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User Experience in Digital Games: Differences Between Laboratory and Home

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Abstract

Playing entertainment computer, video, and portable games, namely, digital games, is receiving more and more attention in academic research. Games are studied in different situations with numerous methods, but little is known about if and how the playing situation affects the user experience (UX) in games. In addition, it is hard to understand and study the psychology of UX in games. The objective of this study is to show how UX differs when the first-person shooter HALO is played in a laboratory and at home. To disclose this difference, a psychologically valid and multidimensional measurement framework is introduced. UX is profiled according to the level of the sense of presence, involvement, and flow in a between-subjects design. Statistically, the structure of the framework is grounded on a large and heterogeneous gamer data set (*N* = 2,182). The results showed that the profile of the sense of presence in the laboratory included higher levels of attention and arousal as compared with that of the natural environment. This finding was independent of any of the measured background variables. Other differences between the two situations were more related to the participants' background. For example, gamers at home were more involved in the game and they felt a higher level of competence. No strong emotional differences between the two situations were found. The authors discuss the complex UX terminology and implications of the framework for implementation of learning games.

Keywords

adaptation, arousal, attention, cognition, computer games, context of play, digital games, emotion, engagement, flow, gameplay, game design, immersion, involvement, learning, motivation, player experience, presence, social presence, user experience

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The popularity of playing entertainment digital games, that is, personal computer (PC), console, and portable games, has increased significantly in the past 10 years. It has become the fastest growing field of the entertainment industry (Entertainment Software Association, 2009). Digital games clearly have a new role in our society. They are no longer for hard-core gamers only; games have become a common form of entertainment for the general public. Playing occurs in different situations, such as homes, subways, and public places. Because of their popularity, the academic world has also realized the challenge offered by games as a field of study (Garris, Ahlers, & Driskell, 2002). A body of research has dealt with the negative consequences, such as aggression, of games (Barlett, Anderson, & Swing, 2008). The other line of research has tried to understand positive consequences, such as learning (Greenblat & Duke, 1981) and inner meaning of the game to gamers, for example, what motivates them (Sherry, Lucas, Greenberg, & Lachlan, 2006) and how games are psychologically experienced (Takatalo, Häkkinen, Särkelä, Komulainen, & Nyman, 2004).

As more updated longitudinal studies of the consequences of the games are published, such as *Grand Theft Childhood* (Kutner & Olson, 2008), the research focus is likely to shift even more toward understanding the user experience(UX), that is, a person's perceptions and responses resulting from the use or anticipated use of a product, system, or service (International Organization for Standardization, 2008). Many laboratories are launching game research projects to study gamers' perceptions and responses from playing a digital game. However, in endeavoring to analyze the UX in games, the researchers should answer at least the following two questions: How does the playing situation affect UX and how to measure UX in a valid way? When we can answer these questions, we can better evaluate the numerous consequences related to games.

Some authors suggest that natural environments should be favored when analyzing "emotional responses like fun, immersion, and engagement" (Tulathimutte & Bolt, 2008). They mention task- and time-based constraints on a gameplay and the physical presence of the moderator as some of the reasons for interrupting and interfering with the normal way of experiencing games in a laboratory. However, how does a laboratory setting actually interfere and interrupt the normal way of experiencing? After all, the game software attempts to adapt the gamer into another reality, away from the physical—natural or unnatural—environment. The impact of the social environment in which playing takes place is obvious in many game genres (e.g., portable or pervasive games), but how does it affect PC and console games played in a single-user mode? In addition, how can we measure UX with generic concepts, such as fun, immersion, and engagement, which are hardly one-dimensional concepts but rich latent constructs that require multidimensional measurements (IJsselsteijn, de Kort, Poels, Jurgelionis, & Bellotti, 2007).

Whichever concepts and methods we use to assess UX in games, they should regard the multidimensional nature of UX and its connections to basic psychology (Takatalo, Häkkinen, Kaistinen, & Nyman, 2007). Many empirical user-centered studies provide evidence for the potential subcomponents of the UX in games. Table 1 presents an overview of the 10 general UX subcomponents found in nine empirical studies. The sample sizes in these studies vary from dozens to thousands, and the number of studied subcomponents varies from 3 to 10. Depending on both the scope and the methodology

Table 1. A Summary of Game-Related Studies Introducing Potential Empirically Derived UX Subcomponents

	Method	Number of Participants	Skill, Competence	Challenge	Emotions	Control, Autonomy, Freedom	Focus, Concentration	Physical Presence	Involvement, Meaning, Curiosity	Story, Drama, Fantasy	Social Interaction	Interactivity, Controls, Usability
Jennett et al. (2008)	PC	260	×	×	×		×		×			×
Poels, de Kort, and IJsselsteijn (2007)	Qu	21	×	×	×	×	×	×		×	×	
Ryan, Rigby, and Przybylski (2006)	QN	927	×		×	×		×		×		×
Sherry et al. (2006)	PFA	550		×	×					×	×	
Ermi and Myyrä (2005)	PFA, Qu	234		×				×		×		
Lazzaro (2004)	Qu	30		×	×				×		×	
Sweetser and Johnson (2004)	PC, Qu	455				×		×		×		
Takatalo et al. (2004)	PFA	232	×	×	×	×	×	×	×	×	×	×
Pagulayan, Keeker, Wixon, Romero, and Fuller (2003)	Qu, QN	Thousands		×	×							×

NOTE: UX = user experience; PFA = principal factor analysis; PC = principal components analysis; Qu = qualitative interview; QN = quantitative data collection. An "×" indicates that the authors gave consideration to that subcomponent. The main scopes (e.g., motivation to play, immersion) and the methodologies used (e.g., qualitative, quantitative) vary in the studies.

of the approach, the presented subcomponents may overlap conceptually. However, a majority of the studies have some kind of reference both to emotions and to cognitively evaluated challenges. Most of these subcomponents are also necessary for learning in games (Garris et al., 2002). We have developed the Presence-Involvement-Flow Framework ($PIFF^2$; Takatalo et al., 2004) to integrate the vast number of relevant UX subcomponents into one framework and study the UX in games as multidimensional and psychological in nature.

Here we use this multidimensional $PIFF^2$ to profile changes in participants' UX when they play Microsoft's first-person shooter (FPS) HALO (2001) in a laboratory and at home. With a $PIFF^2$ analysis we are able to disclose experiential attributes, such as the quality, intensity, meaning, value, and extensity (i.e., voluminous or vastness, a spatial attribute) of the UX and show how the playing situation affects the UX.

Presence-Involvement-Flow Framework²

Adaptation: Presence and Involvement

The Adaptation part of the $PIFF^2$ describes the way the gamers willingly form a relationship with a digital game (Takatalo, Häkkinen, Särkelä, Komulainen, & Nyman, 2006b). Theoretically, Adaptation is grounded on studies concerning the sense of presence (Lombard & Ditton, 1997) and involvement (Zaichkowsky, 1985). Presence describes gamers' experience of being in the game world and its story and sharing these with other agents. Involvement (Zaichkowsky, 1985) provides a measure of gamers' motivation, that is, how interesting and important they perceive the game. Presence and involvement are crucial when evaluating the fundamental technical game components, such as the interface and narrative (Hunicke, LeBlanc, & Zubek, 2004). Together interface and narrative supposed to create gamers a feeling of a place in which the action as well as the social interaction within the story takes place. Interface and narrative motivate and involve gamers to pay attention to the game world provided (Sweetser & Wyeth, 2005).

As a result of Adaptation, UX gets its psychological meaning, intensity, and extensity (e.g., voluminous). Adaptation also includes game characteristics, which Garris et al. (2002) considered necessary for learning, namely, fantasy, sensory stimuli, and mystery/curiosity. We have studied Adaptation, for example, in four different digital games played at home (Takatalo, Häkkinen, Kaistinen, et al., 2006). In addition to interface and narrative, games have certain mechanics (e.g., rules, goals; Hunicke et al., 2004), which the gamers constantly evaluate. The evaluation process concerning own abilities and game challenges is likely to affect the emotional quality of the UX. In $PIFF^2$, we have dealt this evaluation process with the flow part, which is based on the theory of flow (Csikszentmihalyi, 1975).

Flow

Csikszentmihalyi (1975) defines flow as a positive and enjoyable experience stemming from interesting activity that is considered worth doing even for its own sake. He relates many factors to this kind of an optimal experience, such as clear goals, sense of control, and instant feedback, just to name few (Csikszentmihalyi, 1990). In the core of the theory of flow is the interplay between the subjectively evaluated challenges provided by the activity and the skills possessed by the respondents. The theory considers challenges and skills as cognitive key antecedents, which are followed by different emotional outcomes. Different ratios between the evaluated challenges and skills are likely to lead to different emotional outcomes: a positive state of flow evolves through a cognitive evaluation in which both the skills and the challenges are evaluated as being high and in balance (Csikszentmihalyi, 1975; Takatalo, Häkkinen, Lehtonen, Kaistinen, & Nyman, 2010).

Psychologically, the core idea of the flow theory (Csikszentmihalyi, 1975) is similar to cognitive theories of emotions (Ellsworth & Smith, 1988; Frijda, 1987; Lazarus, 1991). These theories support the idea that cognitive evaluations of events in the world are necessary parts of emotions. Various evaluations, such as the effort anticipated in a situation, and perceived obstacles shape the emotions attached to these events (Ellsworth & Smith, 1988). In the theory of flow, the evaluation concerns the game challenges and the skills of the gamer. Also, memory and previous experiences have an effect on the cognitive evaluation process and the evolvement of emotions. The cognitive-emotional flow part in PIFF^2 provides insight in to both the quality and intensity attributes of the UX as well as their cognitive antecedents. Moreover, the flow subcomponents of the PIFF^2 cover the key gaming features necessary for learning: challenge, control, and rules/goals (Garris et al., 2002).

Figure 1 presents the measured theoretical concepts and their interrelations in PIFF^2. In the Method section, we will introduce the 15 PIFF^2 subcomponents, which we use to form the multidimensional UX profiles and measure UX in games. The PIFF^2 profiles are based on gamers' subjective interpretations of the game event, made within preset psychological boundaries (the questionnaire). In this study we use PIFF^2 to evaluate how much playing a game in a laboratory differs experientially from playing the same game at home.

Method

Participants and Procedure

Laboratory group. The participants ($n = 59$) played two different versions of the FPS HALO. Thirty male university students participated in the laboratory experiment, in which they played a single-gamer mode of HALO: COMBAT EVOLVED (2003), with a PC off-line and using a 17-in. monitor. First, the participants practiced the game after which they played two 40-minute sessions. After the second session, they filled in the Experimental Virtual Environment Experience Questionnaire–Game Pitkä (EVEQ-GP), which included the 139 questions forming the 15 PIFF^2 subcomponents. EVEQ-GP is administered after a playing session, and participants are encouraged to reflect on their UX of the particular game they have just finished. The method used enables the participant to report, within the preset multidimensional boundaries, how it felt to be, and interact, within one specific game world. During the playing session, the following

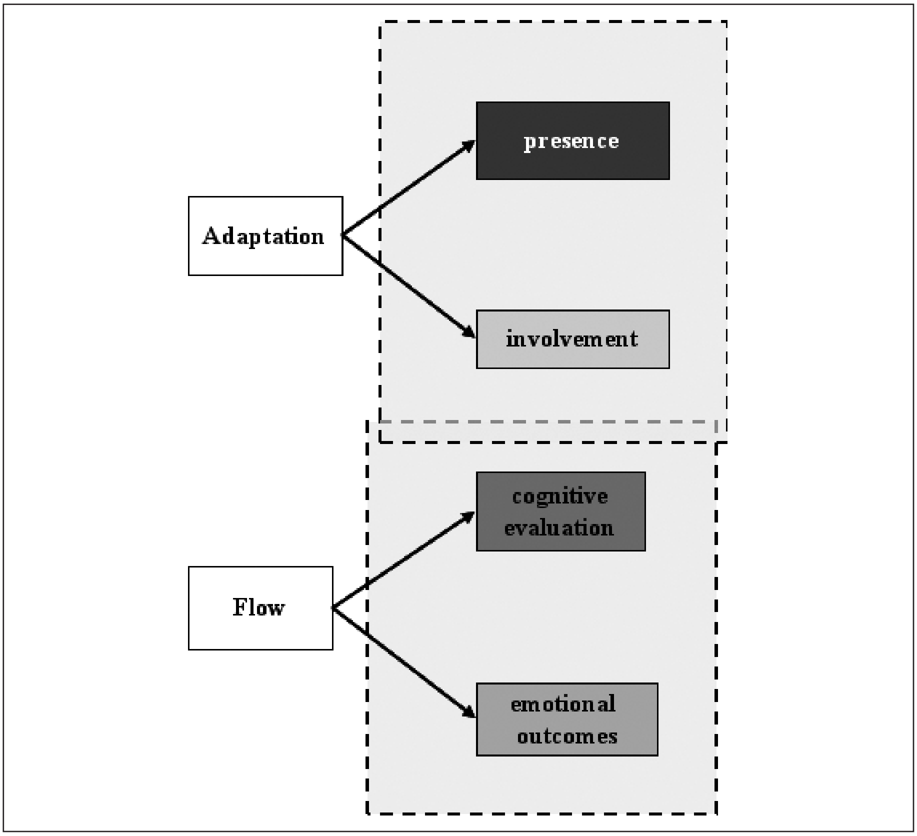

Figure 1. Theoretical concepts measured in Presence-Involvement-Flow Framework[2]
NOTE: Adaptation is measured with presence and involvement and flow includes both cognitive evaluations made of the game and emotional outcomes related to that game.

physiological data were also recorded: changes in skin conductance (electrodermal activity), contraction of facial muscles (electromyography), and heart rate (electrocardiogram). The use of physiological measurement instruments creates an extremely experimental laboratory setting and should provide a clear opposite to the natural playing environment (Pace, 2004). We do not report the results from the physiology measurements in this study.

The laboratory participants had at least some prior experience concerning the HALO: COMBAT EVOLVED and a positive attitude toward FPS games. Despite the artificial environment, the playing situation in the laboratory was made as casual as possible; for example, the participants were able to adjust game settings such as the audio and difficulty level. Although all the participants played the same two sequences, the total time

Table 2. Home and Laboratory Groups and the Background Variables

Background Variable	Home, *M* (*SD*)	Laboratory, *M* (*SD*)	*F*	χ^2	*p*
Size of the display	21.4 in. (5.2)	17 in.	21.26		<.001
Length of the playing session prior to answering the questionnaire	197.5 minutes (165.5, mode = 90)	80 minutes	15.16		<.001
Age	17.9 years (4.4)	24.1 years (4.8)	26.88		.001
Prior experience with HALO	4.48 (0.74)	3.8 (0.76)		12.866	<.01
Frequency of playing digital games	4.93 (0.84)	4.20 (1.32)		7.229	NS

NOTE: Means and standard deviations are presented for all the variables. Differences in continuous variables are studied with ANOVA, in which the *F* statistics are presented. Differences in classificatory variables are studied with χ^2 test.

played and the well-selected game periods provided the gamers with the full spectrum of experiences available in HALO: COMBAT EVOLVED.

Home group. Another group ($n = 29$) of participants filled in the online version of the EVEQ-GP after playing either HALO: COMBAT EVOLVED with a PC ($n = 9$) or HALO 2 (2004) with a console ($n = 20$). These participants took part in a larger study conducted on the Internet (Takatalo, Häkkinen, Särkelä, et al., 2006). When we compared these two different versions of HALO, we did not find any differences between the two versions in any of the $PIFF^2$ subcomponents. Those playing HALO: COMBAT EVOLVED were older ($M = 21.1$ years, $SD = 6.0$ years) compared with those playing HALO 2 ($M = 16.5$ years, $SD = 3.4$ years), $F(1, 27) = 7.17$, $p < .05$. These two groups did not differ in any other background variables. Thus, we merged the two groups into one group. The playing situation in this group was not in the laboratory, and was most likely at home. All the participants were males playing a single-gamer mode of the game offline.

Since its first Xbox version released in 2001, HALO has been one of the most popular FPS games. In 2003, the PC version of the HALO: COMBAT EVOLVED was nominated for the GameSpy's PC game of the year top 10. GameSpy claimed, for example, "that HALO PC offers the best pure combat of any first person shooter . . . ever" (http://archive.gamespy.com/goty2003/pc/index5.shtml). The next Xbox version, HALO 2 was the Metacritic's 2004 Xbox-game of the year. Metacritic described it as continuing the story of the first part and expanding the arsenal of powerful weapons and driveable vehicles (http://www.metacritic.com/games/platforms/xbx/halo2?q=halo). The similarity between the two versions also supported the merging of the two gamer groups into one, which we named the home group. Table 2 presents background differences between

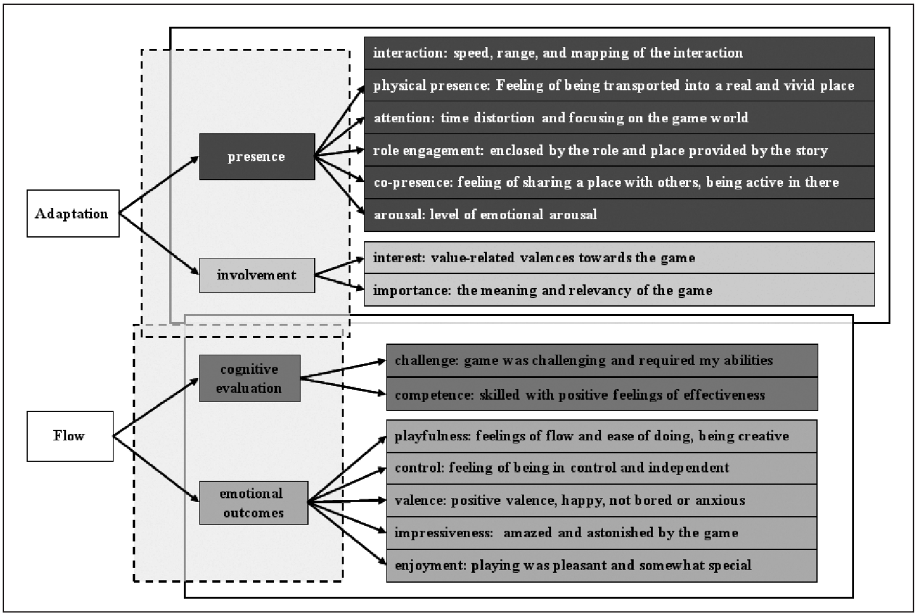

Figure 2. The name and description of the 15 subcomponents measuring Adaptation and Flow
NOTE: Interaction is reported among the two other cognitive evaluations, namely, challenge and competence.

the groups. We used these background differences as covariates, when we further studied the PIFF^2 subcomponents.

PIFF^2 Subcomponents

Figure 2 presents the 15 PIFF^2 subcomponents, which we used to measure Adaptation and Flow. We have used factor analysis (direct oblimin) to derive the subcomponents from heterogeneous data (n = 2,182 participants), collected with the EVEQ-GP questionnaire. The participants filled in the EVEQ-GP either in our various laboratory experiments or in the Internet survey. We then integrated and analyzed the data as one sample, which include approximately 320 different games, various displays (HMD, TV, CRT), and contexts of play (online, off-line, home, laboratory). The data gives a broad range to the different aspects of the UX in games.

We formed the eight extracted Adaptation subcomponents from the 83 EVEQ-GP questions and divided them into presence and involvement (Takatalo, Häkkinen, Särkelä, et al., 2006). We measured the seven flow subcomponents with 56 questions (Takatalo et al., 2010) and divided them into cognitive evaluations and emotional outcomes (Takatalo et al., 2010). Although we extracted interaction in the Adaptation model, we included it in the Flow model and studied alongside competence and challenge, the two other cognitive evaluations of the game world. Taken together, the 15 PIFF^2 subcomponents cover the multidimensionality of the UX and enable evaluation of the desired subjective learner outcomes, such as intensity of arousal, attention, enjoyment, and involvement as well (Cordova & Lepper, 1996).

The authors estimated the internal consistencies of the subcomponents with Tarkkonen's ρ (Vehkalahti, Puntanen, & Tarkkonen, 2010), which ranged between .70 and .89. We used rho instead of the popular Cronbach's alpha, because alpha has a tendency to underestimate the measures and thus threaten the validity of the measures (Vehkalahti, Puntanen, & Tarkkonen, 2009). Tarkkonen's rho is interpreted the same way as Cronbach's alpha: Values above .70 indicate that the items forming a subcomponent measure the same phenomenon.

We formed factor scores from each subcomponent and used as measurement scales (variables) to study two different playing situations (laboratory and home). We conducted two distinct between-subjects multivariate analyses of variance (MANOVA) for both sets of subcomponents (Adaptation and Flow) to control familywise Type 1 error. We further studied significant differences in MANOVA in univariate analysis. To get a broader view of the direction of the UX, we reported and discussed some liberal nonsignificant tendencies. In addition, we performed an extra multivariate analysis of covariance (MANCOVA) to study the situation and user background in more detail. The inspection of the distributional assumptions crucial for multivariate statistical tests showed no univariate or multivariate outliers and the normality, homogeneity of variance-covariance matrices, and correlations between the used subcomponents (Pearson correlation of .012-.612) were all satisfactory. We conducted all statistical analysis with a SPSS 13.0 statistical program.

Results

Adaptation (e.g., Involvement and Presence) to a game differs between the laboratory and the home. The results of the MANOVA indicated a significant main effect for the situation in all eight Adaptation subcomponents with Wilks's $\Lambda = .33$, $F(7, 51) = 14.51$, $p < .001$, $\eta^2 = .67$. The univariate analyses of variance (ANOVAs) showed that the gamers who played at home were more involved in the game, that is, they considered the game more interesting, $F(1, 57) = 6.53$, $p < .05$, $\eta^2 = .10$, and important, $F(1, 57) = 28.34$, $p < .001$, $\eta^2 = .33$. On the other hand, those playing in the laboratory experienced the sense of presence differently. They were more aroused, with arousal, $F(1, 57) = 18.42$, $p < .001$, $\eta^2 = .24$, and allocated more attentive resources to the game, with attention, $F(1, 57) = 39.80$, $p < .001$, $\eta^2 = .41$ (Figure 3). The seven flow subcomponents were also affected by the playing situation. The results of the MANOVA indicated a significant main effect with the use of Wilks's criterion: Wilks's $\Lambda = .48$, $F(8, 50) = 6.86$, $p < .001$, $\eta^2 = .52$. The univariate ANOVAs revealed that those playing at home considered themselves more competent than those playing in the laboratory, with competence, $F(1, 57) = 41.42$, $p < .001$, $\eta^2 = .42$. The analysis also showed two nonsignificant tendencies: at home, the game felt more playful, with playfulness, $F(1, 57) = 3.54$, $p = .065$, $\eta^2 = .06$, and the gamers had a higher sense of control over the game, with control, $F(1, 57) = 3.64$, $p = .061$, $\eta^2 = .06$, when compared with those participating in the

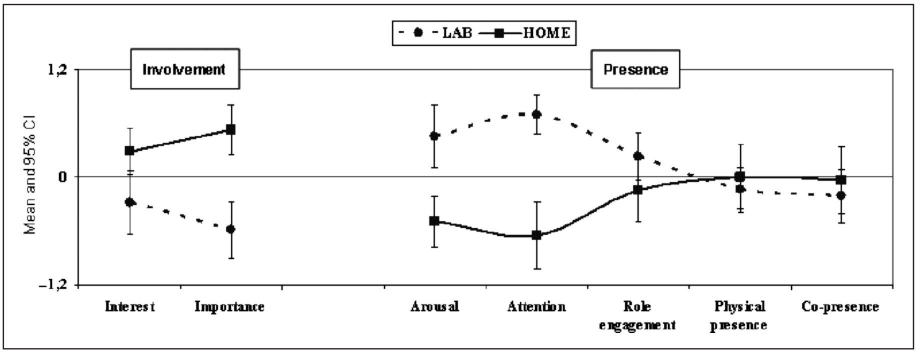

Figure 3. Group means in eight Adaptation (e.g., Involvement and Presence) subcomponents in *laboratory* and *home* conditions

NOTE: The error bars represent the difference between the groups in a 95% confidence interval. An overlap by half the average arm length of the error bar indicates a statistical difference between the groups ($p \approx .05$). If the tips of the error bars just touch, then the difference is $p \approx .01$. A gap between the error bars indicates $p < .001$.

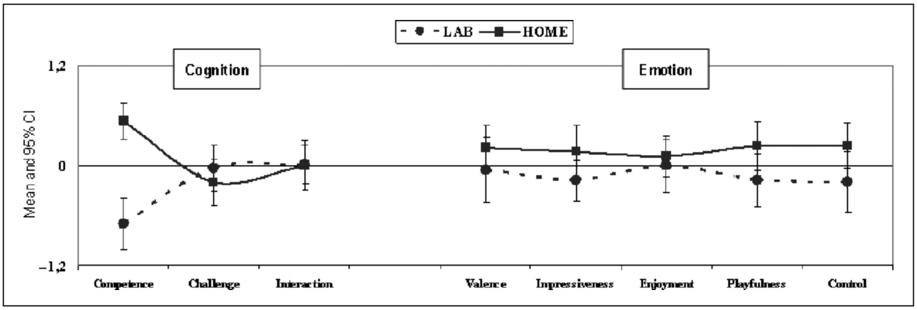

Figure 4. Group means in seven Flow subcomponents in *laboratory* and *home* conditions

NOTE: Evaluated interactivity of the game is presented here with cognitive evaluations of one's competences and evaluated challenges provided by the game. The error bars represent the difference between the groups in a 95% confidence interval. An overlap by half the average arm length of the error bar indicates a statistical difference between the groups ($p \approx .05$). If the tips of the error bars just touch, then the difference is $p \approx .01$. A gap between the error bars indicates $p < .001$.

laboratory experiment (Figure 4). Table 3 presents the means and standard deviations of the two playing situations in measured $PIFF^2$ subcomponents.

Multivariate Analysis of Covariance

Our main interest in the MANCOVA was to see whether the effect of the situation on arousal and attention was independent or mediated by the other differences we found between the groups. We performed a between-subject MANCOVA on attention, arousal, and situation. Included were the following seven covariates: age, playing

Table 3. Means and Standard Deviations of the Two Playing Situations in Measured PIFF² Subcomponente

	Playing Situation			
	Laboratory		Home	
Subcomponents	Mean	*SD*	Mean	*SD*
Challenge	–0.03	0.76	–0.20	0.75
Interaction	0.01	0.63	0.00	0.80
Valence	–0.05	1.08	0.21	0.72
Impressiveness	–0.17	0.67	0.17	0.86
Enjoyment	0.00	0.87	0.11	0.65
Playfulness	–0.18	0.87	0.23	0.78
Control	0.20	1.01	0.24	0.73
Competence	–0.70	0.86	0.53	0.58
Role engagement	0.23	0.73	–0.15	0.93
Attention	0.69	0.61	–0.65	0.99
Interest	–0.28	0.98	0.29	0.69
Importance	–0.59	0.86	0.52	0.73
Copresence	–0.22	0.83	–0.04	1.00
Arousal	0.45	0.94	–0.50	0.75
Physical presence	–0.14	0.67	0.00	0.96

NOTE: PIFF² = Presence-Involvement-Flow Framework.

time, prior experience, screen size, interest, importance, and competence. The results of the MANCOVA indicated a significant independent main effect for the situation: Wilks's $\Lambda = .54$, $F(2, 41) = 17.56$, $p < .001$, $\eta^2 = .46$, and importance, Wilks's $\Lambda = .86$, $F(2, 41) = 3.34$, $p < .05$, $\eta^2 = .14$. The effect of the screen size indicated a tendency toward an independent main effect, Wilks's $\Lambda = .87$, $F(2, 41) = 3.06$, $p = .058$, $\eta^2 = .13$. Univariate analysis revealed that the effect of the situation was independent from the covariates both in *attention*, $F(1, 42) = 34.31$, $p < .001$, $\eta^2 = .45$, and arousal, $F(1, 42) = 6.91$, $p < .01$, $\eta^2 = .20$. Importance, that is, the meaning of the game to the gamer showed an independent effect on attention, $F(1, 42) = 5.73$, $p < .05$, $\eta^2 = .12$. Thus, the more important the game was, the more participants attended to it, no matter where it was played. Also the screen size of the display had an independent effect on attention, $F(1, 42) = 6.00$, $p < .05$, $\eta^2 = .13$. The level of attention increased in accordance with the screen size in both playing situations. Age, playing time, prior experience, competence, and interest had no independent effect on either arousal or attention.

Discussion

We studied how playing a single-gamer FPS HALO in an experimental laboratory conditions differs experientially from playing the same game in a natural environment. The playing situation had a strong and independent effect on both the level of attention and arousal. It was not mediated by any of the experiential (interest, importance, competence) or background variables (age, playing time, prior experience, screen size). In our attentive system, continuous interaction occurs between the cognitive (i.e., attention) and physiological (i.e., arousal) components. The more aroused the participants are, the greater the attentional resources available to them (Kahneman, 1973). However, the relationship between the two attentive components is not a linear one: although moderate arousal increases attentional performance, it is likely to drop when high excitement is reached (Easterbrook, 1959). Scientists have recognized this phenomenon as the inverted-U relationship between the level of arousal and human performance (Yerkes & Dodson, 1908). On the other hand, prolonged attention reduces arousal and causes drowsiness (Babkoff, Caspy, & Mikulincer, 1991). This makes both attention and arousal relevant UX subcomponents when consequences of playing games, such as learning are evaluated (Cordova & Lepper, 1996).

Prior research has shown that a right amount of the sensory stimuli and challenge, which are the two key game characteristics (Garris et al., 2002), can be beneficial for learning. However, too much of these two could be detrimental to learning (Lepper & Chabay, 1985; Wilson et al., 2009). This relationship is similar to the inverted-U theory (Yerkes & Dodson, 1908). Consequently, increasing sensory stimuli and challenge in games increases the level of arousal, which affects performance, such as focusing of attention and eventually learning. Our PIFF^2 framework includes subcomponents, which evaluate both these game characteristics and their outcomes. However, we did not find any differences between the studied groups in experienced challenges or amount of sensory stimuli (e.g., role engagement, physical presence, and social presence). In this study, the playing situation increased the level of arousal and attention. Although we did not measure performance or learning, researchers interested in the consequences of the games should consider both the UX and the playing situation when evaluating the outcomes of the games. PIFF^2 provides a valid tool for this.

In our laboratory experiment, participants' attention and arousal heightened during the 80 minutes of playing. We did not detect any mediating effect on the part of the playing time. We may ask: How would attention and arousal change if the playing time had been shortened or prolonged? It is critical for the researchers to know when attention or arousal is increased over the critical thresholds and what the consequences of this are to learning, for example. In our study, attention also showed a tendency to increase as the screen size increased, independently of where the game was played. This finding is in accordance with previous studies, which also suggest that larger screen size is associated with an increased level of arousal (Reeves, Lang, Kim, & Tatar, 1999). However, those playing at home used larger screens but had lower attention and arousal. It seems that the effect of the playing situation exceeded the effect of the screen size on attention and arousal.

We could associate some findings with the gamers' background; the gamers at home had voluntarily chosen to play HALO and they reported having more prior experience in it. This naturally made them more motivated to play HALO and consider it more interesting and important. In addition, importance, that is, the meaning of the game, had an independent effect on attention. This finding is in line with the principles of psychology, which state that we attend to important, meaningful, and motivating stimuli (James, 1890). High involvement and extensive prior experience in the home group were associated with higher evaluated competence in the game. Although competence had no mediating effect on the level of arousal and attention alone, a low competence–high challenge ratio in the laboratory may have increased the levels of these two. The opposite competence-challenge ratio in the home group could explain the slightly heightened levels of both playfulness and control. Despite the low competence–high challenge profile in the laboratory, the emotional quality in the laboratory was equally positive when compared with the home situation. Thus, the increased level of attention and arousal were not experienced negatively during the 80 minutes of playing.

These findings show the complexity of the UX in games and the advantages of psychologically grounded multidimensional measurement in studying it. With PIFF^2, we were able to show which parts of the UX were mostly affected by an extremely experimental laboratory condition. If we are able to evaluate UX in games, we can understand the consequences of games, such as learning, better. However, to answer the numerous research questions in the field of games research, different research settings and various methods are needed. In some cases, ecological validity and long playing hours are critical to understand the topic studied, whereas in some cases, playing only 20 minutes in a laboratory can be sufficient. Also in some cases, naive participants are preferred over more experienced ones. These issues are critical when studies are designed, participants are recruited, and results are compared across the studies. Above all, it is important to understand the possible constraints of the set up and keep in mind, what is actually measured with different methods.

Conclusions

The contribution of this study is twofold: (a) it shows how UX differs in two different playing situations (laboratory and home) and (b) it presents a valid way to assess multidimensional UX in games. Instead of measuring generic concepts such as fun, immersion, and engagement, we measured UX with a psychological PIFF^2 framework. We have designed PIFF^2 to study the multidimensional UX in games (Takatalo et al., 2007). Integrating the concepts of the sense of presence, involvement, and flow, the framework includes 15 subcomponents, which are extracted empirically from a large data set ($N = 2{,}182$). The results showed differences in gamers' involvement, presence, and cognitive evaluation of the playing session. The background of the gamer affected the involvement and cognitive evaluation. The playing situation had the strongest effect on the nature of the sense of presence, especially in the level of arousal and attention.

In the laboratory, the gamers were more attentive and aroused than engaged in the role, place, and social interaction provided by the game. Those playing at home experienced presence as just the opposite: they were not that aroused and attentive because of the game but considered the game to be engaging, a real-life place, and socially interactive. The two groups had the similar profiles in rest of the presence subcomponents (role engagement, physical, and social presence). It seems that something in the laboratory, for example, the measuring devices or the atmosphere, affected the participants' arousal and attention. Although both arousal and attention are desired outcomes in learning games (Cordova & Lepper, 1996), too much of them may have negative effect on performance (Yerkes & Dodson, 1908). On the other hand, a formal laboratory experiment forces the participants to concentrate on the studied game. A well-designed experiment aims at cutting out all distracting variables. After all, the scope of any study should determine the required level of analysis. It is of utmost importance that the researcher always knows what is measured and how the procedure affects the participants and desired outcomes.

Suggestions for Future Research

We reported results of one single-gamer FPS game played in one—quite extreme—laboratory condition with one experimental setting. We used two versions of HALO (HALO 2 and COMBAT EVOLVED) to represent the home group. Although we could not find any differences between the two versions, this remains an interesting topic for future studies. In addition, further analysis is needed to understand how the time spent in the laboratory directs the tendencies detected in both the playfulness and control subcomponents.

The complex terminology used to describe the UX in games needs to be simplified. We started with popular but rather generic concepts of fun, immersion, and engagement. However, we approached these concepts with the measures of presence, involvement, and flow, because the subcomponents forming these concepts are both theoretically and statistically well grounded (Takatalo et al., 2007). We could roughly equate immersion with presence, engagement with involvement, and fun with the three distinct emotional subcomponents in our flow model: valence, enjoyment, and playfulness. However, UX can also be described with experiential attributes, which have a long tradition in psychology, namely, quality, intensity, meaning, value, and extensity (i.e., voluminous or vastness, a spatial attribute; James, 1890; Wundt, 1897). In our case, the playing situation increased the intensity of the UX and the user background affected the meaning and value of it. No matter what terminology is used and where the games are played, they always affect gamers. If the researcher understands the complexity and multidimensionality of this effect, it can be studied anywhere. In addition, the numerous consequences related to different games, such as learning, can be evaluated better. A holistic approach to the UX in games and the factors affecting it enhances our understanding of not only a particular game or a playing situation but the whole digital games culture in general.

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