Using Heuristics to Evaluate the Overall User Experience of Video Games and Advanced Interaction Games

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Abstract

This book chapter describes an approach of evaluating user experience in video games and advanced interaction games (tabletop games) by using heuristics. We provide a short overview of computer games with a focus on advanced interaction games and explain the concept of user-centred design for games. Furthermore we describe the history of heuristics for video games and the role of user experience of games in general. We propose a framework consisting of three sets of heuristics (game play/game story, virtual interface and tabletop specific) to detect the most critical issues in video games as well as advanced interaction games. To assess its applicability we compare the results of expert evaluations of five current games with the user experience-based ratings of various game review sites. In the conclusion we provide an outlook on possible extensions of our approach.

1 Introduction

The computer games industry has remarkably increased in importance over the last years (ESA 2008). The number of units sold climbs up steadily and video games have changed from being a product for a small minority to a widely used and accepted medium. The expanding game market also opens the door for a series of research-related activities. Especially the term user experience (UX) has become increasingly important. Researchers and human-computer interaction (HCI) experts want to find out how computer gamers experience the game situation (cf. Clarke and Duimering 2006), and the industry is interested in finding ways to measure the user experience and to interpret the collected data (e.g. to acquire new target groups). The evaluation of the user's experience and the closely connected user-centred development of video games have been addressed in numerous publications (cf. Marsh et al. 2005). Several researchers have designed

methods for game evaluation by adopting techniques from the usability field such as usability tests and heuristic evaluations. In recent years several documents on heuristic evaluation of video games have been proposed, all treating overlapping subject areas but diverse in detail and quality of description (cf. Federoff 2002; Desurvire et al. 2004; Röcker and Haar 2006; Koivisto and Korhonen 2006; Pinelle and Gutwin 2007; Schaffer 2007; Pinelle et al. 2008; Jegers 2008; Bernhaupt et al. 2007, 2008).

Social and physical interactions are a new frontier in entertainment. Today countless applications are built that provide entertainment to the masses, but very few support truly new user experiences. Nintendo's Wii[1] controller is an excellent example for a novel interface that allows a very intuitive and natural interaction leading to a completely new user experience. This even motivates non-traditional target audiences like elderly players to try playing video games. However people also still love traditional board games, such as Risk, Monopoly etc., mostly due to the rich social interaction. Instead of sitting sole in front of a screen, playing with friends over the internet or even having a shoulder-by-shoulder experience, people still enjoy having a face-to-face experience (Amaya and Davis 2008). Most traditional board games are multiplayer games and game sessions are organized as social events. Experiencing close social interactions like laughter, cheering, discussions or even shouting makes classical board games interesting enough to prevail against video games despite limits in interactivity and complexity.

On the one hand today's video game consoles and video games lack all sorts of nonverbal communication which are crucial for face-to-face communication. On the other hand traditional board games are limited because of static game media, hindering the implementation of complex game scenarios and truly interactive game environments. Therefore the logical consequence is to combine the advantages of both video games and traditional board games for a new gaming experience. In various areas digital tabletops have already been used successfully. For example interactive tabletop interfaces have already emerged as an effective tool for co-located collaboration over digital artefacts (Scott and Carpendale 2006). Related research shows that in the case of collaborative work, a tabletop device can have a significantly higher job performance than a traditional desk (Scott and Carpendale 2006) and encourages a higher level of creativity and interaction among users (Buisine et al. 2007). And Microsoft's Surface[2] table and Smart's SmartTable[3] are trying to bring digital tabletop applications to the next level by releasing commercially available platforms to the market.

In the past few years, tabletop installations and games have become more and more popular (Kojima et al. 2006; Lee at al. 2005; Loenen et al. 2007; Magerkurth et al. 2004; Tse et al. 2007). Most recent work on interactive surfaces deals with merging the real with the virtual (digital) enabling people to share the same ex-

1 http://wii.nintendo.com/

2 http://www.microsoft.com/surface/

3 http://www2.smarttech.com/st/en-US/Products/SMART+Table/

perience (Dietz and Leigh 2001; Morris et al. 2006). Example applications are the STARS platform (Magerkurth et al. 2004), Augmented Coliseum (Sugimoto et al. 2005), PlayAnywhere (Wilson 2005), PlayTogether (Wilson and Robbins 2006) or MonkeyBridge (Barakonyi et al. 2005).

(a) (b) (c) (d)

Fig. 1. Different tabletop games. (a) NeonRacer[4] is an interactive car-racing game, (b) PenWars is a sketch-based tank-war game[5], (c) Comino[6] is a domino game that combines the physical and digital world, and (d) IncreTable[7] is follow-up game from Comino and allows one modifying the digital terrain using physical (tangible) objects.

Over the past four years, we developed different tabletop games (see Fig. 1), focusing mainly on interaction techniques. During the development, we found that it is even more important for game designers to get a framework for identifying usability problems both in early designs, but also in more mature prototypes.

There is little research about the user-performance of tabletop devices and only few formal user studies are performed to demonstrate the real benefits of tabletop games. Most studies so far focus more on tabletop setups in general and researchers evaluate interactive tables more on a technical level (e.g. comparing different interaction metaphors). Besides our focus on measuring user experience with heuristics of a broad variety of games, we provide methods for a more narrow and specific field of games: tabletop games.

1.1 Overview

Few approaches are currently linking the results of heuristic evaluation methods to user experience. Especially in the field of computer games, where the experience is the leading factor, different aspects can be evaluated using heuristics. Therefore, we first put the main focus of this chapter on demonstrating the connection between heuristics for games and a game's user experience. Next, we provide an overview of previously available heuristics and introduce summarized heuristics of a higher quality. To test the applicability of our heuristics to user experience

4 http://www.neonracer.net/

5 http://mi-lab.org/projects/penwars/

6 http://mi-lab.org/projects/comino

7 http://mi-lab.org/projects/incretable

ratings, we conduct heuristic evaluations on several games and compare the resulting data to user experience-based game reviews. Finally we critically assess our method and offer improvements and future perspectives. This discussion of current advanced interaction games leads to the introduction of a set of specific evaluation heuristics applicable to the user experience of these games. Together with the aforementioned general game heuristics (which focus on game play/game story and the virtual interface), we deliver a complete framework usable for either evaluating the user experience of games in general or specifically for advanced interaction games.

2 Video Game Definition and Genres

Before discussing heuristics for video games, we want to get a clear understanding of the terminology "video game". Esposito provides an interesting definition for a video game:

> "A video game is a game which we play thanks to an audiovisual apparatus and which can be based on a story" (Esposito 2005)

Esposito's definition contains four important elements that classify a video game: *game*, *play*, *audiovisual apparatus,* and *story*. These elements are derived from literature such as (Huizinga 1950; Callois 1961; Zimmermann 2004).

We second this definition in most of its statements but want to add that the mentioned audiovisual apparatus is not necessarily limited to two senses. Touch-based input and haptic feedback mechanisms allow a broader range of video game devices. We also want to point out the need to clearly distinguish games from productivity applications as done in (Pagulayan et al. 2003). Finally, to avoid misunderstandings about the term itself we consider video games as an umbrella term for all electronic games, independent of their platform (computer, console, arcade, etc.). Still there is need to put games into certain categories to be able to unite titles of similar type.

There are many different distinctions available, some more common than others. Wolf defined a set of 41 genres in (Wolf 2001), being sometimes too specific (e.g. when defining Diagnostic Cartridges as a genre). Ye proposes to adapt the genre term and certain genre conventions from movies to games, but does not give a clear genre definition himself (Ye 2004). A common and well established genre definition has been created by the NPD group and is mentioned amongst others in (Pagulayan et al. 2003) and used by (ESA 2008) for their market statistics. This classification contains eleven well known and established (super-) genres such as role-playing game (RPG), action or shooters and abstains from introducing fine-grained subcategories. We propose the use of theses genres in order to be able to classify games in accordance with the market/industry for our test in section 6.2.

3 User-centred Design in Games

User-centred design is a design philosophy which describes a prototype-driven software development process, where the user is integrated during the design and development process. The approach consists of several stages which are iteratively executed: Requirements analysis, user analysis, prototyping and evaluation. User-centred design is specified in EN ISO 13407 – Human Centred Design Processes for Interactive Systems (ISO 13407:1999 1999). This approach is also used for game design as described in (Fullerton et al. 2004) and a central topic at Microsoft Game Studios[8]. It contains three distinct development phases: conceptualization, prototyping and playtesting. The first phase typically involves the complete planning such as identification of goals, challenges, rules, controls, mechanics, skill levels, rewards, story and the like (Pagulayan et al. 2003). These specifications are done by game designers and are put on record in game design documents.

The second phase–prototyping–is used to quickly generate playable content, which can be efficiently used to do playtesting and measure attributes such as user experience, the overall quality (commonly denoted as fun), the ease of use or the balancing of challenge and pace (Pagulayan et al. 2003).

To gather results for these variables a range of usability methods such as structured usability tests (Dumas and Redish 1999) and rapid iterative testing and evaluation (RITE, Medlock et al. 2002) can be applied. Pagulayan et al. propose additional evaluation methods such as prototyping, empirical guideline documents or heuristics (Pagulayan et al 2003). We believe that especially heuristics can be a fast and cost-efficient but still effective and accurate evaluation method for user experience in games. Therefore we will present our own set of heuristics in sections 5 and 7 and verify them by conducting an expert evaluation. Before that we will give a short introduction to heuristic evaluation as an expert-based usability approach.

Heuristic evaluation is one of the so-called expert-based usability inspection methods (Nielsen and Mack 1994). It is an efficient analytical and low-cost usability method to be applied repeatedly during a development process, starting at the very beginning of a project design circle (Nielsen and Mack 1994). In general, heuristics can be considered as rules of thumb that describe the affordances of the users to a particular system. The formulation of heuristics is more universal than the one of usability guidelines (Koeffel 2007). The heuristics should provide enough information to enable the evaluator to judge all possible problems of a system (Sarodnick and Brau 2006). During a traditional user-interface evaluation three to five experts (in the field of the application, usability or both) inspect a system according to recognized and established usability principles (i.e. the heuristics). Heuristics allow for an evaluation of systems in a very early stage of the design process (e.g. paper mock-ups). Although numerous heuristics are available

8 http://mgsuserresearch.com/

for the evaluation of video games (see following section), no particular work on how to evaluate user experience through the application of heuristics has been introduced.

4. History of Heuristics for Video Games

In the following a brief overview of the history of heuristics for video games will be presented, starting with Malone who was the first one to introduce the idea of using heuristics to evaluate games (Malone 1980, 1982). His heuristics mainly focused on educational games, not possessing the graphical, acoustic and computational possibilities that current video games offer. Malone categorized his heuristics into challenge, fantasy and curiosity.

Although Malone has introduced his heuristics as early as 1980, this method was adopted by a wider audience with Jakob Nielsen's 10 heuristics introduced in 1994 (Nielsen 1994). Since then these 10 heuristics are the mostly referenced set of heuristics and frequently used for different kinds of applications. Originally they have been developed for traditional interfaces, nevertheless they are also (to a certain extend) applicable to several other areas such as pervasive games or video games. Federoff assessed the applicability of these heuristics to the area of video games (Federoff 2002). She discovered that they were usable and developed a set of 40 heuristics which was partially based on Nielsen's heuristics. For a better overview and easier assignment of single problems to heuristics she categorized them into game interface, game mechanics and game play. We think that the heuristics published by Federoff appear slightly superficial and sometimes do not cover the entire extent of facets offered by video games, especially when considering the capabilities of state of the art video games. Furthermore they appear to concentrate on role playing games and are therefore not applicable to all possible game genres.

In 2004 Desurvire et al. released a new set of verified heuristics, the HEP (heuristic evaluation of playability), which were based on the heuristics introduced by Federoff (Desurvire et al. 2004). In contrast to Federoff's approach, these heuristics were categorized into the four sections game story, game play, game mechanics and game usability. Through further evaluations these heuristics have proven to be effective. We think that the heuristics by Desurvire et al. do not consider the important impact of challenge onto the user's experience. Nevertheless the categorisation of heuristics for video games into game play, game story, game mechanics and game usability has been taken into account when formulating our framework. Two years after Desurvire et al. designed their heuristics, Röcker and Haar tested the adaptability of these heuristics to the area of pervasive games (Röcker and Haar 2006). It was their basic assumption that no aspects related to the game platform were to be found in the heuristics for game play and game story. Furthermore they expected this information to be contained in the categories

game mechanics and game usability, which were deemed to be platform dependent. For this reason these heuristics had to be reconsidered. The results of a study connected to their investigations revealed that the heuristics concerning the game mechanics are the same for all types of games. Besides the evaluation of pervasive games, the evaluation of mobile games has also been of interest to researchers. In 2006 Nokia released a framework for the evaluation of the playability of mobile games (Koivisto and Korhonen 2006). Their framework is split into modules containing heuristics for game play, game usability and mobility. The modules do not have to be evaluated at the same time and at least the modules concerning game play and game usability should be able to be applied to other kinds of games, not only mobile games.

Another approach towards the evaluation of groupware has been published in (Pinelle and Gutwin 2007). They developed the T-CUA (Table-Collaboration Usability Analysis) which is based on the Collaboration Usability Analysis (CUA). It is especially designed to evaluate collaborative groupware and concentrates on issues in connection with teamwork. In April 2007 Schaffer released a white paper introducing a new version of heuristics for video games (Schaffer 2007). According to his opinion, the heuristics introduced so far were too vague, difficult to realize, more suitable to post-mortem reviews and not applicable during the design process. He provides a set of detailed heuristics with graphical examples for each heuristic which eases the evaluation significantly, especially when it is not conducted by an expert in the field of computer games. Pinelle et al. introduced a set of heuristics based on game reviews in 2008 (Pinelle et al. 2008). For their work 5 researchers have reviewed 108 game reviews of the Gamespot[9]-website and categorized the issues found into 10 final heuristics. According to Pinelle et al. this approach offers the possibility to evaluate a game's usability without reviewing unnecessary technical issues and issues related to entertainment.

Based on the idea of heuristics for pervasive games by (Röcker and Haar 2006), Jegers has introduced a study investigating the special characteristics and issues of pervasive games (Jegers 2008). He criticises the approach of Röcker and Haar as being too focused onto Smart Home technology and the evaluation as being too theoretical. Therefore Jegers has developed a pervasive game and conducted an iterative evaluation using different methods. When comparing his findings to Desurvire's HEP (Desurvire et al. 2004) and to traditional usability issues, he found out that there are several problems that are not covered by the aforementioned principles. Therefore he suggests further methodological research in this area.

9 http://www.GameSpot.com

5 User Experience of Games

Within recent years the term "user experience" has become a buzzword within the community focusing on HCI. According to (Hassenzahl and Tractinsky 2006) this is the counter-reaction to the more dominant task and work related usability paradigm. Still, this is not a completely new concept. The American philosopher and psychologist John Dewey described experiences to be *"not mere feelings; they are characteristics of situations themselves, which include natural events, human affairs, feelings, etc."* as early as 1934 (Dewey 1934).

Nevertheless, a clear definition and grounded understanding of this term is still missing (Law et al. 2008). According to Law the main problem is that user experience treats non utilitarian aspects of interactions between humans and machines. This means that user experience mainly focuses on affect and sensation–two very subjective impressions. It encompasses areas from traditional usability to beauty, hedonic, affective or experimental aspects of technology use (Forlizzi and Battarbee 2004). Hassenzahl and Law, leading researchers in the field of user experience, define it as *"a momentary, primarily evaluative feeling (good-bad) while interacting with a product or service"* (Hassenzahl 2008). Therefore user experience is designing for joy and fun instead of designing for the absence of pain (Hassenzahl and Tractinsky 2006). Thus the community has recently undertaken measures to better understand the meaning of user experience and to find a unified definition through different conferences, workshops (Law et al. 2008; Roto and Kaasinen 2008), forums and the like. Especially the MAUSE COST Action 294[10] has aimed for finding a definition and measurement of user experience.

According to literature, user experience in games can be measured using the following qualitative and quantitative methods (Federoff 2002; Desurvire et al. 2004; Sweetser and Wyeth 2005; Hazlett 2006; Koivisto and Korhonen 2006; Mandryk and Atkins 2007): physiological measurements, expert evaluation (heuristics etc.), subjective, self-reported measures and usability tests.

Integral factors of user experience are the state of flow and immersion defining the level of enjoyment and fun (IJsselsteijn et al. 2007).

The measurement of the state of flow through different methods is one of the major topics of user experience in games and by many seen as the optimal experience when playing games (cf. Sweetser and Wyeth 2005). According to Hassenzahl the concept of flow is very close to the idea of user experience and he describes flow as *"a positive experience caused by an optimal balance of challenges and skills in a goal-oriented environment"* (Hassenzahl 2008). The concept of flow was first introduced in (Csikszentmihalyi 1975) and further refined to fit to video games and player enjoyment in (Cowley et al. 2008; Sweetser and Wyeth 2005). Whereas Cowley et al. introduce a framework to map flow to the game play, Sweetser and Wyeth try to integrate heuristics into a model to help design

10 http://www.cost294.org/

and evaluate enjoyment in games. They found out that there is a certain overlap of the heuristics investigated and the concept of flow. Based on this, Jegers introduced the pervasive game flow model that enhances the game flow idea from Sweetser and Wyeth with aspects that are particular to pervasive games (Jegers 2007).

Another concept that is tightly linked to user experience is immersion. One definition of immersion and its stages has been proposed in (Brown and Cairns 2004). Through a semi-structured interview with seven gamers they were able to distinguish immersion into three phases: engagement, engrossment and total immersion. Engagement is the first stage of immersion. According to Brown and Cairns the players have to be interested in the game to reach this state. When the user continues to play a game after the stage of engagement she will reach engrossment. When engrossed in a game, the player's emotions are directly affected by the game. Total immersion is the most immersed a user can get. She will be completely involved in the game and experience absolute presence, where only the game and the emotions produced by the game matter. In a follow-up work Cheng and Cairns have further investigated the different stages of immersion (Cheng and Cairns 2005). They tested a game with changing graphics and behaviour on 14 different users. Through this experiment Cheng and Cairns found out that when a user is immersed in a game, she would oversee usability issues and even not notice changes in the game's behaviour.

Our work is influenced by the first approach described in (Sweetser and Wyeth 2005) to integrate heuristics into the game design process and especially to use it for the evaluation of user experience. Sweetser and Wyeth accomplished this by integrating common known heuristics into the eight steps of flow as proposed by Csikszentmihalyi. Nevertheless, we will not try to measure the user experience through the factor flow, especially since the GameFlow approach has been criticised by (Cowley et al. 2008) stating that through the employed mapping important, if not elementary issues got lost and also question the necessity of social interaction as a central point. Instead we will provide a set of heuristics that is independent of the flow approach and will target usability and user experience of the evaluated games. A comprehensive overview of this process will be given in section 6.

6 Overview and Review of Existing Video Game Heuristics and their Impact onto User Experience

As introduced in section 3 and further discussed in section 4, heuristics can be a valuable method in video game design. In this section we want to present a modular framework which is based on previous literature and was introduced in (Koeffel 2007). The framework consists of the sections game play/game story, virtual interface and device- and application-specific heuristics. The review of existing

literature as introduced in section 4 has indicated that separating the heuristics into different categories appears to be most effective. Especially since a categorization allows for a better readability by experts and therefore for more clarity during the review.
The section game play/game story contains heuristics regarding these very topics. In the section about the virtual interface heuristics concerning the displayed virtual and not physical interface that the player interacts with are presented. The device- and application-specific heuristics are supposed to symbolize an exchangeable part that can be substituted with heuristics that are specific for a special area, such as tabletop games (see section 7) or mobile games. Hence the heuristics treating game play/game story and the virtual interface are generally applicable to video games as they are formulated in Table 1. For use with other devices (i.e. input devices, setups, etc.), the third (device- and application-specific) part was formulated. Therefore all possible eventualities offered by those games can be covered.

In the following the heuristics of the sections game play/game story and virtual interface of the framework will be listed. As an example for the modularity of the framework, the heuristics concerning special properties of tabletop games will be introduced in section 7.

6.1 Video Game Heuristics

In section 4 existing heuristics for video games have been summarized and criticized. As mentioned before, our heuristics for video games are literature-based and derive from work and research by (Nielsen and Molich 1990; Federoff 2002; Desurvire et al. 2004; Sweetser and Wyeth 2005; Koivisto and Korhonen 2006; Röcker and Haar 2006; Schaffer 2007; Pinelle et al. 2008). These heuristics do therefore originate in the field of usability.

The major part of the heuristics introduced in section 4 is also part of the approach introduced in (Sweetser and Wyeth 2005). Nevertheless it is their main goal to establish a method to measure the state of flow that a game offers to the player. Moreover they set usability equal to user experience, which has proven to be a different concept (see section 4). Furthermore they only have applied their heuristics to the area of real time strategy games, whereas we seek to generate a set of heuristics that is applicable to multiple game genres.

The previously presented heuristics do focus on usability but also on playability, fun and enjoyment – factors closely connected to user experience. In their work Pinelle et al. focus solely on usability issues (Pinelle et al. 2008). Through their selection process based on game design reviews, they have eliminated all aspects related to fun, enjoyment and technical issues. Since it is our goal to evaluate user experience as well as the usability of a game, we decided to base our heuristics on the aforementioned literature, but also include the usability issues distinguished by Pinelle et al. We therefore want to create a more holistic set of heu-

ristics that does not solely concentrate on either user experience or usability. Moreover we want to focus on all aspects offered by video games, especially as occurring problems have an impact onto the user experience, and the quality of a game can hardly be determined by usability only. In their conclusion, Pinelle et al. even recommend the inclusion of user experience-based heuristics. Furthermore they base their heuristics only on reviews of the website GameSpot.com. We believe that although GameSpot is one of the largest and most comprehensive video game review sites, it is not recommendable to rely solely on its reviews. The site has been under heavy criticism in November 2007 for allegedly firing a reviewer due to negative reviews of a game published by a financial sponsor of GameSpot[11]. Relying on multiple sources can help to attenuate possibly biased reviews. Table 1 contains the final heuristics concerning game play/game story and the virtual interface. These heuristics have been chosen based on a qualitative review of the sources mentioned in section 4.

	No.	Heuristic	Source
Game play / Game story	1	The player should be presented with "clear goals" early enough or be able to create her own goals and "should be able to understand and identify them". There can be "multiple goals on each level", so that there are more strategies to win. Furthermore, the player should know how to reach the goal without getting stuck.	(Federoff 2002; Desurvire et al. 2004; Koivisto and Korhonen 2006; Schaffer 2007)
	2	The player should receive meaningful rewards. "The acquisition of skills" could also be a reward.	(Federoff 2002; Koivisto and Korhonen 2006)
	3	The player should "feel that she is in control". That includes the "control over the character" as well as the "impact onto the game world". "The controls should allow management that is appropriate to the challenge." Changes the player makes to the game world should be persistent and noticeable". Furthermore, the player should be able to "respond to threats and opportunities".	(Desurvire et al. 2004; Koivisto and Korhonen 2006; Schaffer 2007; Pinelle et al. 2008)
	4	"Challenge, strategy and pace should be in balance". "Challenges should be positive game experiences".	(Desurvire et al. 2004; Koivisto and Korhonen 2006)
	5	"The first-time experience is encouraging".	(Koivisto and Korhonen 2006)
	6	The "meaningful game story should support the game play" and be "discovered as part of the game play".	(Desurvire et al. 2004; Koivisto and Korhonen 2006)
	7	"The game does not stagnate" and the player feels the progress.	(Koivisto and Korhonen 2006; Schaffer 2007)
	8	The game should be consistent and "respond to the user's action in a predictable manner". This includes "consistency between the game elements and the overarching settings as well as the story". The story should "suspend disbelief" and be perceived as a single vision, i.e. the story should be planned through to the end.	(Desurvire et al. 2004; Koivisto and Korhonen 2006; Pinelle et al. 2008)

11 http://www.shacknews.com/onearticle.x/50134

	9	"It should be clear what's happening in the game, the player should understand failure conditions and be given space for making mistakes"	(Schaffer 2007)
	10	"There should be variable difficulty levels" for a "greater challenge". The game should be "easy to learn, but hard to master".	(Federoff 2002; Desurvire et al. 2004; Pinelle et al. 2008)
	11	The game and the outcome should be perceived as being fair.	(Federoff 2002; Desurvire et al. 2004)
	12	The game itself should be replayable and the player should enjoy playing it. Nevertheless "challenging tasks should not be required to be completed more than once". The challenge should create the desire to play more. This includes also the possibility to skip non-playable and repeating content if not required by the game play.	(Desurvire et al. 2004; Schaffer 2007; Pinelle et al. 2008)
	13	"The artificial intelligence should be reasonable", "visible to the player, consistent with the player's expectations" and "yet unpredictable".	(Federoff 2002; Desurvire et al. 2004; Röcker and Haar 2006; Pinelle et al. 2008)
	14	The game should be "paced to apply pressure to but not frustrate the player.	(Federoff 2002; Desurvire et al. 2004)
	15	The "learning curve should be shortened". The "user's expectations should be met" and the player should have "enough information to get immediately started". Tutorials and adjustable levels should be able to involve the player quickly and provided upon request throughout the entire game.	(Federoff 2002; Desurvire et al. 2004; Röcker and Haar 2006; Schaffer 2007; Pinelle et al. 2008)
	16	"The game emotionally transports the player into a level of personal involvement (e.g. scare, threat, thrill, reward, punishment)".	(Desurvire et al. 2004)
	17	The game play should not require the player to fulfil boring tasks".	(Koivisto and Korhonen 2006)
	18	"The game mechanics should feel natural and have correct weight and momentum". Furthermore they should be appropriate for the situation the user is facing.	(Federoff 2002; Pinelle et al. 2008)
Virtual Interface	19	"The player should be able to identify game elements such as avatars, enemies, obstacles, power ups, threats or opportunities". The objects "should stand out, even for players with bad eyesight or colour blindness and should not easily be misinterpreted". Furthermore the objects "should look like what they are for".	(Koivisto and Korhonen 2006; Schaffer 2007; Pinelle et al. 2008)
	20	The "acoustic and visual effects should arouse interest" and provide meaningful feedback at the right time. Hence the effects should give feedback to create a challenging and exciting interaction and involve the player by creating emotions. The feedback should be given immediately to the user's action	(Federoff 2002; Desurvire et al. 2004; Röcker and Haar 2006)
	21	The interface should be "consistent in control, colour, typography and dialog design" (e.g. large blocks of text should be avoided, no abbreviations) and "as non-intrusive as possible".	(Federoff 2002; Desurvire et al. 2004; Schaffer 2007)
	22	The player should not have to "count resources like bullets, life", score, points and ammunition. This "relevant information should be displayed and the critical information should stand out". Irrelevant information should be left out. The user should be provided	(Federoff 2002; Desurvire et al. 2004; Schaffer 2007; Pinelle et al. 2008)

	enough information to recognize her status and to make proper decisions. Excessive micromanagement by the user should be avoided.	
23	The menu should be "intuitive and the meanings obvious" and "perceived as a part of the game".	(Desurvire et al. 2004; Schaffer 2007)
24	"The player should know where she is on the mini-map if there is one and should not have to memorize the level design".	(Schaffer 2007)
25	The player "should be able to save the games in different states" (applies to non arcade-like games) and be able to "easily turn the game off and on".	(Federoff 2002; Desurvire et al. 2004; Röcker and Haar 2006)
26	"The first player action is obvious and should result in immediate positive feedback".	(Desurvire et al. 2004)
27	Input methods should be easy to manage and have an appropriate level of sensitivity and responsiveness. The input methods should allow customization concern the mappings.	(Schaffer 2007; Pinelle et al. 2008)
28	The visual representation (i.e. the views) should allow the user to have a clear, unobstructed view of the area and of all visual information that is tied to the location.	(Pinelle et al. 2008)
29	The game should allow for an appropriate level of customization concerning different aspects.	(Pinelle et al. 2008)

Table 1. Heuristics concerning game play/game story and virtual interface.

As mentioned before, the 29 heuristics introduced in Table 1 are the result of an extensive literature review of several different existing sets of heuristics in the field of video games. Furthermore the authors' experience in the area of video games has influenced the selection of the heuristics. For reasons of redundancy and simplicity the literature-based heuristics have been narrowed down to the 29 statements as shown in Table 1. Moreover the most important aspects of video games are reflected in these heuristics. Especially through the literature review it has become clear that certain aspects, such as learning phase, mental load, or a reasonable artificial intelligence have been addressed by several sources. Thus, they have been summarized into one heuristic and have been given the according level of importance. Additionally, we tried to keep the number of heuristics short, to allow for a more efficient review of the games. From the first draft to their current status the heuristics have been continuously expanded to cover all necessary areas, resulting in our final set of 29 heuristics.

We assume that it is necessary to investigate the usability as well as the user experience of a video game to detect its overall quality. As mentioned before, heuristics have already been employed in (Sweetser and Wyeth 2005) to detect the flow potential of games. But in the contrary to our approach presented here, they base their results on the concept of flow. They have taken the eight elements of Csikszentmihalyi's concept of flow (Csikszentmihalyi 1975) and mapped them onto computer games (Sweetser and Wyeth 2005), creating the GameFlow approach to flow. As described in section 5, this method has been criticised amongst others by (Cowley et al. 2008).Using the approach described in this chapter we are

able to overcome the described weaknesses such as the possibility to lose elementary issues.

First we do not use any kind of mapping to the flow-concept. The 29 heuristics as introduced in Table 1 represent a summary of existing heuristics, without any direct connection or modification towards the flow theory. Secondly, the above mentioned ambiguities of social interaction are not treated in the heuristics. Moreover they are part of the device- and application-specific part of the framework introduced above. Especially, since games on different devices offer different kinds of social experiences, this particular area has been relocated to this separate part of our framework as shown in section 7.

The work introduced in this section leads us to the conclusion that it is possible to detect a computer game's user experience through heuristic evaluation. Our assumption is that a game that is enjoyable to play has to a large extent be free of usability issues that keep the user from enjoying a game. Especially the heuristics targeting game play/game story deem appropriate not only for classical usability issues (missing feedback, etc.), but also to issues connected to enjoyment and fun of a game (challenge, fairness, etc.).

In order to be able to estimate the user experience through heuristics, we have set up a methodology to prove this concept (see following section). Our approach states that the overall user experience of video games can be determined by conducting an expert-based evaluation of the game in question, using the heuristics shown above. The more heuristics are met, the higher the overall user experience is, the more heuristics point to flaws in the game, the worse the user experience is.

6.2 Heuristic Approach to User Experience

To prove our assumption that an expert-based heuristic usability evaluation of a game can be used to determine its user experience, we have chosen to conduct an evaluation. Larsen states in his work that common game reviews are to a major part based on the subjective evaluation of a game's user experience from the game reviewer's point of view (Larsen 2008). Game reviewers have been unwittingly evaluating user experience of games for nearly two decades.

Following this idea, we chose to evaluate a number of computer games using our 29 heuristics and compare the results to common game reviews. Therefore, we were able to compare the heuristics–primarily designed to detect usability issues–with the user experience oriented game reviews. In order to be able to make a quantitative statement we tried to establish a connection between the number of problems found through the heuristic evaluation and the numerical rating obtained from several different game reviews. The process of our evaluation was designed as a heuristic evaluation for video games. To obtain meaningful results, two evaluators conducted the study. Both of them were experienced in the area of computer games and usability, with one being a usability expert with gaming experi-

ence and the other vice versa. To avoid gender-specific ambiguities, a female and a male researcher were selected. Since gaming habits and preferences could influence the outcome, we have selected evaluators with different gaming habits and backgrounds. One evaluator can be considered as a so-called core-gamer who frequently plays games of different genres. The second evaluator was rather a representative of the casual gaming scene with experience in different genres (among them also core-games). For the evaluation we decided to choose games from several different genres in order to avoid biasing towards one genre, as experienced in some of our analyzed work (cf. Federoff 2002; Sweetser and Wyeth 2005). Furthermore the chosen games had to be rather recent ones to exhaust all current technical possibilities. To allow for a reliable comparison of our testing results with a large number of reviews we chose five popular games. Therefore the following games have been selected:

- Shooter: Team Fortress 2[12] (Valve Software)
- Role playing game: Sacred 2[13] (Ascaron)
- Adventure: Sam and Max, Season one, Ep. 5: Reality 2.0[14] (Telltale Games)
- Racing: Racedriver GRID[15] (Codemasters)
- Realtime Strategy: Die Siedler: Aufbruch der Kulturen[16] (Funatics)

The five genres above mentioned were chosen due to their popularity in terms of video game units sold (ESA 2008). “Family Games” although being among the top five genres has been deliberately omitted since games in this genre usually rely on a greater number of people playing at the same time (e.g. Wii party games) and our heuristics were primarily developed for traditional single player video games. Nevertheless, we decided to include one multiplayer game (Team Fortress 2) to prove the applicability of our heuristics to this type of game too. Due to the lack of literature on the correct conduction of heuristic evaluations of video games, we defined our evaluation protocol according to available literature in heuristic evaluation (Nielsen and Mack 1994) with adaptations towards the affordances of video games. Each evaluator obtained a list with the according heuristics and an evaluation report for the found usability issues. Previous to the evaluation the reviewers met and previewed the heuristics in order to get familiar with them and to avoid misapprehensions. Both reviewers evaluated each single game by playing single player campaigns or internet matches with Team Fortress 2. Issues found while playing were noted in the evaluation report. After playing the game the experts again reviewed the game and their perceived experience according to the heuristics. For the assessment of the games, two different ratings

12 http://www.teamfortress.com/

13 http://www.sacred2.com/

14 http://www.telltalegames.com/samandmax

15 http://www.racedrivergrid.com

16 http://siedler.de.ubi.com/

were applied: a Nielsen severity scale and a point-scale ranking (to enable a better comparison to the game-review site).

First the researchers reviewed each game after playing it, using the heuristics to rank the found issues according to Nielsen and Mack's severity scale (Nielsen and Mack 1994) which led to the number of total usability issues found per game as displayed in Table 2:

0. Not a usability problem at all
1. Cosmetic problem only: It does not have a profound impact onto the game
2. Minor problem: It has a slight impact onto the game and influences the experience a bit
3. Major problem: This problem has a severe impact onto the game and negatively influences the user experience
4. Usability catastrophe: This problem has to be fixed in order to allow for a decent user experience

Second the evaluators assigned a score from 1 to 5 (1 being worst, 5 being best) to every single heuristic to determine how well the game fulfilled each of them. For this rating the severity-ranking of the found issues was used as an indicator for the degree of fulfilment. In general the problems and their severity, which were found during the rating according to the above mentioned scale, helped to determine which heuristics were the least satisfied ones. After the ranking of the heuristics, the evaluators met again and discussed possible inconsistencies in their evaluation. These problems were resolved through discussions and when necessary evaluation and/or ranking were adapted. The achieved overall score was obtained by the summation of the ratings by the single evaluators and the calculation of an average ranking. This score was then converted into a percentage scale indicating to which degree the game complied with the heuristics (100 % would mean the achievement of maximum points). The resulting ranking is shown in Table 2.

To compare the results of the expert-based heuristic evaluation, we chose to select at least 10 game reviews (on average 20) for each game to avoid biasing of the single reviewers and therefore guarantee a more objective rating. Metacritic.com[17] exactly fulfils these requirements by accumulating scores from different reviewing sites and calculating a weighted average. Their score reaches from 0 to 100 and can therefore be seen as a percentage rating which is very common among reviewing sites. Unfortunately Metacritic.com did not have a rating for "Die Siedler: Aufbruch der Kulturen". Therefore we gathered 13 different review scores from several review pages through our own research and calculated the average rating.

Rank	Ranking according to found issues	Ranking according to points	Metacritic.com ranking
1	Team Fortress 2 (18)	Team Fortress 2 (82.9 %)	Team Fortress 2 (92 %)
2	Sam & Max, GRID (22)	Die Siedler (79.65 %)	GRID (87 %)

17 http://www.metacritic.com/

3		GRID (77.93 %)	Sam & Max (82 %)
4	Die Siedler (26)	Sam & Max (77.7 %)	Die Siedler (80.6 %)
5	Sacred 2 (29)	Sacred 2 (75.17 %)	Sacred 2 (78 %)

Table 2: The results of the evaluation ranked according to issues found, points obtained and compared to the results of Metacritic.com.

The resulting ranking of our study can be seen in Table 2. It shows that the sequence of the games evaluated according to process described above is similar to the sequence obtained from Metacritic.com. This tendency shows the connection between heuristic evaluations and user experience (which is the main focus of the review from Metacritic). Especially the ranking according to usability issues found during the evaluation appears to comply with the user experience-based results from Metacritic.com. In relation to the results from Metacritic.com we can state that the more usability issues are found during a heuristic evaluation, the worse the user experience is. The fact that the ranking according to points is not as high as the ranking according to Metacritic.com can be caused by the fact that our heuristics focus on usability issues which might not be detected during a game review or which might not be weighted that dramatically. On the other hand we also acknowledge that the testing time of about two hours per game was most likely not long enough to achieve total immersion. Therefore certain effects as described in (Cheng and Cairns 2005) such as overlooking usability issues when being totally immersed did not occur. Nevertheless to further prove this concept more extensive evaluations (with more games from different genres and for longer periods of time) are proposed. This could also lead to a definite number of heuristics that have to be fulfilled in order to grant an optimized user experience. In order to combine research conducted both in the area of video games and tabletop applications and to complete the framework as introduced in this section, Koeffel and Haller introduce ten heuristics for the development of tabletop games, which are described in more detail in the next section (Koeffel and Haller 2008).

7 A Framework of Heuristics for the Evaluation of a Tabletop Game's User Experience

While the heuristics introduced in section 6 are very well suited for most video games such as standard platform PC or console games, they lack tabletop specific aspects. According to (Jegers 2008), pervasive games differ in many ways from traditional computer games. This principle also applies to tabletop games, especially since they include new social and physical experiences as described in section 1. Therefore within this section a set of device-specific heuristics will be introduced, which includes the social issues as pointed out in (Jegers 2008; Sweetser and Wyeth 2005) as well as particular issues that arise when interacting with a

tabletop game. This section completes the aforementioned framework (see section 6) with tabletop specific aspects, some of which might seem similar to other heuristics in the framework at first. Nevertheless the here selected 10 heuristics are tailored to tabletop games and can profoundly influence experience as well as the usability of such a game. To emphasize this aspect, these heuristics are deliberately placed in the device-specific part of the framework.

To achieve a set of rules as complete as possible, an iterative approach based on existing tabletop-related work has been chosen. Our approach, first described in (Koeffel 2007), began with the creation of a first set of twelve heuristics, based on existing literature work and research trials in the field of usability. After additional research these heuristics have been checked for weaknesses, refined and paraphrased. The second iteration focused on comprehensibility and tried to better fulfil the original concept of heuristics as "rules of thumb". Additional feedback from experts initiated the creation of a third iteration of heuristics.

These now eleven rules were used to conduct a heuristic evaluation. Six different games were evaluated. Twelve participants (3 usability experts, 3 double experts, 3 game experts and 3 medium experienced users) were presented with the eleven heuristics from the third set and then instructed to play each of the games. They were asked to identify problems and assign them to the matching heuristics afterwards. The results and findings of this evaluation led to the final version of our proposed heuristics for tabletop games.

This final set of tabletop-specific heuristics emanated from the third set after the heuristic evaluation was conducted. It saw an inclusion of subcategories to further aid evaluators by clarifying potential obscurities. Table 3 shows the final heuristics we achieved:

No.	Heuristic
1	**Cognitive Workload:** The cognitive workload which is not connected to the game play (i.e. in connection with the acquisition of skills, the view, the screen orientation and the input methods), should be minimized.
2	**Challenge:** The system should be designed in a way that the challenge satisfies the preconditions of a tabletop setup and the target group.
3	**Reach:** The reach of the players should be adapted to the requirements of the game play
4	**Examinability:** The players should not be hindered to examine the area required by the game play.
5	**Adaptability:** The system should be adaptable to the player in terms of the setup.
6	**Interaction:** The interaction method should satisfy the expectations of the player and follow the game logic.
7	**Level of Automation:** The player should be able to execute all actions relevant to the game by herself.
8	**Collaboration and Communication:** The interpersonal communication and collaboration should be supported by the entirety of the game (such as game play and setup).
9	**Feedback:** Feedback and feedthrough should be adapted to the possibilities of tabletop games, used adequately and be provided to the players when appropriate.

10	**Comfort of the Physical Setup:** The construction of the setup (including the display) should be comfortable to use and not require the player to take an awkward position.

Table 3: Device-specific heuristics for tabletop games.

A full description of all ten heuristics (illustrated with pictures to display occurring issues) can be found in (Koeffel 2007).

Our approach of using usability-based heuristics to determine the user experience of video games can also be adapted to tabletop games. As introduced above, the heuristics concerning the tabletop specific aspects of games focus on particular attributes and circumstances that can be offered by tabletop games. Especially social aspects and issues connected to the physical setup such as comfort are factors that are deeply influencing the user experience when playing tabletop games. We therefore deem the ten heuristics as introduced above together with the rest of the framework (see section 6) to be appropriate to evaluate the overall user experience of modern tabletop games. In order to establish an optimum combination between the three areas of the framework further studies have to be designed. The coverage of all possible issues by the heuristics has to be assured. Since there are no possible mechanisms for comparing the results to established reviews, such as game reviews, the reference values have to be obtained by already investigated means to distinguish a game's user experience, such as physiological measurements.

8 Summary and Future Challenges

This chapter introduces a possibility to evaluate the overall user experience of traditional video games and advanced interaction games using heuristic evaluation. The term user experience has significantly gained in importance in the HCI community and although a standardized definition is missing, research strives to employ it in the evaluation of modern interfaces. The experience a user perceives when playing a computer game has been one of the central issues of many recent publications. Although being a subjective impression, researchers seek to objectively evaluate and properly describe it (Phillips 2006). The current possibilities include mostly subjective measures but also objective means such as physiological measurements are applied. An area increasing in importance, not only in the field of video games, but also in the field of advanced interfaces, is the evaluation based on heuristics.

Therefore we analyzed and reviewed the most common heuristics for video games and advanced interaction games and built a framework upon our findings. This framework consists of the following three parts: game play/game story, virtual interface and device- and application-specific properties of a system. We

demonstrated the application of the device- and application-specific heuristics with a set of heuristics developed for the application of tabletop games.

We used the video game related part of our framework to conduct an expert-based heuristic evaluation of five different video games to determine weaknesses and problems. We then tried to prove that heuristics can be used to measure the level of user experience by comparing the results of our study with accumulated reviews from several different gaming sites. Since these reviews focus on explaining how the user experience of a game was perceived by the respective author we see it as a legitimate description of a game's user experience.

We do however acknowledge that we use a quantitative score from the reviews and not the qualitative data represented by the actual content of the review. Such a score cannot represent the written review in its entirety and is therefore less accurate. Still, using the review score allows us to draw the conclusion that the user experience of a game is worse the less it adheres to the heuristics. To further prove this statement we suggest more extensive empirical evaluations involving more games that belong to several different genres other than the five tested so far. Also games with a greater variety of review-ratings (e.g. extremely low rated games) should be included. Additionally testing games still under development could further prove the concept of applying heuristics during all stages of the development process. The ideal outcome of such tests could then be a definitive number of heuristics which have to be fulfilled in order to grant an optimized user experience. Further studies are also suggested to investigate the best possible combination of the three areas covered by our framework and to advance the heuristics for tabletop games which offer a new possibility to evaluate advanced interaction games. Additionally an evaluation of the tabletop-specific heuristics according to a similar collection of reviews such as Metacritic.com would allow for a more reliable rating of our heuristics. For a broader applicability of the entire framework, application- and device-specific heuristics for advanced interaction games other than tabletop games could be developed. Therefore the overall usefulness of the framework for different kinds of games can be evaluated.

For the heuristics in particular, experience has shown that an additional category concerning the graphics quality and connected issues could be needed for an extensive evaluation of a game. Furthermore differentiation regarding the various aspects of the virtual interface (e.g. main menu or in-game menu) is needed. To allow for a better comprehension of the single heuristics the inclusion of exemplary graphics is recommended.

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