

Chapter 3

Presence, Involvement, and Flow in Digital Games

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Abstract Digital games elicit rich and meaningful experiences for the gamers. This makes games hard to study solely with usability methods that are used in the field of human–computer interaction. Here is presented a candidate framework to analyze multidimensional user experience (UX) in games. Theoretically, the framework is grounded both on previous game studies and on relevant psychological theories. Methodologically, it relies on multivariate data analysis of approximately 320 games ($n = 2182$), with the aim of revealing the subcomponents of UX in games. The framework captures the essential psychological determinants of UX, namely, its quality, intensity, meaning, value, and extensity. Mapping these determinants to the game mechanics, the narrative and the interface offers a rich view to UX in games and provides added value to those who want to understand why games are experienced in certain ways.

3.1 Introduction

Entertainment computer and video games, that is, digital games, elicit rich and personally meaningful experiences for the gamers. This makes games hard to study solely with methods that are used to analyze the functionality or productivity of software in the field of human–computer interaction (HCI). The emergence of research into user experience (UX) in HCI has opened new ways of evaluating digital games. The critical criteria in making these evaluations are psychological in nature. Thus, there is a need for a relevant research framework that concerns both technical game components and user psychology in UX that evolves from game playing. Here, we present a theoretical and methodological background of a candidate empirical framework for analyzing UX in games. Theoretically, it is grounded both on previous game studies and on relevant psychological theories. Methodologically, it

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relies on multivariate data analysis of approximately 320 games ($n = 2182$), with the aim of revealing the subcomponents of UX in games. We emphasize the multi-dimensional approach in both the analysis of the game and the gamer. This enables capturing the essential psychological determinants of UX, namely, its quality, intensity, meaning, value, and extensity. These basic determinants have already been outlined in the early days of psychology (James 1890, Wundt 1897) and they still provide relevant metrics to evaluate such rich psychological experiences.

The proposed framework is applied and demonstrated here with two different cases to disclose the holistic UX. First, it is used to analyze the differences between two different games. The results are then related to expert reviewer's critics (METASCORE[®]) and user ratings provided by the Metacritic.com (Metacritic.com 2009). Second, we show how the framework can be utilized in an individual-level analysis of evaluated difficulty of playing and skill development during the first hour of play. Performance analysis and qualitative interview of the gamers are integrated into this case. The examples demonstrate the multifaceted nature of UX and show how it is related to technical game components. In both cases, the utilization of the framework in different phases of the game development life cycle is discussed.

3.1.1 Games and Playing

Any digital game can be considered a system that can be controlled and tuned by its designers. The available technology, their designing skills, and desired end-user UX are typical constraints on designers. The components of the game system can be broadly described as the mechanics, the narrative, and the interface (Hunicke et al. 2004, Winn 2006). Game mechanics include the goals of the game, the rules and rewards of action, and the choices provided the gamers. The narrative creates the game world, setting the stage for the storyline. Closest to the gamers is the interface, that is, what the gamers actually see, hear, perhaps even feel, and how they interact with the game (e.g., control system). Although the designer may have a clear idea of the UX that the game system should provide, this experience will not necessarily be the gamers' experience. The UX is founded on the above components of the game system, but it evolves from the game play.

When games are played, the game dynamics emerge from the mechanics (Hunicke et al. 2004). Meaningful game goals direct gamers' actions. Within the game rules and choices, gamers pursue these goals, earn rewards, make decisions, and face challenging situations. Gamers consistently evaluate, consciously or unconsciously, their performance in the game; are they reaching the desired goals and do they have the abilities to meet the challenges? When they reach the goals after overcoming obstacles, positive feelings and a sense of competence emerge. Game narrative turns into storytelling, in which the gamer has an active role. Curious places in spaces draw the gamers' focus to the game world and provide escape from the real world. The gamers become engaged in their role with the events in the game. The creation of the game world is also supported by the interface, which sets limits on both physical and social interactions in the game. The interface provides an environment to explore, discover, and collect new things. There gamers interact

with other agents and adapt and become drawn deeper into the game world. All this is inseparably accompanied by rich emotions, which are an essential part of playing games. But how can we measure the UX in such a rich interaction?

Many authors have presented different motivating aspects of game play, such as challenges, sensations and feelings, other gamers, and narrative that encourage gamers to play and elicit fun experiences (Hunicke et al. 2004, Lazzaro 2004, Sherry et al. 2006). Motivation to play is also explained by rewards and achievements. Seeking game rewards is believed to reinforce playing chiefly in order to obtain more rewards (Ducheneaut et al. 2006). The above studies show clearly what playing affords the gamers, and they provide a useful list of game-relevant issues. But to help designers in their efforts to offer gamers the chance to “think clever thoughts and feel profound emotions” (Pagulayan et al. 2003, p. 891), an analysis of the UX that goes beyond fun, gratification, and the behavioristic reward cycle is needed. Understanding games is approaching a phase where it is close to understanding the psychology of individual life experiences in general.

3.1.2 Psychology of User Experience

There is no one unified and general definition of the UX, but there have been serious attempts to achieve such a definition. Current research on the UX concentrates on a person’s perceptions and responses resulting from the use or anticipated use of a product, system, or service (ISO 9241-210:2008 2008). Here, both “perceptions and responses” are considered psychological in nature. According to this view, for example, the perception of a reward by the gamer will not simply lead to an impulsive response to play more. Even if both “perception and response” are considered psychologically, the perceived reward will not lead to fun either. Responses are actively generated in a psychological evaluation process that includes basic psychological compartments. For example, we perceive and focus our attention on stimuli that motivate and interest us (James 1890). Only those perceptions that are interesting and meaningful enough to us will be evaluated in our consciousness and will form a part of our inner world. Some perceptions are evaluated subconsciously, whereas others are evaluated in awareness. Awareness can best be understood through the concept of trilogy of mind, namely, the psychological set consisting of thinking, feeling, and will (Hilgard 1980). Over decades, this trilogy has concerned human cognition, emotion, and motivation (Mayer 2001). As the research paradigms in psychology have changed from the stimulus-response paradigms to information-processing paradigms, this traditional trilogy has been cut to pieces and studied separately (Lubart and Getz 1998). However, for example, cognitions and emotions are so intimately connected that studying emotions without cognitions makes a little sense (Lazarus 1991a). When we look at the UX by integrating cognition, emotion, and motivation with perception and attention, we obtain a realistic set of psychological compartments that make an analysis of “person’s perceptions and responses” relevant and valid in any given context. Naturally, our past experiences (memories) and attitudes have an impact on this experiential process (Särkelä et al. 2004).

Although the foundations of these psychological compartments can be traced back to the history of psychology, they have not changed significantly. An excellent example of this is that such compartments are present when today's gamers spontaneously describe their experiences: They report emotional feelings (e.g., enjoyment), cognitive evaluations (e.g., game challenge), and motivations (e.g., curiosity) while playing games (Komulainen et al. 2008). Thus, the content we are dealing with orients the psychological compartments. If we are able to recognize how these psychological compartments are shaped by the game and represented in the game play, we can achieve many advantages for evaluating the UX. Measuring gamers' cognition, emotion, motivation, perception, and attention will reveal relevant determinants of the UX, such as its quality, intensity, meaning, value, and extensity (i.e., voluminous or vastness, a spatial attribute). Taken together, these determinants allow the profiling of experiences and give them their special and distinctive characteristics. Although the determinants have also been outlined already in the beginning of the psychology (James 1890, Wundt 1897), their importance in understanding any mental phenomena and human behavior should not be overlooked.

Together with the external game components, these internal psychological compartments help us to understand different aspects of the multidimensional UX in games (Fig. 3.1). By using these psychological compartments as lenses through

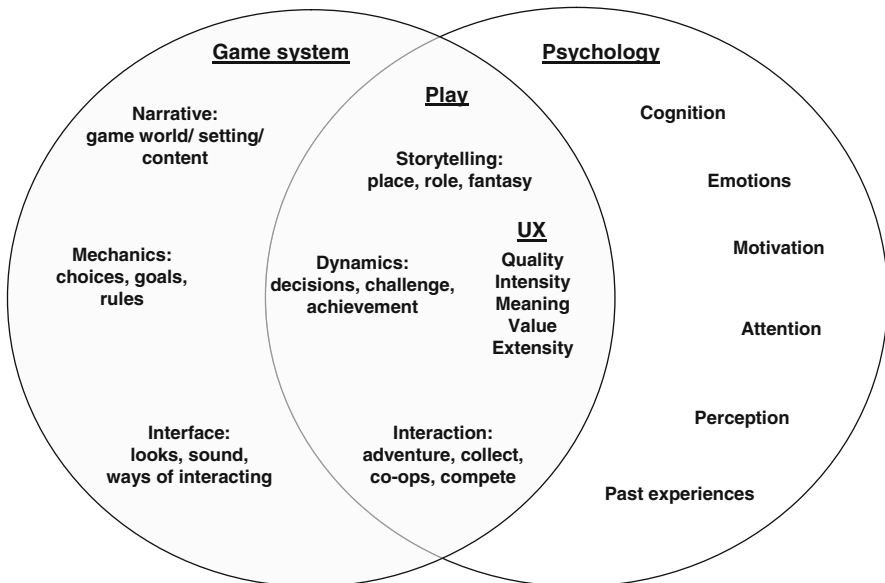


Fig. 3.1 The game system can be affected by the game designer. Play is when the user interacts with a game. Within this interaction UX characteristics evolve. Besides the game system, the UX is strongly affected by the ever-present basic psychology and the user background. The way psychology is represented in UX depends on the content, that is, the game

which we observe the gamers' inner world, we can consider the game achievements and rewards discussed earlier in a new light. Because not all rewards motivate gamers equally to continue playing, it is likely that there is a deeper psychological evaluation process underlying human motivation. A reward will be evaluated based on how relevant it is, how challenging it was to achieve, whether it required the use of special skills and abilities, and how enjoyable and satisfying it was to achieve. Such an evaluation assigns a particular reward to its intrinsic value. If some specific behavior pattern in a game has no intrinsic value but is done because of an external reward (e.g., one gets paid), then it is said to be extrinsically motivating (Atkinson 1964). In general, intrinsically rewarding behaviors are experienced as more enjoyable and are more likely to be repeated (Csikszentmihalyi 1975). Whether some rewards are intrinsically or extrinsically rewarding is difficult or even impossible to know by looking at the outer behavior only. Evaluating UX from the outer behavior possesses its own challenges as well. But what are the relevant game-related concepts that best represent the psychological compartments in games and could enable us to measure the true characteristics of the UX?

3.1.3 User Experience in Games

Numerous candidate concepts, such as, immersion, fun, presence, involvement, engagement, and flow have been used to describe the UX in games (Brown and Cairns 2004, IJsselstein et al. 2007, McMahan 2003, Nakatsu et al. 2005, Sweetser and Wyeth 2005). Often these concepts are defined quite broadly, for instance, presence is "the sense of being there," while flow describes "an optimal experience." Various psychological compartments are attached to these concepts, for example concentration, emotions, and cognitive evaluations of the game's challenges are each referred to as immersion (McMahan 2003). Thus, there is a great overlap among the concepts and as a consequence, numerous challenges to understanding and actually measuring them. For instance, considering flow as an "optimal experience" by definition (Csikszentmihalyi 1975) and restricting it to extreme situations only (Jennett et al. 2008) would diminish its applicability to the analysis of the UX in typical games. The subcomponents of flow, such as, skills and challenges (Csikszentmihalyi 1975) provide psychologically valid metrics to evaluate games, even if the gamers would never reach the actual "optimal experience." Concentrating on the subcomponents instead of the concept that has a complex underlying structure itself has other advantages as well. We have shown, for example, how equally high "meta-presence" scores in four different games actually hide clear experiential differences between the games found in five measured presence subcomponents (e.g., physical presence, attention, and co-presence) (Takatalo et al. 2006a).

There are empirical user-centered data that provide evidence for potential subcomponents of the UX in games across the concepts. Jennett and her colleagues (2008) studied immersion in games. They extracted five experiential subcomponents in a principal component analysis ($n = 260$) and named them as *cognitive involvement* (curiosity and interest), *real-world dissociation* (attention, temporal

dissociation), *challenge*, *emotional involvement* (empathy, enjoyment), and *control* (ease of controls, interacting with a game). Similarly, Ermi and Mäyrä (2005) studied immersion. Although their model is based on the interviews of children who played the games with their parents, the model was further supported by a factor analysis of a sample ($n = 234$) collected from grown-up gamers. Their three extracted subcomponents were: *sensory immersion* (e.g., “The sounds of game overran the other sounds from the environment”), *challenge-based immersion* (challenges and abilities), and *imaginative immersion* (use of imagination, empathy, and fantasy).

Sherry et al. (2006) used factor analysis ($n = 550$) to extract uses and gratification dimensions. They named the six extracted motivations to play as *competition*, *challenges*, *social interaction*, *diversion* (“I play instead of other thing I should do”), *fantasy* (to be someone else), and *arousal* (excited, adrenaline). Lazzaro (2004) found four main motivations to play from the qualitative and quantitative analysis of 15 gamers and 15 nongamers. Included were *hard fun* (meaningful challenges), *easy fun* (excitement and curiosity of exploring new adventures), *altered states* (emotions inside), and *people factor* (compete and co-ops with others). Likewise, Ryan et al.’s (2006) Player Experience in Need Satisfaction (PENS) framework deals with the reasons that keep gamers playing the games. Measures in this framework are composed of summed scales that have been used in previous studies: *in game competence* (capable and effective), *in game autonomy* (free to do things that interest), *presence* (physical, emotional, and narrative), and *intuitive controls* (easy to remember). In addition to PENS measures, *subjective vitality* (energy and aliveness), *self-esteem*, *mood*, *game enjoyment*, *preference for future play*, and *continued play behavior* were measured. Sweetser and Johnson (2004) investigated, which issues in games impact player enjoyment. Their principal components analysis ($n = 455$) resulted five subcomponents, *physics* (gravity, life-like graphics), *sound* (effects and soundtrack), *narrative*, *intuitiveness* (interaction with objects), and *the freedom of expression* (many different as well as unique ways of using objects).

Pagulayan et al.’s (2003) four important factors in game evaluation were *overall quality* (e.g., fun), *ease of use* (controls, interface), *challenge*, and *pace* (the rate of new challenges) are based on strong empirical data gathered in various studies conducted in Microsoft Game Studios. Poels and her colleagues’ (2007) study revealed nine relevant subcomponents that were based on both qualitative gamer interviews and expert evaluations. Included were *enjoyment* (fun, pleasure, and relaxation), *flow* (concentration, absorption), *imaginative immersion* (story, empathy), *sensory immersion* (presence), *suspense* (challenge, tension, and pressure), *negative affect* (disappointment, frustration), *control* (autonomy, power), *social presence* (being connected with others, empathy), and *competence* (pride, euphoria). An overview of the 10 general UX subcomponents found in the above empirical studies is presented in Table 3.1. There is conceptual overlapping between the subcomponents depending on both the scope and the methodology of the approach. However, common to majority of the studies is some kind of a reference to both emotions and challenges. We have developed the Presence-Involvement-Flow Framework (PIFF) (Takatalo et al. 2004) in order to integrate the vast amount of relevant UX subcomponents

Table 3.1 A summary of game-related studies introducing potential empirically derived UX subcomponents. Marked x indicates that the authors have considered that subcomponent. The main scopes (e.g., motivation to play, immersion) and the methodologies used (e.g., qualitative, quantitative) vary across the studies

	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)	–	x	x	–	x	–	x	–	–	x
Poels et al. (2007)	x	x	x	x	x	x	–	x	x	–
Ryan et al. (2006)	x	–	x	x	–	x	–	x	–	x
Sherry et al. (2006)	–	x	x	–	–	–	–	x	x	–
Ermi and Mäyrä (2005)	–	x	–	–	–	x	–	x	–	–
Lazzaro (2004)	–	x	x	–	–	–	x	–	x	–
Sweetser and Johnson (2004)	–	–	–	x	–	x	–	x	–	x
Takatalo et al. (2004)	x	x	x	x	x	x	x	x	x	x
Pagulayan et al. (2003)	–	x	x	–	–	–	–	–	–	x

into one framework and to study the UX in games as multidimensional and psychological in nature.

3.1.4 Presence-Involvement-Flow Framework (PIFF)

PIFF is a psychological research framework to study experiences in digital games. It has been constructed on the basis of the extensive concepts of the sense of presence, involvement, and flow. They represent the psychological compartments in digital games well: Presence (Lombard and Ditton 1997) describes the perception of and attention to the game world and both spatial and social cognitions in game play, involvement (Zachkowsky 1985) is considered a measure of gamer motivation, and flow (Csikszentmihalyi 1975) refers to the subjective, cognitive-emotional evaluation of the game. Each concept includes subcomponents that are relevant to both technical game components and psychological determinants of the UX.

3.1.4.1 Presence and Involvement

Gamers often mention realistic high-quality graphical interface and an engaging narrative as central game components responsible for various game-related feeling (Sweetser and Johnson 2004, Wood et al. 2004). The feeling of being in a realistic place with others is indeed the core idea of the concept of presence (Lombard and Ditton 1997). Presence has been studied in a variety of different media, for instance, in virtual environments, movies, and television (Schuemie et al. 2001). The research on presence has extensive theoretical and empirical foundations. Hence, it provides valid and tested metrics to study experiences in games (Pinchbeck and Stevens 2005). The subcomponents of presence are proven to be especially useful when the intensity and extensity of the UX is evaluated (Takatalo et al. 2006a).

The following three subcomponents of presence have been used to study the “sense of being there” or spatial presence in mediated environments: attention (psychological immersion), perceptual realness (naturalness), and spatial awareness (engagement) (Lombard and Ditton 1997). This threefold construct has also been reliably extracted in empirical studies (Lessiter et al. 2001, Schubert et al. 2001). Additionally, the level of arousal and the range and consistency of the physical interaction are integral parts of spatial presence (Lombard and Ditton 1997). Social content is a significant factor in many games and it elicits the sense of social presence. In Lombard and Ditton’s (1997) explication, social presence was composed of social richness, social realism, and co-presence (shared space). These aspects correspond well to the social features found in digital games, such as, narrative and the engagement with one’s own role in a story. Social richness refers to the extent to which a game is perceived as personal and intimate. Social realism refers to the sense of similarity between real-world and game-world objects, people and events. Co-presence is the feeling of being and acting in a game together with other agents.

We have found out a clear distinction between presence and the motivational concept of involvement (Takatalo et al. 2006b). Psychologically, involvement is defined

as a motivational continuum toward a particular object or situation (Rothschild 1984). Involvement concerns the level of relevance based on inherent needs, values, and interests attached to that situation or an object (Zaichkowsky 1985). Thus, involvement determines the meaning and value of the UX. The main interest here is not in what motivates gamers to play, but in understanding the meaning and personal relevance of the game. Whether we want to understand UX in a high-end technological setup or mobile device in a rush-hour subway meaning plays always a key role. Involvement is a central and well-established concept in the field of buyer behavior studies (Brennan and Mavondo 2000). It includes two distinct but closely related dimensions: importance and interest (McQuarrie and Munson 1992). Importance is dominantly a cognitive dimension concerning the meaning and relevance of the stimulus, whereas interest is composed of emotional and value-related valences (Schiefele 1991). This makes importance similar to the cognitive involvement subcomponent that was extracted by Jennett et al. (2008). On the other hand, interest is close to Lazzaro's (2004) curiosity and the will to find out something new in a game. Curiously enough, we have found out that first-person shooters are less involving compared to third person role-playing games (Takatalo et al. 2006a), but it is difficult to point out exactly which game components affect involvement the most.

Taken together, presence and involvement indicate the switch between the real world and a game, namely, the way gamers willingly form a relationship with the physical and social features of the game.

3.1.4.2 Flow

The concept of flow in PIFF describes the subjective, qualitative direction of the UX. In psychological terms, it explains the cognitive evaluation and emotional outcomes of the game play. The cognitive evaluation is often related to game mechanics. In PIFF, the cognitive evaluation of the game concerns, for example, game challenges and gamer skills. These evaluations are related to a number of emotional outcomes (e.g., enjoyment, boredom). This way of looking at the subcomponents of flow is based on different flow-channel models, such as the four-channel flow model (Csikszentmihalyi 1975). The flow-channel models share the idea that there are certain cognitions that are followed by emotions. In an ideal situation where skills and challenges are high and in balance, an optimal state of flow occurs. Such a close coupling of cognitions and emotions is widely acknowledged in psychology in cognitive theories of emotion (Lazarus 1991b). Cognitive evaluations by the gamers and the related emotional outcomes provide useful subcomponents for analyzing the UX from the first hour of play to the full completion of the game.

In addition to describing the subjective evaluations of challenge and skill, the flow theory (Csikszentmihalyi 1975) also considers clear goals and instant feedback as important features that are evaluated cognitively in a given situation. The theory also includes the sense of control, the level of arousal, concentration, time distortion, the loss of self-consciousness, and the merging of action and awareness as prerequisites or correlates of the flow experience. In PIFF, the level of arousal, concentration, and time distortion are included as subcomponents of presence. This theoretical

overlap between flow and presence supports the findings of presence being a prerequisite of flow (Novak et al. 2000). Losing self-consciousness and merging action and awareness have been difficult for respondents to recognize in previous studies (Rettie 2001). The actual state of flow is often characterized as ease of doing, enjoyment and positive valence (pleasure), and the absence of boredom and anxiety (Csikszentmihalyi 1975). Previously, flow has been related to playfulness (e.g., cognitive spontaneity) (Webster and Martocchio 1992) and the sense of control (Ghani and Deshpande 1994, Novak et al. 2000). In addition to these, a wide variety of other emotional feelings has been reported in games, such as, pleasantness, strength, and impressiveness of the experience, amazement, and excitement (Lazzaro 2004, Schubert et al. 2001).

Although all the above PIFF subcomponents have a strong theoretical foundation, we have studied them psychometrically in a large empirical data set.

3.2 PIFF: Methodological Background

PIFF is based on the quantitative data gathered with the Experimental Virtual Environment Experience Questionnaire-Game Pitkä (i.e., long) (EVEQ-GP). EVEQ-GP is composed of approximately 180 items presented in previous studies concerning the sense of presence (Kim and Biocca 1997, Lessiter et al. 2001, Lombard et al. 2000, Schubert et al. 2001, Usoh et al. 2000, Witmer and Singer 1998), involvement (McQuarrie and Munson 1992), and flow prerequisites and correlates (Della Fave and Massimini 1988, Fontaine 1992, Ghani and Deshpande 1994, Mehrabian and Russell 1974, Novak et al. 2000, Webster and Martocchio 1992). All the items were translated into Finnish and transformed either into a seven-point Likert-scale (1 = Strongly Disagree to 7 = Strongly Agree) or into seven-point semantic differentials. The items were modified so that they were assessing experiences received from one game playing session. EVEQ-GP is administered to an individual gamer after a playing session. The gamers who fill in the questionnaire are encouraged to reflect on their subjective experiences of the game they just played. The method enables the participants to report, within the boundaries of the 180 items, how they experienced that particular game. In the field of behavioral sciences, the use of questionnaires has proved to be a valid way of assessing various mental phenomena (Rust and Golombok 1999).

The first version of the PIFF was based on two smaller data sets ($n = 68$ and $n = 164$). Of the 180 EVEQ-GP items, 146 were used to form 23 subcomponents measuring the UX in games (Takatalo et al. 2004). Thereafter, a heterogeneous data from 2182 Finnish gamers who filled in the questionnaire were collected. Data from laboratory experiments and an Internet survey are included in the data set. The data include approximately 320 different games, various displays (HMD, TV, and CRT), and contexts of play (online, offline, home, and laboratory), giving a broad scope to the UX in games. This data enabled more advanced statistical analyses of the PIFF subcomponents. As a result of these analyses, a refined version of the framework, i.e., PIFF² was developed.

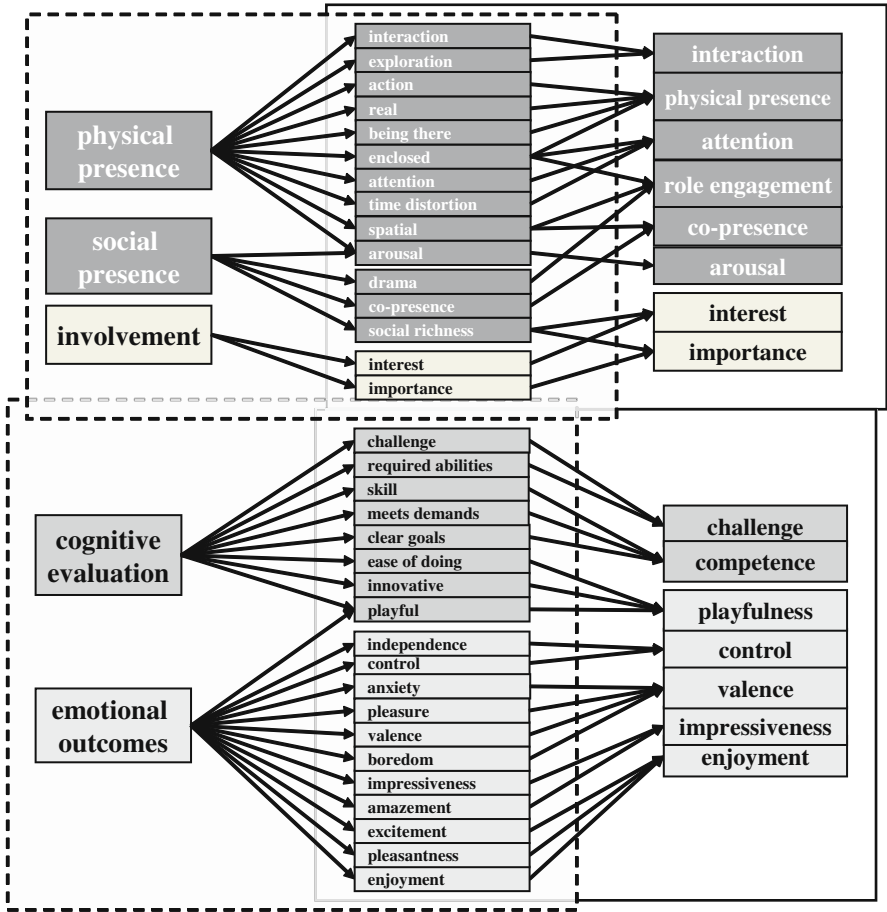


Fig. 3.2 The two measurement models that form the PIFF². On the *left*, measured latent variables in five boxes, in the *middle*, 139 measured questionnaire items (observed variables) represented in 34 boxes. On the *right*, 15 factor-analytically (PFA) extracted subcomponents of UX in games

Methodologically, PIFF² is grounded on two separate multivariate measurement models (Tarkkonen and Vehkalahti 2005), which assessed presence and involvement as well as flow (Fig. 3.2). In psychometrics, measurement models include latent variables (i.e., those difficult to measure straightforwardly), which are measured with observed variables such as questionnaire items. These observed variables are analyzed with multivariate methods to form subcomponents (i.e., measurement scales). These subcomponents thus formed can then be used to assess latent variables.

We used principal axis factor analysis (PFA) with an oblique direct Oblimin rotation ($\delta = 0$) independently in both measurement models to compress a large number of questionnaire items into the subcomponents. Of the 180 EVEQ-GP items,

163 measure presence, involvement, and flow. The rest of the EVEQ-GP items assess background information and game-related issues. After a series of PFA's in both the measurement models including the 163 items, 15 theoretically meaningful subcomponents could be reliably formed out of the 139 highest loading items (Takatalo et al. 2006b, Submitted). Next, a short description of both the measurement models and each of the subcomponents forming them is given. The number of items forming a subcomponent and an estimation of the reliability of a subcomponent are given in parenthesis. Reliabilities were estimated with Tarkkonen's rho (ρ) (Vehkalahti et al. 2006). Rho was used instead of a popular Cronbach's alpha, because alpha has a build-in assumption of one-dimensionality of a measure and a tendency to underestimate the measures (Tarkkonen and Vehkalahti 2005, Vehkalahti et al. 2009). This may lead to biased conclusions and discarding of suitable items or even subcomponents (Vehkalahti et al. 2006). Tarkkonen's rho is interpreted the same way as the Cronbach's alpha: Values above 70 indicate that the items forming a subcomponent measure the same phenomenon.

3.2.1 Presence and Involvement

Of 93 EVEQ-GP items forming the presence and involvement measurement model, 83 highest loading ones are those that form the eight extracted subcomponents (Fig. 3.2). This solution explained 41.67% of the total variance in the final PFA (Appendix A). The *physical presence* subcomponent ($\rho = 0.82/17$ items) describes the feeling of being in a real and vivid place. Items included, for example, "In the game world everything seemed real and vivid." The third presence dimension in Lombard and Ditton's (1997) description, *attention*, that is, time distortion, focuses on the game world instead of the real world, formed a subcomponent of its own ($\rho = 0.88/12$). Included were items, such as, "My vision was totally engaged in the game world" and "I was not aware of my 'real' environment." Two subcomponents for different aspects of social presence were also extracted. *Co-presence* ($\rho = 0.89/14$) includes the feeling of sharing a place with others and being active there (e.g., "I felt that I was in the game world with other persons"). *Role engagement* ($\rho = 0.80/12$) describes being transported into the story: how captivated gamers were by the role provided in the narrative (e.g., "I felt that I was one of the characters in the story of the game"). Two more subcomponents measuring emotional arousal ($\rho = 0.70/5$ items, e.g., active, stimulated vs. passive, unaroused) and game world's interactivity were extracted. *Interaction* subcomponent ($\rho = 0.72/9$) was composed of items assessing, for example, speed, range, mapping, exploration, and predictability of one's own actions in the game world (e.g., "The game responded quickly to my actions"). In our further analysis (Takatalo et al. 2006b), the *interaction* subcomponent did not fit with the rest of the subcomponents extracted in the presence and involvement measurement model. One explanation could be the nature of the interaction subcomponent: It is more of a cognitive evaluation of the game interactivity than a subjective perceptual experience as pointed out by Schubert

and his colleagues (2001). Similarly, Jennett and her colleagues (2008) considered their control subcomponent (i.e., “using the controls as travelling somewhere and interacting with the world”) as a game factor instead of a person factor. Thus, we have analyzed interaction among the other cognitive game evaluations extracted in our flow measurement model.

In the same PFA, the two theoretical subcomponents of involvement, namely, importance and interest, were extracted. *Interest* ($\rho = 0.72/6$) is composed of emotional and value-related valences, such as, “the game was exciting.” *Importance* ($\rho = 0.89/8$) is dominantly a cognitive dimension showing how meaningful, relevant, and personal the game was (e.g., “the game mattered to me”). More details of the extraction and utilization of the eight presence and involvement subcomponents can be found in our previous studies (Takatalo et al. 2006a, b).

3.2.2 Flow

Of the 70 EVEQ-GP items forming the flow measurement model, 56 highest loading ones are those that form the seven extracted subcomponents (Fig. 3.2). This solution explained 41.30% of the total variance in the final PFA (Appendix B). The *challenge* subcomponent ($\rho = 0.76/5$ items) assesses the degree to which abilities were required to play the game as well as how challenging the gamer felt it was to play (e.g., “playing the game felt challenging”). *Competence* ($\rho = 0.86/11$) combined measures of user skills and positive feelings of effectiveness. It also included items, which assessed clear goals and items that evaluated both demand and competence (e.g., “I felt I could meet the demands of the playing situation”). Furthermore, five subcomponents with emotional content were extracted. *Hedonic valence* ($\rho = 0.77/10$) is the bipolar subcomponent having pleasure on one end and displeasure on the other. It was composed of semantic differentials, such as, “I felt happy/I felt sad.” The *enjoyment* subcomponent ($\rho = 0.74/7$) included aspects such as pleasantness and enjoyment. Playing was also somehow special (e.g., “I will recommend it to my friends” and “I had peak experiences while playing”). Items forming the original *playfulness* scale (Webster and Martocchio 1992) (e.g., “I felt innovative” and “I felt original”) formed a subcomponent of their own ($\rho = 0.78/9$). Items measuring actual feelings of flow, such as ease of doing, loaded on the playfulness subcomponent as well. *Control*, that is, being dominant and independent, formed one subcomponent ($\rho = 0.74/5$) composed of semantic differentials, such as, “I was dominant/I was submissive.” Feelings of being amazed and astonished formed the *impressiveness* subcomponent ($\rho = 0.79/9$), which included items, such as, “I was astonished and surprised at the game world” and “I felt something dramatic in the game world.” For more details of the extraction and utilization of the seven flow subcomponents, see our previous studies (Takatalo et al. 2008, Submitted).

Factor scores with Bartlett’s method (Tabachnick and Fidell 2001) were computed from the 15 PIFF² subcomponents. Next, these subcomponents are used to analyze different aspects of the UX in games.

3.3 PIFF² in Practice

We have demonstrated here the multidimensional and psychological nature of the UX in games. The rest of the chapter presents two distinct practical examples of how to utilize the mapping of PIFF² subcomponents in different phases of the game development life cycle. First, all the subcomponents are used to compare groups of expert gamers in two different games. Psychological profile provided by the PIFF² is compared against METASCORE[®] and user ratings provided by the Metacritic.com (Metacritic.com 2009). However, sometimes more detailed information about a specific game feature is needed as quickly and efficiently as possible. Using only selected PIFF² subcomponents in a more qualitative manner would then be a better choice. Our second case deals with an individual-level analysis of experienced game difficulty and learning of skills during the first hour of play. Analysis of game mechanics and qualitative interview are integrated into this case. However, the use of complete subscales with several participants guarantees more extensive and reliable results.

3.3.1 Between Groups: PIFF² in Two Different Games

A standard way of using PIFF² is to gather post-game experiences with an EVEQ-GP questionnaire. This would be most beneficial, for example, in the production phase when all content can be represented, but there is still time and possibility to introduce changes before releasing the game. If used as a post-launch study, a PIFF² analysis can provide useful information and facilitate evaluation of the released product. Here, we conduct such a post-launch analysis to two first-person shooters (FPS) and compare PIFF² profiles with the METASCORE[®] and the user ratings of these games. Both these numeric values are provided by the Metacritic.com (Metacritic.com 2009). METASCORE[®] is based on a weighted average of various scores assigned by expert critics to that game. The user ratings are means of all the ratings given to a game by the users. Metacritic.com provides the amount of users that have rated a particular game. This comparison will demonstrate the added value of the psychological and multidimensional analysis of the UX based on gamers' own reflections from the game.

The data included 109 expert male gamers, who played either Valve's *Half-Life 2* (HL2; $n = 62$) or *Counter Strike: Source* (CS; $n = 47$), both run by the same Source[®] game engine. This makes the interface in studied games exactly the same. After they finish playing either HL2 or CS, each gamer filled in the EVEQ-GP in our Internet survey. HL2 is described as "it opens the door to a world where the player's presence affects everything around him, from the physical environment to the behaviors even the emotions of both friends and enemies. The player again picks up the crowbar of research scientist Gordon Freeman, who finds himself on an alien-infested Earth being picked to the bone, its resources depleted, its populace dwindling" (Half-Life 2 2004). In CS, gamers can "engage in an incredibly realistic

brand of terrorist warfare in this wildly popular team-based game” (Counter-Strike: Source 2004). In addition, “CS modifies the multiplayer aspects of ‘Half-Life’ to bring it a more team-oriented game play. CS provides the player with an experience that a trained counter-terrorist unit or terrorist unit experiences” (Metacritic.com 2009). Thus, there were differences in game mechanics and narrative between *HL2* and *CS*.

HL2 has received a METAScore® of 96/100 based on 81 reviews and *CS* 88/100 based on nine reviews. A METAScore® between 90 and 100 is considered as a “Universal Acclaim” and between 75 and 89 a “Generally favorable reviews” (Metacritic.com 2009). The users rated *HL2* 9,3/10 (3487 votes) and *CS* 9,2/10 (7532 votes) (situation in March 22, 2009). Although the background of the players rating the games was not standardized in any ways (e.g., skill, gender), this variation between scores and ratings gives an interesting starting point for the inspection of the PIFF² profiles. Two distinct between-subjects multivariate analyses of variance (MANOVA) were conducted for both presence and involvement as well as flow subcomponents. Significant differences in MANOVA’s were further studied in univariate analyses. The UX determinants are included in bold face.

Figure 3.3 shows that the levels of both *presence* and *involvement* differed between the games (Wilk’s Lambda = 0.70, $F(8,100) = 5.46, p < 0.001, \eta^2 = 0.30$). *HL2* was considered more *interesting (value)* than *CS* (one-way ANOVA, $F(1, 4,05) = 4.10, p < .05, \eta^2 = 0.04$). The presence profiles of the games were also quite different. *CS* was high in *co-presence* ($F(1, 5,46) = 5.93, p < 0.05, \eta^2 = 0.05$), *attention* (NS), and *arousal* ($F(1, 5,90) = 4.23, p < 0.05, \eta^2 = 0.04$), whereas characteristic for *HL2* was quite steady scores in each of the subcomponents. Especially high it was in *role engagement* ($F(1, 16,38) = 14.89, p < 0.001, \eta^2 = 0.12$) and *physical presence* ($F(1, 8,08) = 5.41, p < 0.05, \eta^2 = 0.05$) compared to *CS*. Both the games were considered equally *important* and *attentive*. These differences show, quite simply, how

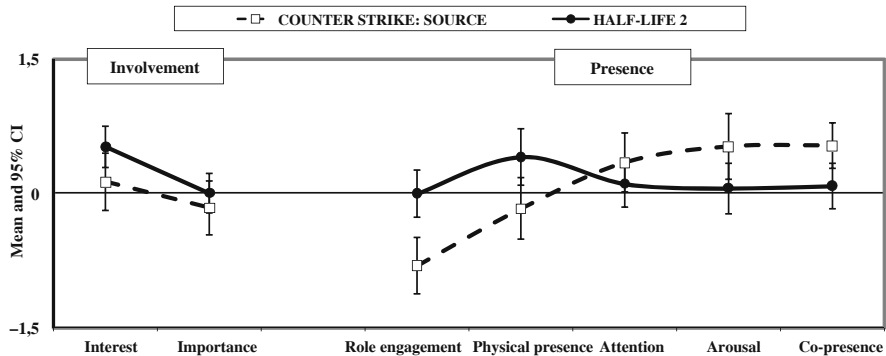


Fig. 3.3 Group means in involvement and presence subcomponents in *Half-Life 2* and *Counter Strike: Source*. The error bars represent a 95% confidence interval. An overlap by half the average arm length of the error bar indicates a statistical difference between the groups ($p \approx 0.05$). If the tips of the error bars just touch, then the difference is $p \approx 0.01$. A gap between the error bars indicates $p < 0.001$

the narrative affects the UX: *HL2* builds on the realistic game world, the city seven (**extensivity**), and provides the role of the Gordon Freeman to an individual gamer (**meaning**). With a similar interface, *CS* provides teamwork and **intensive** performance. Naturally, the difference in game narrative is linked to the game mechanics, which was studied with the flow subcomponents.

Figure 3.4 shows that the cognitive-emotional flow subcomponents in both games were significantly different (Wilk’s Lambda = 0.59, $F(7,101) = 10.10$, $p < 0.001$, $\eta^2 = 0.41$). Especially, in cognitive evaluations the games were quite different. Gamers evaluated *CS* more *challenging* ($F(1, 12,13) = 4.04$, $p < 0.01$, $\eta^2 = 0.07$), *interactive* ($F(1, 14,35) = 11.64$, $p < 0.01$, $\eta^2 = 0.10$), and themselves more *competent* to play ($F(1, 5,50) = 10.58$, $p < 0.01$, $\eta^2 = 0.09$). However, the emotional **quality** of their UX was somewhat “thinner” compared to *HL2*. *HL2* was more positive in *valence* (pleasure) ($F(1, 4,80) = 5.68$, $p < 0.05$, $\eta^2 = 0.05$), *enjoyable* ($F(1, 5,38) = 4.64$, $p < 0.05$, $\eta^2 = 0.04$), *playful* ($F(1, 3,40) = 4.40$, $p < 0.05$, $\eta^2 = 0.04$), and *impressive* ($F(1, 14,44) = 13.60$, $p < 0.001$, $\eta^2 = 0.11$). There was no difference between the games in the sense of *control*. Game mechanics providing competition and co-operative performance are the most likely cause for the flattened emotional profile in *CS*. However, it should be emphasized that the UX in *CS* is still far from being negative or boring. Heightened attention and arousal and highly evaluated cognitive and social features in the game are enough to keep gamers in *CS* for hours.

Both the PIFF² analysis and a METASCORE[®] found the differences between *HL2* and *CS*. A well-prepared narrative combined with good AI-based action seems to be engaging and heart-touching compared to extreme challenge and action with live comrades. The advantage of the PIFF² is its potential use in any phase of the game development cycle: stimulating, supporting thinking, and giving ideas for the UX goals in concept phase and providing a facilitative tool to evaluate these goals

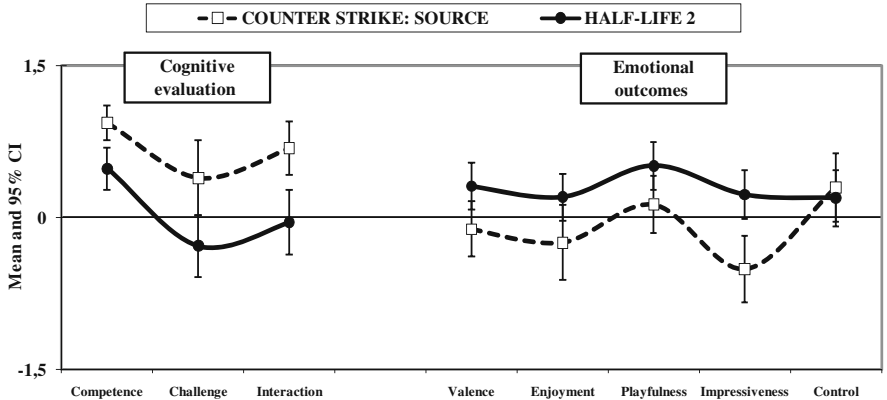


Fig. 3.4 Group means in flow subcomponents in *Half-Life 2* and *Counter Strike: Source*. The error bars represent a 95% confidence interval. An overlap by half the average arm length of the error bar indicates a statistical difference between the groups ($p \approx 0.05$). If the tips of the error bars just touch, then the difference is $p \approx 0.01$. A gap between the error bars indicates $p < 0.001$

in beta versions in a production phase, as it was shown here. Relating PIFF² to user ratings provides a good demonstration of our content-oriented approach in media psychology in general. In order to understand the user rating, one needs to understand both the content and the psychology involved. Gamers rated both *HL2* and *CS* as about equally high, but clearly for different reasons, which were out of the reach of the single rating grade given. However, these nuances could be disclosed by a multidimensional psychological profile of PIFF². The analysis of the profile indicated that the two games were equally interesting and attentive, which could explain the similar ratings given by the gamers. It is an old psychological fact that we perceive and focus our attention on stimuli that motivate and interest us (James 1890). This part of the UX cannot be reached by an outside observer, thus a measure which considers meaning and personal relevance in that particular game is needed. As presented in this example, the involvement concept fits well into this purpose.

3.3.2 Between Users: Competence and Challenge in the First Hour

In the previous example, games were evaluated by groups of gamers at a general level. User ratings and PIFF² profiles were based on hours of playing. However, sometimes a finer detail, such as, a particular game feature or user group needs to be investigated. Critical issues in production phase are often related to game mechanics and could include, for example, evaluating the learning curve or adjustment of the difficulty level. Usually, such issues take place in the first hour of play, which should convince the gamer to keep on playing instead of suffocating an evolving enthusiasm (Davis et al. 2005). To study these, a large data and a heavy questionnaire are not the best option. It is enough to (1) define the investigated problem well, (2) know what to measure, and (3) how to measure. Here, we give an example where the focus is on understanding how competence develops and game challenges are evaluated during the first hour of play. The cognitive-emotional flow subcomponents provided by PIFF² serve this purpose well, disclosing both the cognitive game evaluations and the quality of UX. In addition, a lighter way of utilizing PIFF² dimensionality is introduced and PIFF² findings are integrated into gamer interviews and the observed performance in the game.

Evaluations of challenge and competence by two male gamers' (Mr. 1 and Mr. 2) were analyzed during their first hour playing Valve's *Portal*. *Portal* is a single-player game, in which "players must solve physical puzzles and challenges by opening portals to maneuvering objects, and themselves, through space." *Portal* has been called "one of the most innovative new games on the horizon and will offer gamers hours of unique game-play" (Portal 2007). *Portal* provides game mechanics with clearly distinguished levels (i.e., chambers) that enable study of the process that gives the UX its quality. This process was captured by suitably interrupting the gamers twice during the 1 h of play. The breaks were timed so that the gamers were in "the elevator" between the chambers. The third evaluation was made after 60 min of playing. The gamers were in the laboratory by themselves, and the interruptions were made as natural as possible. During the breaks, the gamers rated one item in each of the

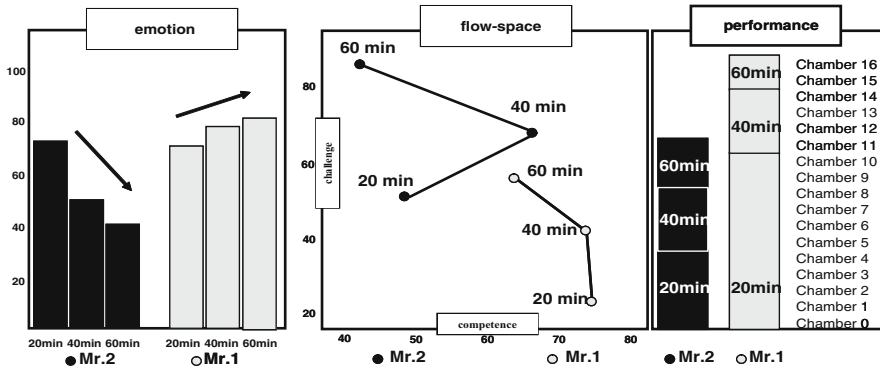


Fig. 3.5 (a) Composite measure of emotions of the two gamers during the first hour of play. (b) Flow space and evaluations of challenge and competence of the two gamers during the first hour of play. (c) The number of chambers finished by the two gamers during the first hour of play. Each measure was taken after 20, 40, and 60 min of playing

selected PIFF² subcomponents in the touch-screen next to them. Thus, the method was called PIFF²-in-breaks analysis. The first page on the touch-screen included a flow space (Fig. 3.5b). The flow space is formed from the *challenge* and *competence* subcomponents. The idea of the flow space was to evaluate both competences and challenges together in each game period. So, during each break the gamers marked the point in the flow space that best corresponded to their evaluations in that particular game period. Flow space is based on the flow-channel models, such as the four-channel model (Csikszentmihalyi 1975) and the flow grid (IJsselstein W and Poels K, personal communication, April 24, 2008). The second page of the touch screen presented one question in each of the emotional subcomponents (*pleasure/valence*, *control*, *enjoyment*, *impressiveness*, and *playfulness*). These five individual scores were summed and used as a composite measure of emotional outcomes in this example (Fig. 3.5a). Gamers could not see their previous evaluations when using the touch-screen. While using the touch-screen, the instructor interviewed the gamers in order to deepen their answers. This qualitative–quantitative data collection procedure during each break took approximately 2–3 min. The performance in the game was evaluated based on how many chambers the gamers finished in each of the approximately 20-min game periods (Fig. 3.5c). Although both gamers fulfilled the prerequisite for participating in the experiment, namely, that they had no prior experience on *Portal*, there were other background differences between them.

Mr. 1 is 21 years old and plays games on average for 300 min at a time. He considers that “I have played games for a long time. . . My little brother has told me that this is an easy one.” Mr. 2 is 30 years old and plays games on average 60 min at a time. He thinks that “I have not played this kind of game before. I’m not an expert at these games.” Although both play games equally often (50% or more of days), Mr. 1, being younger, invests more time in playing. He seems to be a more

experienced gamer and more confident when starting a game. This difference in the gamers' backgrounds is seen both in their cognitive evaluation shown in the flow space (Fig. 3.5b) and in their performance (Fig. 3.5c) after the first 20 min of play. They began their cognitive evaluation at different points, Mr. 2 being more challenged and less competent. Consequently, Mr. 2 completed only four chambers compared to Mr. 1's 10 chambers. However, the composite measure of the two users' emotions was on the same level after 20 min of playing. This shows the complexity of measuring the UX. Gamers have the same level of emotions for different reasons. That is why, for example, measuring only fun in games is not enough; multidimensional measures are needed to uncover the underlying experiential subcomponents.

The shape and magnitude of the two gamers' flow-space profiles disclose the evaluation process that took place during the first hour. After 40 min of play, Mr. 1 had completed only four chambers more, shown in the flow space as increased challenge and stagnation in competence. However, Mr. 1's positive feelings kept increasing. Mr. 2 did essentially the same number of chambers as in his first 20 min. He considered himself competent and the game more challenging. Although his competence increased after 40 min, his feelings dropped dramatically. In the interview he said: "(the level of) arousal decreased and I felt tired"; "The game doesn't feel novel any more; I have become numb"; "It has become more demanding... so many things should be used and considered." This indicates a clear mental collapse, which is seen in his cognitive evaluation of the last period. During the last 20-min period, he reached Chamber 11, never finished it, and experienced a dramatic decrease in competence. At the end he described his UX: "My skills decreased; I lost the logic. It is frustrating because I cannot proceed and do not understand what is going on... I lost concentration and started to try solutions randomly. The Portals were confusing; there were so many things that I could not control." Clearly, after an hour of play, Mr. 2 was giving up. The choices and challenges provided by the game were too overwhelming. He was not ready to commit himself to the game and work to meet its demands. By contrast, Mr. 1 was just getting warmed up. In the last period, he managed to do only two more chambers, but he considered the game to be challenging: "Clearly more challenging. I needed to really think of what to do. The feeling of skill is getting stronger when I learned what I can do... I'm becoming more and more impressed with it." Although his evaluations of competence dropped somewhat in the last period, he was learning to play the game and was confident about continuing.

This simple example shows what kind of information can be obtained with the PIFF² subcomponents to support a specific design problem concerning, for example, the game mechanics. Cognitive-emotional flow subcomponents show how the learning curve, difficulty of the game, and the quality of the UX evolve and change during the critical first hour of play. PIFF²-in-breaks method utilizes reliable measures drawn from a large data more efficiently. This example shows one way of utilizing the PIFF²-in-breaks method. If the interest is in the analysis of the interface or narrative, then the presence and involvement subcomponents could be included in the PIFF²-in-breaks analysis. It can also be accompanied by other measures

(e.g., usability) in order to analyze design goals at particular game levels, game features, or user groups. The touch-screen can be used at home as well as in the laboratory and the time period evaluated can range from minutes to days, depending on the scope of the study.

3.4 Contributions and Future Challenges

Numerous concepts have been proposed to describe and explain the UX in games. Clearly, there is no one concept alone, but rather a wide and multidimensional array of psychologically relevant subcomponents that can capture the experiential richness provided by digital games. PIFF² provides one way of integrating such subcomponents into a single framework. Although it is based on the wider concepts of presence, involvement, and flow, PIFF² aims at understanding the subcomponents of “being there” and “optimal experience,” for example, when playing games. Theoretically, PIFF² is founded on previous studies conducted in the field of game research, while it takes into consideration the basic psychology and the game content, that is, fundamental game components (i.e., the mechanics, the narrative, and the interface). Methodologically, it is based on a large multivariate data set that is psychometrically analyzed in order to establish a reliable and valid set of subcomponents. These analyses have provided 15 subcomponents for analyzing the UX in games. These subcomponents disclose the content, quality, meaning, value, intensity, and extensity of the UX.

It was shown here how PIFF² can be utilized to analyze the UX in a group and individual contexts. Because in PIFF² gamers are considered to be in a game world instead of merely using a game, this framework enables consideration of a broad range of psychological phenomena occurring in games. This is beneficial for basic research in games. As it was shown in the two cases presented, PIFF² metrics can be incorporated into different phases of the game development cycle. In the concept and prototyping phases, a multidimensional framework will be helpful in determining the desired psychological attributes for the UX. Designers can use the psychological information as inspiration and support for their own thoughts when creating new and added value for their games. In the production phase, quality assurance professionals and those evaluating beta versions of the games appreciate validated and reliable tools when evaluating the UX alongside game usability.

Although EVEQ-GP seems to work well in the research settings, future work will involve condensing it into a more convenient tool to be used in various experimental settings. It will then be used to collect multicultural data to support the current framework. The use of the individual PIFF² subcomponents for the study of specific game design problems will also be considered in more detail. This will include studying the relationships between different PIFF² subcomponents and the game components. In future, we will deepen the social and story-related subcomponents of the PIFF² in order to deal with socially rich game contents, such as massively multiplayer online role-playing games. The current multidimensional structure of PIFF² provides a firm foundation for these future goals.

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Appendix 1: The Final PFA of the Presence and Involvement Measurement Model

Total variance explained

Factor	Initial Eigen values			Extraction sums of squared loadings			Rotation
	Total	Percentage of variance	Cumulative percentage	Total	Percentage of variance	Cumulative percentage	
Role engagement	19,650	23,674	23,674	19,125	23,042	23,042	9,382
Attention	6,189	7,456	31,130	5,657	6,816	29,858	8,310
Interest	3,394	4,089	35,220	2,811	3,387	33,245	4,235
Importance	2,715	3,271	38,491	2,204	2,656	35,900	10,179
Co-presence	2,025	2,439	40,930	1,496	1,803	37,703	11,823
Interaction	1,803	2,172	43,103	1,193	1,438	39,141	5,613
Arousal	1,782	2,148	45,250	1,147	1,382	40,523	4,498
Physical presence	1,485	1,789	47,040	954	1,150	41,673	11,537

Extraction method: Principal axis factoring.

Appendix 2: The Final PFA of the Flow Measurement Model

Total variance explained

Factor	Initial Eigen values			Extraction sums of squared loadings			Rotation
	Total	Percentage of variance	Cumulative percentage	Total	Percentage of variance	Cumulative percentage	
Valence	13,279	23,713	23,713	12,762	22,788	22,768	7,543
Impressiveness	4,055	7,241	30,955	3,458	6,175	28,963	4,573
Competence	2,540	4,535	35,490	2,020	3,608	32,571	7,453
Challenge	2,013	3,594	39,084	1,445	2,581	35,152	3,272
Enjoyment	1,898	3,371	42,454	1,261	2,252	37,404	4,848
Playfulness	1,695	3,027	45,481	1,140	2,036	39,440	6,707
Control	1,627	2,906	48,387	1,041	1,860	41,298	4,628

Extraction method: Principal axis factoring.

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