USER EXPERIENCE IN PLAYING A DIGITAL GAME IN DIFFERENT SITUATIONS

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ABSTRACT

Digital gaming is receiving more and more attention in the academic research. Games are studied in different situations with numerous methods, but little is known 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 aim of this study is to compare the UX in playing the first-person shooter Halo in a laboratory and at home. Multidimensional UX is profiled according to a psychological framework measuring the level of involvement, sense of presence and flow in a between-subjects design. Statistically the structure of the framework is grounded on a large and heterogeneous game-player data set (n=2182). The results showed that the profile of the sense of presence in the laboratory included higher levels of attention and arousal as compared to that of the natural environment. This finding was independent from any of the measured background variables. Other differences between the two situations were more related to the participants’ background. For example, players at home were more involved in the game and they felt higher level of competence. There were no strong emotional differences between the two situations. In the end, the terminology used to explain experiential phenomena is discussed. The situational impact on UX in games should be considered when laboratory studies are designed, participants are recruited and results are compared across the gaming situations.

KEYWORDS

Digital Games, User Experience, Flow, Presence, Involvement, Native Environment

1. INTRODUCTION

Popularity of digital gaming, that is, PC, console and mobile gaming, has increased significantly in the last ten years. It has become the fastest-growing field of the entertainment industry (Interactive Digital Software Association 2000). Digital games clearly have a new role in our society. They are no longer for hardcore players only; games have become a common form of entertainment for the general public. Gaming occurs in different situations, such as homes, subways and offices. Because of their popularity, the academic world has also realized the challenge offered by games as a field of study. A body of research has dealt with negative consequences, such as aggression, of gaming (Griffiths 1999). The other line of research has tried to understand the inner meaning of the game to the players, for example, what motivates players (Sherry et al. 2006) and how games are psychologically experienced (Takatalo et al. 2004). When more updated longitudinal studies of the game consequences’ are published, such as “Grand theft childhood” (Kutner & Olson 2008), the research focus is likely to shift even more towards understanding the inner meaning of the game and the way players’ experience being in and performing in the game world. Because of this more laboratories are launching game research projects. However, when starting to analyze the inner meaning of digital games, at least the following two questions should be answered: where should games be studied and how can UX in games be measured in a valid way?
It has been suggested that natural environments should be favored when analyzing “emotional responses like fun, immersion, and engagement” (Tulathimutte & Bolt 2008). Task- and time-based constraints on game play and physical presence of the moderator are mentioned as some of the reasons for interrupting and interfering with the normal way of experiencing the game in a laboratory. The observation of participants in their natural environments has clear advantages. But does a laboratory setting actually interfere and interrupt the normal way of experiencing? After all, the game software attempts to adapt the player into another reality, away from the physical - natural or unnatural - environment. The impact of the social environment in which gaming takes place is obvious in many game genres (e.g., mobile or pervasive gaming), but how does it affect on PC and console games played in single-user mode? There are not many studies concerning how laboratory settings affect the UX in such games. An additional problem is the measurement of generic experiential concepts such as fun, immersion, and engagement, which hardly are one-dimensional concepts, but rich latent constructs that require multidimensional measurements (IJsselsteijn et al. 2007). Whatever concepts and methods are used to assess UX in games, they should regard its multidimensional nature and connections to basic psychology (Takatalo et al. 2007). Here we use a multidimensional Presence-Involvement-Flow framework\(^2\) (PIFF\(^2\)) to profile changes in UX when Microsoft’s first-person shooter (FPS) Halo is played in a laboratory and at home. With PIFF\(^2\) analysis we will be able to disclose experiential attributes, such as quality, intensity, meaning, value, and extensity (i.e., voluminous or vastness, a spatial attribute) of game experience and show how the gaming situation affects these. We will also relate concepts of fun, immersion, and engagement to the 15 measurement scales underlying PIFF\(^2\).

1.1 Presence-Involvement-Flow framework\(^2\)

1.1.1 Adaptation: presence and involvement

A good gaming experience is thought to consist of at least the following psychological aspects: perceptual as well as physical realism; it is motivating and involving enough to draw attention and to elicit emotional feelings, and it has a capability to create a feeling of a place/space in which the action as well as the social interaction within a narrative takes place (Sweetser & Wyeth 2005). We have integrated these perceptual-attentive, cognitive-affective as well as motivational aspects of the gaming experience into an Adaptation model (Takatalo et al. 2006a). The adaptation process describes the way the players willingly form a relationship with a digital game. As a result of adaptation, UX gets its meaning, intensity and extensity. Theoretically the model is grounded on the studies concerning involvement (Zaichkowsky 1985) and the sense of presence (Lombard & Ditton 1997). The model has already been applied, for example, in four different digital games played off the laboratory (Takatalo et al. 2006b). In the current study, the eight adaptation components are used to explain game engagement and immersion. In addition to their adaptive qualities, games are also fun and they make players enjoy playing (Sweetser & Wyeth 2005). We have dealt with the quality of the experience in another measurement model that is based on the theory of flow (Csikszentmihalyi 1975).

1.1.2 Flow

Csikszentmihalyi (1975) defines flow as a positive and enjoyable experience stemming from interesting activity that is considered worth doing for its own sake. In a state of such an optimal experience, individuals tend to be playful (cognitively spontaneous, inventive, and imaginative) (Webster & Martocchio 1992), self-consciousness is lost, action and awareness merge, and time passes more rapidly (Csikszentmihalyi 1975, Csikszentmihalyi 1990). Concentration, clear goals, instant feedback, and a sense of control are considered to contribute to flow (Csikszentmihalyi 1990). Most of the flow studies have paid attention to its two cognitive key antecedents – evaluations of the challenges provided by the activity and the skills possessed by the respondents. Every time people engage in a meaningful activity, a mental process is activated where the evaluation of its challenges and required skills occurs (Csikszentmihalyi 1975). Different ratios between these two are likely to lead to different emotional outcomes. A positive state of flow evolves through a process in which both the skills and the challenges are evaluated as being high and in balance.

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 suggest that cognitive interpretations and appraisals of events in the world are necessary parts of emotions. There are various
appraisal features and components, such as the effort anticipated in a situation, perceived obstacles, and the sense of control, all of which shape the emotions attached to these events (Ellsworth & Smith 1988). The flow model describes relevant mental aspects of cognition and emotion in an event. Also memory and previous experiences have an effect on the cognitive appraisal process and the forming of emotions depicted here. The cognitive and emotional profiles provided by the flow model give insight to the both quality and intensity attributes of the experience and their cognitive predecessors. They also provide insight to the generic fun aspect of gaming. Combining adaptation and flow measurement models into 15 scales forming PIFF\textsuperscript{2} offers a holistic profile of the content of the UX in games. These profiles are based on players’ subjective interpretations of the game event, made within the pre-set psychological boundaries. In this study we use this integrated framework to evaluate how much playing in a laboratory differs experientially from playing the same game at home.

2.METHODS

2.1 Participants and procedure

The participants (n=59) played two different versions of the FPS Halo. 30 university male students participated in the laboratory experiment, in which they played single-player mode of Halo: Combat Evolved, with a PC offline and a 17” monitor. First, the participants were allowed to practice the game after which they played two 40 minutes sessions. After the second session they were asked to fill in the EVEQ-GP questionnaire that includes 180 items that are used to form the 15 PIFF\textsuperscript{2} scales. It is administered after a gaming session and participants are encouraged to reflect on their subjective gaming experience of that particular game they have just finished. The used method enables the participant to report, within pre-set multidimensional boundaries, how it felt to be and interact within the specific game world. During the gaming session also the following physiological data were recorded: changes in skin conductance (electrodermal activity), contraction of facial muscles (electromyography) and heart rate (electrocardiogram). The use of psychophysiological measurement instruments represents an extremely experimental laboratory setting and should provide a clear opposite to the natural gaming environment (Pace 2004). Results from the psychophysiology measurements are not reported in this study. The participants had at least some prior experience concerning the Halo: Combat Evolved and a positive attitude towards FPS games. Despite the artificial environment, the gaming situation in the lab was made as casual as possible, for example, the participants were able to adjust game settings such as audio and difficulty level. Although all the participants played the same two sequences, the total time played and the well-selected periods provided the players a variety of different experiences.

29 participants filled in the online version of the EVEQ-GP after playing either Halo: Combat Evolved with a PC (n=9) or Halo2 with a console (n=20). These participants were included into a larger study conducted in the Internet (Takatalo et al. 2006a). When these two different versions of Halo were compared, no differences in any of the PIFF\textsuperscript{2} scales were found. Those playing Halo: Combat Evolved were older (m=21.1 years, SD=6.0 years) compared against those playing Halo2 (m=16.5 years, SD=3.4 years) \((F(1,27) = 7.17, p < .05)\). The groups didn’t differ in any other background variables. Thus, the two groups were merged into one group. The gaming situation in this group was off the laboratory, most likely at home. The average size of the display of this group was 21.4” (SD=5.2”) and the average playing time 197.5min (SD=165.6min, mode=90min). All the participants were males playing a single-player mode offline.

Since its first Xbox version released in 2001 Halo (Bungie Software) has been one of the most popular FPS games. In the year 2003 the PC version of the Halo: Combat Evolved (Gearbox) was nominated as the GameSpy’s PC game of the year top 10. It was considered 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, Halo2 (Bungie Software) was the Metacritic’s 2004 Xbox -game of the year. It was described to continue the story of the first part and expanding the arsenal of powerful weapons and driveable vehicles (http://www.metacritic.com/games/platforms/xbox/halo2?q=halo). The similarity between the two versions also supported merging the two player groups into one, which was named as home group.
2.2 Measures

Scales forming the PIFF\textsuperscript{2} are based on heterogeneous data collected from 2182 participants who have filled in the EVEQ-GP questionnaire either in our various laboratory experiments or in the Internet survey. The data include over 300 different games, various displays (HMD, TV, CRT) and contexts of play (online, offline, home, laboratory), giving a broad scope to UX in games. Based on factor analysis (direct oblimin), 15 dimensions measuring UX in games have been extracted (Table 1.). Out of the 180 EVEQ-GP items, 83 measure involvement and presence. These items form the eight Adaptation dimensions (Takatalo et al. 2006a), which include aspects of immersion (attention, arousal) as well as engagement (role engagement, co-presence, physical presence). Out of the 180 EVEQ-GP items, 56 measure Flow (Takatalo et al. Submitted). Flow model is composed of two cognitive and five emotional dimensions (Takatalo et al. Submitted), among which are three different dimensions of fun (valence, enjoyment, and playfulness). Although interaction was extracted in Adaptation model, it is included in the Flow model and studied alongside competence and challenge, the two other cognitive evaluations of the game world. The internal consistencies (Cronbach’s alpha) of the scales ranged between .64 and .90. In order to study two different gaming situations (laboratory – home) both the adaptation factor scores and flow factor scores (and interaction) were examined in two distinct between-subjects multivariate analysis of variance (MANOVA). Additional multivariate analysis of covariance (MANCOVA) was performed to study the situation and user background. Significant differences in MANOVA were further studied in univariate analysis. To get broader view of the direction of the UX, some liberal non-significant tendencies in the results are reported and discussed. Because of this, conservative Bonferroni adjustments to the univariate analysis were not performed. All statistical analysis was conducted with SPSS 13.0 statistical program.

3. RESULTS

Adaptation to a game differs between the laboratory and home. The results of the MANOVA indicated a significant main effect for the situation (Wilk’s Lambda = .33, $F(7,51) = 14.51, p < .001, \eta^2 = .67$). The univariate ANOVAs showed that the players who played at home were more involved in gaming, 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 ($F(1,57) = 18.42, p < .001, \eta^2 = .24$) and allocated more attentive

### Table 1. Name and description of the scales forming the Presence-Involvement-Flow framework

<table>
<thead>
<tr>
<th>Scales</th>
<th>Description</th>
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<tbody>
<tr>
<td>ADAPTATION</td>
<td></td>
</tr>
<tr>
<td>Role Engagement</td>
<td>Captivated and enclosed into the role and place provided by the story</td>
</tr>
<tr>
<td>Attention</td>
<td>Time distortion, focus on the game world instead of the real world</td>
</tr>
<tr>
<td>Interest</td>
<td>Interesting, exciting and lively</td>
</tr>
<tr>
<td>Importance</td>
<td>Meaning, relevant, close, personal, and sensitive</td>
</tr>
<tr>
<td>Co-Presence</td>
<td>Feeling of sharing a place with others, being active in there</td>
</tr>
<tr>
<td>Interaction</td>
<td>Speed, range, mapping, exploration, predictability of own actions</td>
</tr>
<tr>
<td>Arousal</td>
<td>Active, stimulated vs. passive, unaroused</td>
</tr>
<tr>
<td>Physical Presence</td>
<td>Feeling of being transported into a real, live and vivid place</td>
</tr>
<tr>
<td>FLOW</td>
<td></td>
</tr>
<tr>
<td>Valence</td>
<td>Positive valence, happy, not bored or anxious</td>
</tr>
<tr>
<td>Impressiveness</td>
<td>Amazed and impressed by the game, the game elicited real feelings</td>
</tr>
<tr>
<td>Competence</td>
<td>Skilled, competent, enjoying using the skills, clear goals</td>
</tr>
<tr>
<td>Challenge</td>
<td>Game was challenging, game required the use of my abilities</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>Pleasant, enjoying and exciting, I’ll recommend it to my friends</td>
</tr>
<tr>
<td>Playfulness</td>
<td>Ease of doing, creative, live, and vivid, not unimaginative</td>
</tr>
<tr>
<td>Control</td>
<td>Feeling of being in control and independent</td>
</tr>
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resources to the game \( F(1,57) = 39.80, p < .001, \eta^2 = .41 \) (Figure 1). The factor scores forming the flow model were also affected by the situation of gaming. The results of the MANOVA indicated a significant main effect with the use of Wilk’s criterion \( (Wilk’s \ Lambda = .48, F(8,50) = 6.86, p < .001, \eta^2 = .52) \). The univariate ANOVAs revealed that those playing at home considered themselves more competent than those playing in the laboratory \( (F(1,57) = 41.42, p < .001, \eta^2 = .42) \). Also two non-significant tendencies were found: at home, playing felt more playful \( (F(1,57) = 3.54, p = .065, \eta^2 = .06) \) and the players had a higher sense of control over the game \( (F(1,57) = 3.64, p = .061, \eta^2 = .06) \) when compared against those participating in the laboratory experiment (Figure 2).

There were also some differences in the background variables measured for our samples. Those playing at home were younger \( (m= 17.9 \text{ years}, SD=4.4 \text{ years}) \) than those in the laboratory \( (m=24.1 \text{ years}, SD=4.8 \text{ years}) \) \( (F(1,57) = 26.88, p < .001) \). They also played for a longer time \( (m=197.5 \text{ min}, SD=165.6 \text{ min}, \text{mode}=90\text{min}) \) \( (F(1,57) = 15.16, p < .001) \) and used a larger display \( (m=21.4", SD=5.2") \) \( (F(1,57) = 21.26, p < .001) \) compared to the laboratory group, in which the game was played for 80 minutes and a 17" monitor was used. The members of both groups reported playing digital games equally often, but the home players had more prior experience in playing Halo \( (\chi^2(2) = 12.87, p < .01) \).

### 3.1 Multivariate analysis of covariance (MANCOVA)

The main interest of the MANCOVA was to see whether the effect of the situation on arousal and attention was independent or mediated by the other differences found between the groups. A between-subjects MANCOVA was performed on attention, arousal and situation. Included were the following seven covariates: age, playing time, prior experience, screen size, interest, importance and competence. The results of the MANCOVA indicated a significant independent main effect for the situation \( (Wilk’s \ Lambda = .54, F(2,41) = 17.56, p < .001, \eta^2 = .46) \) and importance \( (Wilk’s \ Lambda = .86, F(2,41) = 3.34, p < .05, \eta^2 = .14) \). The effect of the screen size indicated a tendency towards an independent main effect \( (Wilk’s \ Lambda = .87, F(2,41) = 3.06, p = .058, \eta^2 = .13) \). 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 player 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 it was attended to 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.

4. CONCLUSIONS

Digital games have become a major form of entertainment for millions of people. Because of their popularity and design interests, there is a need to understand the nature of UX in games. However, it is not clear where and how games should be studied. Some scholars suggest that experiential aspects such as fun, immersion and engagement should be studied in natural environments (Tulathimutte & Bolt 2008). We studied how playing a single-player FPS Halo in an experimental laboratory conditions differs experientially from playing the same game in a natural environment. Instead of measuring generic concepts such as fun, immersion and engagement, UX was measured with a psychological PIFF\(^2\) framework, which is designed to study the multidimensional UX in games (Takatalo et al. 2007). It includes 15 components of the sense of presence, involvement and flow that are extracted empirically from a large dataset \((n=2182)\). Here these components are also related to fun, immersion and engagement. The results showed differences in players’ involvement, presence and cognitive evaluation of the gaming session. The gaming situation had the strongest effect on the nature of sense of presence and especially on its two components, that is, the level of arousal and attention. In the laboratory the players were more attentive and aroused than engaged to the role, place and social interaction provided by the game. Those playing at home experienced presence just as the opposite: they were not that aroused and attentive due to the game, but considered game engaging, real-like place and socially interactive. It seems that something in the laboratory, for example, testing devices or atmosphere affected participants’ arousal and attention. 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. Since the two groups had similar profiles in role engagement, physical and social presence, we can conclude in more generic terms that extreme laboratory conditions seem to have a specific impact on immersion but not on engagement or fun in gaming. The contribution of this study is twofold: 1) it shows how two different gaming situations differ psychologically and 2) present a way to assess multidimensional UX in games. It also strengthens the need for multidimensional methods and clarification of used concepts in the field of UX in games (IJsselsteijn et al. 2007). Next these findings are discussed in more detail.

4.1 PIFF\(^2\) in more detail

The gaming 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). There is a continuous interaction between cognitive (i.e., attention) and physiological (i.e., arousal) components in our attentive system. The more aroused the participants are the greater are 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). On the other hand, prolonged attention reduces arousal and causes drowsiness (Babkoff et al. 1991). Since both these situations are likely to have an impact on UX, the effect of the situation on them needs more careful studying. In our laboratory experiment attention and arousal were heightened during the 80 minutes of play. No mediating effect of the gaming time was detected. We may ask, how attention and arousal would change if the playing time had been shortened or prolonged? It is critical to know when attention or arousal is increased over the critical thresholds and what are the consequences of this? In our study, attention also showed tendency to increase as the screen size increased, independently of where the game was played. This finding is in accordance with previous study, which also suggests that larger screen size is associated with an
increased level of arousal (Reeves et al. 1999). However those playing at home used larger screens, but had lower attention and arousal. It seems that the effect of the gaming situation exceeded the effect of the screen size on attention and arousal.

There were also findings associated more with the players’ background. The players at home had voluntarily chosen to play Halo and they reported having more prior experience of it. This naturally made them more motivated to play Halo and to 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 previous psychological studies, indicating 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. These findings show the complexity of the UX in games and the advantages of the multidimensional measurement in studying it.

4.2 Future

We reported results of one single-player FPS game played in one - quite extreme - laboratory condition with one experimental setting. We used two versions of Halo (2 and Combat Evolved) to represent the home group. Although we couldn’t find differences between the two versions this remains an interesting topic for future studies. Further analysis is needed especially to understand how the time spent in the laboratory directs the tendencies detected in playfulness and control. However, there are many kinds of games and players, numerous gaming situations, different laboratory settings (e.g., living-room like), and different experimental goals that can be reached with various methods (e.g., psychophysiological, display type, usability) and require different time spent in the laboratory. In some cases ecological validity and long playing hours are critical to understand the studied topic, whereas in some cases playing only 20 minutes in a laboratory can be enough. Also in some cases naïve participants are preferred over more experienced ones.

There is a clear need to simplify the complex terminology used to describe UX in games. We started with popular, but rather generic concepts of fun, immersion and engagement. However, we approached these with the measures of presence, involvement and flow, because the components forming these concepts are both theoretically and statistically well grounded (Takatalo et al. 2007). We roughly equate immersion with attention and arousal and concluded that it was affected by the situation. Engagement that was not affected by the situation was equated with the rest of our presence dimensions: role engagement, physical presence and co-presentation. Fun was associated with three distinct emotional components in our flow model: valence, enjoyment, and playfulness. Out of these three components, only playfulness showed a tendency to be higher at home. Besides these concepts and dimension experiential attributes that have a long tradition in psychology can be used to describe UX: its quality, intensity, meaning, value, and extensity (i.e., voluminous or vastness, a spatial attribute) (James 1890, Wundt 1897). In our case, the gaming situation increased the intensity of UX and the user background affected the meaning and value of it.

No matter where the games are played, they always have an effect on the player. If the complexity and multidimensionality of this effect is understood, it can be studied anywhere. The scope of any study should determine the required level of ecological validity as well as the level of analysis. It is of utmost importance that it is always known what is measured and how the procedure affects the participants. Holistic understanding of the UX in games and factors affecting it helps understanding not only a particular game or a gaming situation, but the whole gaming culture in general.

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