84
A	3.78	0.54	4.45	0.46	3.49	0.67	3.77	0.72	3.50	0.72
C	3.53	0.64	4.66	0.29	3.49	0.69	3.55	0.71	3.50	0.81
N	2.78	0.71	1.39	0.34	2.68	1.02	2.37	0.83	2.42	0.84
O	3.70	0.53	4.34	0.40	3.20	0.70	3.44	0.68	3.30	0.76

Table 2. Means and SD for personality by context (CS: composite score, E: Extraversion, A: Agreeableness, C: Conscientiousness, N: Neuroticism, O: Openness).

There was a main effect of controller on overall in-game personality ($F_{2,78}$=3.06, *p*=.050, η^2 =0.04). The Kinect was higher than the GamePad (*p*=.050) or the Move (*p*=.021), which were not different from each other (*p*=.708). Subscale analysis revealed a main effect of controller on Agreeableness ($F_{1.9,145.3}$=6.05, *p*=.004, η^2=0.07) and Neuroticism[1] ($F_{2,154}$=3.4, *p*=.038, η^2=0.04), but not on Extroversion ($F_{2,154}$=2.4, *p*=.100), Conscientiousness

($F_{2,154}$=0.2, p=.795), or Openness ($F_{2,154}$=2.7, p=.071). Pairwise comparisons show that the Kinect yielded more Agreeableness than both the Move (p=.004) and GamePad (p=.001), which were not different from each other (p=.915). Experienced Neuroticism was higher for the GamePad than the Move (p=.047) or Kinect (p=.031), which were not different from each other (p=.687).

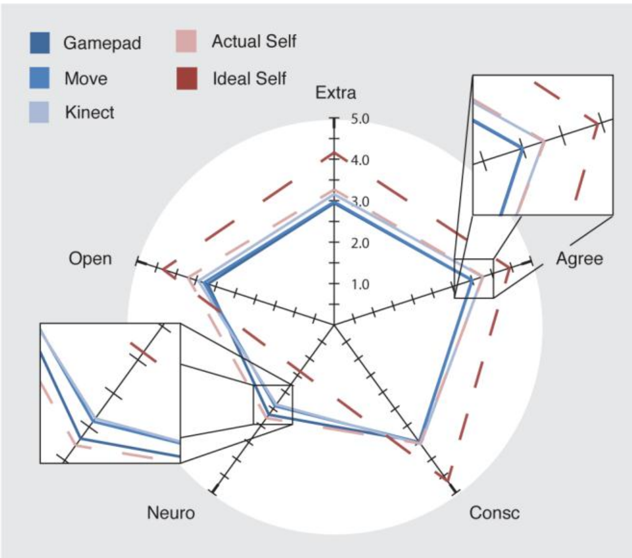

Figure 5. Personality dimension means for: actual-self, ideal-self, and the game-selves (GP, MO, KI) of 1 (low) to 5 (high).

Figure 5 shows the differences in perceived personality in game for the different controllers in the context of perceived actual-self and ideal-self. Interestingly, the in-game personalities are contained within the boundaries of actual-self. Contrary to expectations of game play, the game did not produce more idealized versions of players, but moved their perceived personality further from their ideal than their actual-self (with the exception of neuroticism). This ideal-self-game-self discrepancy is significantly larger for all controller types than for ideal-self-actual-self (all p<.001). We revisit this interesting result in the discussion.

Personality and Need Satisfaction

Figure 5 shows how in-game personality characteristics change with controller type, but also shows how game-self is fairly similar to actual-self. To determine whether the differences in game-self are meaningful for game evaluation, we conducted two-tailed Pearson correlations for game-self and the PENS dimensions separately for each controller. We also calculated the correlations for actual-self and the PENS dimensions across the three controllers. Correlations are displayed in Table 3.

The results show that there are no significant correlations between actual-self and any of the PENS dimensions; however, there are correlations between the PENS dimensions and game-self. For the GamePad condition, the correlation is significant with Autonomy, Relatedness, and Immersion. For the Move condition, the correlation is significant with Competence and Relatedness, and for the Kinect condition, the correlation is significant with Competence, Autonomy, and Relatedness. These results reveal that PX is not related to players' overall personality traits, but is related to their experienced personality within the context of game play, demonstrating that the use of game-self-characteristics for PX is meaningful.

	Actual-self		*GS: GamePad*		*GS: Move*		*GS: Kinect*	
	r	*p*	*r*	*p*	*r*	*p*	*r*	*p*
Com.	.047	.479	.170	.070	.294	.005	.295	.004
Aut.	-.054	.415	.271	.008	.130	.121	.276	.007
Rel.	-.014	.837	.314	.003	.272	.008	.340	.001
Imm.	-.069	.296	.233	.020	.140	.106	.191	.047
Int.	-.031	.635	.150	.097	.050	.319	.150	.088

Table 3. r and p values for correlations between PENS dimensions and personality characteristics.

Added Value of Personality Analysis

The results of the personality analysis show that a choice as simple as which controller is used can affect our in-game personality, and that in-game personality correlates with need satisfaction, whereas actual-self does not; however to understand the role that in-game personality plays in game experience evaluation, we must know the relative contribution of the need satisfaction variables and the personality variables to the overall outcome of increased positive affect or motivation to play. We conducted an analysis of regression with game-self, Competence, Autonomy, Relatedness, Immersion, and Intuitive Control on Positive Affect and overall Intrinsic Motivation (see Table 4 for standardized β-coefficients and p-values). Personality was included as a single factor, indicating overall game-self, whereas the individual contributions from PENS were included individually because they measure distinct dimensions; there is no meaning of an overall PENS score.

	Positive Affect		Intrinsic Motivation	
	β	*P*	*β*	*p*
Game-self	**0.31**	**.000**	**0.18**	**.000**
Competence	**0.23**	**.001**	0.11	.100
Autonomy	**0.28**	**.000**	0.11	.128
Relatedness	0.05	.538	-0.01	.918
Immersion	0.09	.296	**0.46**	**.000**
Intuitive Control	-0.06	.396	0.12	.057

Table 4. Standardized beta coefficients and p values for regression of game-self and PENS dimensions on positive

Our results show that game-self, Competence, and Autonomy predict Positive Affect, with changes in game-self yielding the biggest contribution. In addition, game-self and Immersion predict Intrinsic Motivation, with Immersion providing the larger contribution. These results show that changes to game-self as a result of controller predicts positive affect and intrinsic motivation during game play, and confirm that analysis of in-game personality is a valuable tool to understand PX.

DISCUSSION

Our study shows that there are a number of effects of controller on PX and in-game personality. We describe the significance of the findings, discuss the implications for game design, and finally present the limitations of our study and the future opportunities that our findings provide.

Significance of the Findings

Other researchers have previously applied theories of needs satisfaction to understand and explain player motivation and user experience within a game (e.g., [11, 17, 32]). We do the same in our work but add to the literature with our findings on how controller choice differentially affects our satisfaction of needs. In addition, we demonstrate that the application of self-discrepancy theory to game evaluation adds value to our understanding of PX. Game-self changed significantly with use of a different controller, and the change in game-self as a result of controller choice is a bigger predictor of positive affect than the components of need satisfaction theory. These findings confirm that including trait personality assessment in the PX evaluation toolbox is valuable for understanding player experience.

Our findings also have practical importance. For instance, we use games to escape reality, whether through a fantasy-based role-playing experience (e.g., World of Warcraft) or not (e.g., Bejeweled). We show that controller choice affects game-self, thus it is important for game designers to consider controller choice, to ensure that the escapism provided by games is not unintentionally damaged.

Implications for Game Design

Although the primary purpose of computer and video games has been to entertain, games have also been used to persuade a player to change their attitudes or opinions (e.g., The Cat and the Coup, A Closed World), to inspire behaviour change (e.g., Evoke, Fatworld), and to teach concepts, skills and tools (e.g., Math Blaster, Typing of the Dead, RibbonHero) [18, 3]. Regardless of whether a game is intended to entertain or educate, players will enjoy the experience of play if they are motivated to make progress [32]. Good games draw the player in and keep them engaged during play, and an engaged player will give the game a better chance of success at its intended purpose, irrespective of whether that be to divulge or divert.

Our results demonstrate how the choice of controller in a game mediates the experience, not only for the satisfaction of needs, but also for perceived personality. These findings related to game-self and controllers are useful both as a *lens with which to understand* controller effects in games and as a *guide for choices* on controller in new games.

Findings as a Lens to View Existing Games

Our findings on controller and game-self could be used to understand player experience in a variety of games and situations. For example, consider games where the player must help the character overcome obstacles and prevail (e.g., Deus Ex series, Mass Effect series). In these games, the character begins with vulnerabilities (e.g., low skills) that are resolved through interacting with environmental threats. The designer's intention is that players experience the fragility of the hero and surmount the odds; the goal is to become strong and overcome the feelings of being weak. Players accomplish this through leveling up (which happens to also satisfy our need for Competence). Many of these types of games use traditional controllers (e.g., GamePad), which is shown in our study to increase Neuroticism. By using the GamePad for these types of interactions, the experience of anxiety and instability might be heightened; users may be more likely to experience stress from minor events. It could be that in playing these games with a GamePad, the designer's intention of having players experience the character's fragility is effectively translated.

In another example, consider games designed as social icebreakers or to promote social connectedness (e.g., party games such as Wario's Smooth Moves). Games that target a friendly play environment benefit when players' game-selves are Agreeable. Our results suggest that the Kinect is preferred for enhancing Agreeableness, matching what is working in the games industry; the success of the Kinect has largely been for these types of social games.

Findings as a Guide to Inform New Game Design

Our findings related to in-game personality as a result of controller choice could also be applied to guide controller choice in the design of new games.

For example, consider a game designed to help players learn empathy. Our findings show that using the GamePad heightens the experience of Neuroticism, reinforcing feelings of being uncomfortable with strangers and difficult social situations, and causing players' game selves to be more likely to lose their temper and be prone to annoyance. Our results suggest that using the GamePad would decrease the game-self's natural inclination towards empathy, thus increasing the challenge of experiencing empathy; therefore, it could be a good choice for this application.

In another example, consider a game that encourages deception and betraying others for personal gain (e.g., DayZ). Although the Kinect is a general choice for collaborative or social games, our results show that the Kinect enhances players' Agreeableness within the context of play, reducing willingness to take advantage of others, insult others, and invite conflict. Thus, our findings suggest that the Kinect may not be a good controller choice when designing a game where the mechanics incite low Agreeableness (e.g., by focusing on personal advantage and conflict). The mismatch between the personality affordances of the controller and the intended in-game personality of the player may result in poor PX.

On the other hand, as previously noted, our findings suggest that games designed as social icebreakers or to promote social connectedness would benefit from the Kinect.

Opportunities for Future Work

Our study provides interesting findings for PX research; however, there are some limitations that raise questions for future work. First, our game was intentionally designed to be void of dramatic elements related to story arc or character progression. How our results extend to games where the player relates to their character is unknown. Our results that show how game-self is subsumed by actual-self likely do not extend to situations in which a player interacts via a character with personality traits closer to the player's ideal-self [2]. Second, although our game was engaging, it was not designed to draw a player in like an off-the-shelf game. Our results may differ when applied to games engineered to produce engagement and flow. On the other hand, the underlying mechanism of pursuit tracking used in our game is a common mechanic in a variety of game genres (e.g., first-person shooter), and thus our results related to controller choice have general application. Third, we tested three controllers; extending our results to other game input (e.g., mice, joysticks, touch) is needed. Also, we created a specific control mechanism for Kinect interaction (using torso movement); a different control mechanism (e.g., hand position) may produce different effects on game-self. Finally, our analysis considers all participants as a group. Examining results by demographic factor, such as age, sex, personality traits, or game expertise could produce interesting interactions.

Our findings produce many future opportunities for research, of which we present a few examples. First, we investigated a single-player game; applying our approach to collaborative or competitive play could inform the choice of controller for this popular genre. Second, we look specifically at controller choice in digital games; our analysis could be extended to artifact use in board game play. Finally, our findings can be used as a lens to view existing game success. Relating the predictions of positive affect based on changing game-self to market success of games would provide commerce-based validation of our research.

CONCLUSIONS

Traditional game evaluation focuses on the enjoyment provided by a game (i.e., positive affect). We apply satisfaction of needs theory (using PENS) to explain the underlying components of game enjoyment in an experiment with controller type as the manipulation. In addition, we explore the use of game-self as an additional level of PX evaluation to investigate the difference between how a play experience makes a player feel about the game and how the experience makes them feel about themselves. Our study shows that there are a number of effects of controller on PX and player personality within a game. These findings provide both a lens with which to view controller effects in games and a guide for controller choice in the design of new games. Finally, our research demonstrates that including self-characteristics assessment in the PX evaluation toolbox is valuable and useful for understanding player experience.

ACKNOWLEDGEMENTS

Thanks to reviewers for their feedback, the GRAND NCE for funding, and Kristen Dergousoff, Roxanne Dowd, Jared Cechanowicz, and the rest of the Interaction Lab at the UofS for support.

REFERENCES

1. Bateman, S., Doucette, A., Xiao, R.B., Gutwin, C., Mandryk, R.L., & Cockburn, A. Effects of View, Input Device, and Track Width on Video Game Driving. In *Proc. GI*, 2011, 207-214.
2. Bessiere, K., Seay, & F. Kiesler, S., The Ideal Elf: Identity Exploration in World of Warcraft. *CyberPsychology & Behavior*, 2007, 10(4), 530-535.
3. Bogost, I., *How To Do Things With Videogames*, 2011.
4. Csíkszentmihályi, M., *Beyond Boredom and Anxiety*, 1975.
5. Fernandez, A., Fun Experience with Digital Games: A Model Proposition. In *Extending Experiences: Structure, Analysis and Design of Computer Game Player Experience*, 2008, 181-190.
6. Gilbert, R. L., Foss J.A., & Murphy, N.A., Multi Personality Order: Physical and Personality Characteristics of the Self, Primary Avatar and Alt. In *Reinventing Ourselves: Contemporary Concepts of Identity in Virtual Worlds*, 2011, 213-234.
7. Hefner, D., Klimmt, C. and Vorderer, P., Identification with the player character as determinant of video game enjoyment. In *Proc. of ICEC*, 2007, 39-48.
8. Higgins, E.T., Self-Discrepancy: A theory relating self and affect. *Psychological Review*, 1987, 94(3), 319-340.
9. Isbister, K., & Schaffer, N., *Game Usability: Advice from the Experts for Advancing the Player Experience*, 2008.
10. John, O. P., Naumann, L. P., & Soto, C. J., Paradigm Shift to the Integrative Big-Five Trait Taxonomy: History, Measurement, and Conceptual Issues. In *Handbook of personality: Theory and research*, 2008, 114-158.
11. Johnson, D., & Gardner, J., Personality, Motivation and Video Games (2010). In *Proc. of OZCHI*, 2010, 276-279.
12. Kim, J., Gunn, D., Schuh, E., Phillips, B., Pagulayan, R., & Wixon, D. Tracking Real-Time User Experience (TRUE): A comprehensive instrumentation solution for complex systems. In *Proc. of SIGCHI*, 2008, 443-452.
13. Lazzaro, N., Why we play games: 4 keys to more emotion. In *Proc. of GDC*, 2004.
14. Li D., Liau A., & Khoo A., Examining the Influence of Actual-Ideal-Self-Discrepancies, Depression, and Escapism, on Pathological Gaming Among Massively

Multiplayer Online Adolescent Gamers *Cyberpsychology, Behavior, and Social Networking*, 2011, 14(9), 535-539.

15. Lindley S. E., Le Couteur J., & Berthouze N. L, Stirring up experience through movement in game play: effects on engagement and social behaviour. In *Proc. CHI*, 2008, 511-514.

16. Mandryk, R.L., Atkins, M., & Inkpen, K., A Continuous and Objective Evaluation of Emotional Experience with Interactive Play Environments. In *Proc. of CHI*, 2006, 1027-1036.

17. McEwan, M., Johnson, D., Wyeth, P. & Blacker, A. Videogame Control Device Impact on the Play Experience. In *Proc. of IE*, 2012, 1-3.

18. McGonigal, J., *Reality Is Broken: Why Games Make Us Better and How They Can Change the World*, 2010.

19. McMahon, N., Wyeth, P. & Johnson, D., Personality and Player Types in Fallout New Vegas. In *Proc. of FNG*, 2012, 113-116.

20. Napatov, D.,Castellucci, S.J., & MacKenzie, I.S., ISO 9241-9 evaluation of video game controllers. In *Proc. of GI, 2009*, 223-230.

21. Park J., Song Y., & Teng C., Exploring the Links Between Personality Traits and Motivations to Play Online Games. *Cyberpsychology, Behavior, and Social Networking*, 2011, 14(12) 747-751.

22. Partala, T., Psychological needs and virtual worlds: Case Second Life, *International Journal of Human-Computer Studies*, 2011, 69(12), 787-800.

23. Peever, N., Johnson, D., & Gardner, J., Personality and Video Game Genre Preferences. In *Proc.of IE*, 2012

24. Peng, W., Lin, J., Pfeiffer. P., & Winn, B., Need Satisfaction Supportive Game Features as Motivational Determinants: An Experimental Study of a Self-Determination Theory Guided Exergame, *Media Psychology*, 2012, 15(2), 175-196.

25. Pietschmann D., Valtin, G., & Ohler O., The effect of Authentic Input Devices on Computer Game Immersion. In *Computer Games and New Media Cultures: A Handbook of Digital Games Studies*, 2012.

26. Pinelle, D., Wong, N., Stach, T., & Gutwin, C., Usability Heuristics for Networked Multiplayer Games, In *Proc. of GROUP*, 2009, 169-178.

27. Procci, K., Singer, A. R., Levy, K. R., & Bowers, C., Measuring the flow experience of gamers: An evaluation of the DFS-2. *Computers in Human Behavior*, 2012, 28(6), 2306-2312.

28. Przybylski, A.K., Weinstein, N., Murayama, K., Lynch, M.F., & Ryan, R.M., The ideal-self at play: The appeal of video games that let you be all you can be. *Psychological Science*, 2011, 23 (1), 69-76.

29. Quick, J. M., Atkinson, R. K., & Lin, L., Empirical Taxonomies of Gameplay Enjoyment: Personality and Video Game Preference. *International Journal of Game-Based Learning*, 2012, 2(3), 11-31.

30. Ryan, R. M., Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology*, 1982, 43, 450-461.

31. Ryan, R. M., & Deci, E. L., Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 2000b, 55, 68-78.

32. Ryan, R. M., Rigby, C. S., & Przybylski, A. K., Motivational pull of video games: A self-determination theory approach. Motivation and Emotion, 2006, 30, 347-365.

33. Seif El-Nasr, M., Drachen A., Canossa A., Game Analytics: Maximizing the Value of Player Data. Springer, (to appear).

34. Shafer, D.M., Carbonara, C.P., & Popova, L., Spatial Presence and Perceived Reality as Predictors of Motion-Based Video Game Enjoyment, *Presence*, 2011, 20(6), 591-619.

35. Sheldon, K. M., & Filak, V., Manipulating autonomy, competence and relatedness support in a game-learning context: New evidence that all three needs matter. *British Journal of Social Psychology*, 2008, 47, 267-283.

36. Skalski, P., Tamborini, R., Shelton, A., Buncher, M. & Lindmark, P., Mapping the road to fun: natural video game controllers, presence, and game enjoyment. *New Media & Society*, 2010, 224-242.

37. Sweetser, P. & Wyeth, P., GameFlow: a model for evaluating player enjoyment in games. *Computer Entertainment*, 2005, 3-3.

38. Watson, D., & Clark, L. A. *The PANAS-X: Manual for the positive and negative affect schedule-Expanded Form*, 1994.

39. Yee. N., Ducheneaut, N., Nelson, L., & Likarish, P. Introverted Elves & Conscientious Gnomes: The Expression of Personality in World of Warcraft. In *Proc. of CHI*, 2011, 753-762.