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Broken Soft Drink Machines

London, Heathrow. Like a blood cell being pumped from the heart's ventricles back into the outer arteries, I had left the exhilarating mass reunion scenes at the arrival hall behind me. At the bus stop, the first vehicle brakes with fizzling sound, I get in. A quick ride later, I was cutting through a dark, early September night alone on my way to find a place to sleep on Brunel University campus. What am I doing here, again? Right, I will be speaking at a conference the next day on playability and biometric player measurement, a topic I have been passionate about during the past years of undertaking Ph.D. studies in Digital Game Development.

Finally, I found the booked accommodation, a student room on campus. Dirt stains glared from the second-hand furniture and the bathroom did not reveal where the shower ended and the toilet began. Nothing says you are still a student like campus accommodation. Trying to find a comfortable position to lie on the squeaky little bed, my thoughts drifted away from this stressful day to the time when I decided to enter the academic rollercoaster.

Scientists vs. Rock Stars

U2's Bono once said: "As a rock star, I have two instincts: I want to have fun and I want to change the world." I had the same instincts; only at the time I was a computer science student (or more precisely a computational visualistic student, trying to combine the joys of beautiful code, visualizing information, and pretty graphics). Don't get me wrong, I know that geeks have come a long way to popular culture since—but those were the days, when Transformers were kid's toys, the big bang

theory was only really appreciated by cosmologists and to become a guitar hero you actually had to learn how to play a real guitar. While I learned to play the guitar in high school, my skills never rose to a Jimi-Hendrix-level, so I figured by going to University, I might actually get a good shot at doing something that I like and also have the possibility to change the world, or at least a tiny part of it. In a nutshell, I had the best intentions with choosing my area of research. However, the topic of digital games was at that time not really considered by my peers as a smart career decision for both a profitable professional or a successful academic future. While games were already establishing themselves as the favorite pastime of many people, the motivational power of fun and positive feelings when playing games had not made its way into the marble hallways, wood-boarded lecture auditoriums and solitary offices of the world's ivory towers. The success of digital games today is due to their unique ability to provide people with fun experiences and motivate them to train their skills. Something which I would find out about in the following years as well. People rarely succeed unless they have fun in what they are doing.[1]

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While much of the focus of regular computer science is on computing and information theory or the real-life application and development of information and communication technologies, studying digital games seemed like an ideal opportunity to become a wanderer between the worlds. Ever since I spent sunny afternoons playing Boulder Dash on my father's old Commodore C64 computer, the magic of the machine flickering in pale shades of blue before my eyes had fascinated me. So, I first made game technologies the focus of my studies, but my interest soon shifted to focus on players and how they interact with games and entertainment technologies. UX in games is more focused on the pleasurable interaction of the player and the game, while UX in normal software focuses on the software's utilitarian function to achieve

1. Dale Carnegie (1888 – 1955), American writer and lecturer.

contextual goals. Let us consider the following example: the UX of a plane pilot is certainly shaped by his thoughts about the functionality of the software he is using and his feelings about the contextual impact of incorrect operation of such software. He needs to double check his actions with the co-pilot and monitor the software with high concentration at all times, because pressing the false button at the wrong time will have a much bigger impact on his life and that of the people in the plane than when a player interacts in a game. Here, the impact is powerful, but merely virtual, and because digital games are simulated virtual environments, actions can be undone and behavior can be trained by playing them. This is a huge part of what makes games so entertaining, the user empowerment without short-term real-life consequences. But how do you achieve individual entertainment? Why do humans like to play and have fun while doing it? What impact does playing have on their thoughts and behavior? We need to study game systems and human interaction to get a detailed answer to these questions.

The Joy of Interaction

Like a puff of smoke these thoughts and memories soon fade as I find myself back on the bed in the student dorm room. I should get up as I am starting to feel a bit thirsty and am supposed to meet my colleague Joerg. We used to be childhood friends, but then our paths diverged until recently I got back in touch with him when I visited his university. To my utter surprise we found out that we had developed similar interests and worked within the same area now. We instantly reconnected as we talked about the games we liked, where we saw general benefits of usability in entertainment products and how we could see great potential in studying games to explore essential facets of user experience requirements for non-entertainment products. And in today's understanding of usability, we can indeed witness a growing importance of hedonic qualities of user-product interaction that are concerned with entertainment values and a new thinking about the beauty of Interaction Design. I must admit that I still get a tingling rush of excite-

ment when I witness true emotion or affection in a human being that comes from the joy of interacting with a machine.

The fun and motivation provided by game-like interactions are pretty strong in motivating people to change their behavior, so that we can leverage gaming principles making everyday objects more fun. A good example for this approach is the current Swedish Volkswagen advertising campaign which is focused on what they call "the fun theory"[2]. In the advertisement videos, simple gaming principles are applied to everyday activities to make them more fun and enforce behavioral change in people. The examples from the ad campaign are (1) turning a bottle bank into a gaming arcade machine (you score points for inserting the correct bottles and flashing lights provide you with very positive feedback), (2) turning a subway staircase into a piano to enforce taking the stairs over the escalator, and (3) emulating a really deep garbage bin through sound feedback to enforce people to not throw garbage on the ground. All of these examples have one thing in common: clear goals (behavior change), clear options, and clear feedback, thus providing an instantly clear relationship between user action and game goal. These are great examples of how regular product and software development can benefit from researching fun in gaming.

Hassenzahl[3] said that a user-product experience can differ between individuals, situations, and over time. He also found that products cause different emotional reactions. For example, when I put money into a vending machine, I expect to receive goods that I want. If this works according to my expectations, then I am likely satisfied with the product. Hassenzahl would say that we have achieved our behavioral goal. As we have seen in the examples before, there are clear design principles from games (e.g., clear goal-action relationship, limited options, feedback)

2. Rolighetsteorin, see http://www.thefuntheory.com

3. Hassenzahl, M. The Thing and I: Understanding the Relationship between User and Product. In Funology: From Usability to Enjoyment. Kluwer Academic Publishers, Norwell, MA, USA, 2004, 31-42.

that will make achieving the behavioral goal much easier for us and provide us with real pleasure. Pleasure, for example, may be related to a surprise that happens in user-product interaction. These surprise moments are usually playing with our expectations and provoke a sudden shift in our attention. Games thrive on surprise moments and attention shifts to engage users in interaction. A successful example of this is the gameplay mechanic called quick time events, which has become popular in games like God of War (Sony, 2005) and Resident Evil 4 (Capcom, 2005). These games feature moments, where players are interrupted during a cinematic sequence and prompted to press a combination of buttons or execute a certain move to steer the game's narrative in a certain direction or simply to avoid losing the game. Creating an interesting attention shift or surprise moment may actually be quite hard to design as balancing attention to progress in a game puts a player under cognitive stress. Finding the right balance of such stressful cognitive processing moments and more relaxing recall of learned interactions with a virtual environment is one of the things that makes games fun.

Csíkszentmihályi[4] was one of the first to note that a balance between personal skill and experienced challenge may lead to a feeling of higher consciousness, which he called flow. This concept was developed during his studies of self-motivated behavior of artists, chess players, musicians and sports players, but it can be applied to digital gaming and interactivity[5] perfectly (good examples can be found in [6,7]). The activity

4. Csíkszentmihályi, M. Flow: The Psychology of Optimal Experience. HarperPerennial, New York, 1990.
5. Polaine, A. The Flow Principle in Interactivity. In Proceedings of the second Australasian conference on Interactive entertainment (Sydney, Australia). Creativity & Cognition Studios Press, 2005, 151-158.
6. Cowley, B., Charles, D., Black, M. and Hickey, R. Toward an Understanding of Flow in Video Games. Computers in Entertainment, 6, 2 (2008), 1-27. DOI= http://doi.acm.org/10.1145/1371216.1371223
7. Sweetser, P. and Wyeth, P. Gameflow: A Model for Evaluating Player Enjoyment in Games. Computers in Entertainment (CIE), 3, 3 (2005).

itself leads to feelings of high enjoyment and self-fulfillment. However, Csíkszentmihályi also noted that boredom will kick in if the challenge is too low and too much challenge will lead to frustration. Little did I know that I was about to find out about the frustration that comes from too much challenge in human-product interaction.

The Quest For a Drink

My cell phone rings and puts me back into reality. It is Joerg and he asks to go check for some soft drinks as he is also quite thirsty from the flight—it is surprising how the new restrictions of preventing you to carry along liquids on airplanes sometimes result into real shortages of drinks, when you have a hectic schedule. I agree to search for a zip of water and we soon find ourselves strolling on the University campus. Not much later, we encounter our first soft drink machine, hoping to get a drink quickly and quench our thirst. Out of order! "Look," says Joerg and points to two other machines next to this one "they are all empty." Indeed, all three machines do flash red lights to us. "Bank holiday!" We smirk at each other. Rest assured that it will be hard to find an open shop around midnight. This is a suburb. The quest for a working soft drink machine begins.

For a little while, we stroll around the campus and come to discuss the ideas of self-motivated activities. We both seem to agree on the fact that one of the most powerful aspects of digital games is that they engage you for a longer period of time. Successful games either challenge you to solve a complex puzzle and keep you cognitively engaged by giving you only as much hints as you may need or they present adrenaline-pumping visuals and audio that appeal to you on a visceral level. Thus, whether a game is successful or not is largely dependent on its visual and auditory aesthetics as well as its gameplay dynamics. Prior research suggests that products that have high aesthetic value or attractiveness are also perceived as being more usable than products with a low aes-

thetic quality[8,9,10]. Aesthetic appeal of games might be one important driver of game experience, but incorporating affective gameplay (in which the game world reacts to fuel player emotions) in addition to visual and auditory aesthetics has become an important factor of successful sales, demonstrated by games like the Grand Theft Auto (GTA) series (Rockstar Games) or The Sims franchise (Electronic Arts). A major caveat of this success formula is that currently not much is known in industry or research how to best design for affective gameplay and only recently have we started to use affective measures to evaluate player emotions.

In a way, another driving factor of digital gaming is the quest for information and applying the knowledge that one has to acquire such information to proceed further. Somehow, the situation we were in now was similar to this as both of us had only limited information on where to get a drink at night on a holiday in England, but we were determined to extend our limited information space by exploring the environment. As darkness crawled along on the sides of the campus pathways, we were considering the options given our prior successful quests for drinks. At this time of day, we thought it was possible to find liquid refreshments at either:

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8. Kurosu, M. and Kashimura, K. Apparent Usability Vs. Inherent Usability Experimental Analysis on the Determinants of the Apparent Usability. In CHI'95 Conference Proceedings (Short Papers) (Denver, Colorado, USA). ACM, 1995, 292–293.
9. Tractinsky, N. Aesthetics and Apparent Usability: Empirically Assessing Cultural and Methodological Issues. In CHI 97 Conference Proceedings (Atlanta, GA, 22–27 March). ACM, 1997, 115–122.
10. Tractinsky, N., Katz, A. S. and Ikar, D. What Is Beautiful Is Usable. Interacting with Computers, 13, 2 (2000), 127-145. doi: DOI: 10.1016/S0953-5438(00)00031-X 0953-5438.

1. A soft drink machine. The most common way of getting refreshment after hours. Advantage: You can take the drink with you. Drawback: The machine might be out of order.

2. A pub. Might be specialized in selling alcoholic beverages. Advantage: Might be a way to get a soft drink. Drawback: Might be long walk off campus.

3. A water fountain. Not as common in England as in the United States. Advantage: Instant water goodness. Drawback: Might not be available in this country or campus.

The list shows how limited our information space was, given that we were thirsty and only making assumptions about our unknown environment. Like headless chicken, we were really confused and wanted to find a soft drink machine and go back to the dorms when we encountered security guards at the campus information center. Finally, a place brightly illuminated and hopefully the end of our quest for a drink.

Strolling Around

We quickly reported our problem and the guards told us the location (not far away) of a building with a soft drink machine inside, we decided to go and try that one out. If it was out of stock as well, we should return and find a solution together. The lady speaking to us was really nice and I always enjoy listening to a clean English accent. Should not be more than a five-minute walk for us. Or so we thought.

As we came to a road leading us off campus, after 10 minutes of searching around, we figured that we had probably taken a wrong turn. Having no campus and walking around at night were certainly handicaps we had to face on our quest. So, on our hike back we discussed handicaps in general. In games, a handicap is a concept that is probably taken from Golf sports. When playing golf, a handicap allows a player to deduct a number of strokes from his score to adjust his abilities to

those of a less-experienced player. This way, golfers with different abilities can compete with each other, leaving the other rules of the game intact. Such handicaps are also popular in digital games that rely heavily on skill, especially on motor skill. For example, a classic game that stands out in its use of radically teaching a player motor skills for interaction is Street Fighter II: The World Warrior (Capcom, 1992), a fighting game that relies on certain controller pad and button combinations to execute powerful special moves. While more casual fighting games like Super Smash Bros. Brawl (Nintendo, 2008) allow a good amount of special moves to be carried out simply by button smashing, the classic challenge of Street Fighter II was to precisely learn and time the attack movements to overrule the opponent. I remember childhood days, when I had blisters on my thumb, because I practiced the Shōryū-ken (昇龍拳: "Rising Dragon Fist" move of the Ryu and Ken characters in the game) all day. However, one might consider these as simple learning obstacles that can be overcome with training. The regular form of handicaps in games can be found in simply trying to balance out skill by limiting resources. This can be often be found in game difficulty settings, allowing for a smaller or weaker number of opponents.

Of course, the concept of training a skill to gain a gaming advantage has been exploited more recently in the development of "serious games".[11,12] Although sounding a bit odd, serious games refer to the concept of training certain skills, making education more fun and also informing about complex processes. An example of such a game is Re-Mission[13], where players are fighting cancer as a nanobot on cellular level, related to infections such as non-Hodgkin's lymphoma and leukemia. The game was designed to inform children battling cancer in an entertain-

11. Michael, D. R. and Chen, S. L. Serious Games: Games That Educate, Train, and Inform. Thomson Course Technology, Boston, MA, 2005.
12. Zyda, M. From Visual Simulation to Virtual Reality to Games. Computer, 38, 9 (2005), 25-32.
13. HopeLab 2006, see http://www.re-mission.net

ing way that gives them hope and to have real psychological impact on the success of their treatment.

Of course, in such an environment user experience tests are very important for digital games that have a certain goal (other than general enjoyment or fun). The assessment of fun and other game objectives allow us to leverage powerful game experiences for education, training and strategic communication. However, I believe that all digital games are powerful motivators to engage in a subject and make it easier to process, store and recall information. Norman's[14] definition of emotion is that it works through neurochemical transmitters, which influence areas of our brain and successively guide our behavior and modify how we perceive information. The ease with which this information is stored is related among other factors to the aesthetical presentation of the information. In this context, emotional and cognitive processing in player's minds creates game experiences. These experiences result from affective engagement with a game's presentation or content and the cognitive processing of gameplay to advance in the game. While Norman makes a distinction between affect and cognition, he also constitutes that both are information-processing systems with different functionalities. The emotional connection makes it easier to retrieve information when we need it.

During my dissertation I came to explore various aspects of fun and positive emotion in gameplay and how to measure emotions when playing games[15]. The user experience measurements that I used, usually consisting of a multi-method, qualitative-quantitative approach, were most helpful when the game was designed for a certain purpose. Once you have a hypothesis of what impact a game is supposed to

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14. Norman, D. A. Emotional Design. Basic Books, New York, NY, 2004.
15. Nacke, L. Affective Ludology: Scientific Measurement of User Experience in Interactive Entertainment. Ph.D. Thesis, Blekinge Institute of Technology, Karlskrona, 2009.

have, you can employ methodology from psychology to validate or cross-reference this impact in an experimental design.

In the context of serious games, affective measurements are especially helpful when exploring information acquisition strategies. Humans strive to maximize their knowledge by accumulating novel but also interpretative information. The processing of novel information activates endorphins in the brain, which guide how we sense pleasure. For example, presenting novel cues in a game will affect player experience and learning. While experiencing novel information and being able to interpret it may be a cause of neurophysiological pleasure, long-term information acquisition is usually done by mastering cognitive or motor skills through repetition. In modern emotion theories, cognition and affect mutually influence each other[16,17]. Knowledge of affective system mechanics may help us understand and relate to its cognitive impact.

The Soft Drink Machine

As our discussion about the use of handicaps in games had led us to philosophize about the impact of serious games and how to measure user experience with games, time had flown by as we finally encountered the described building. While we managed to prowl around for about half an hour, the building was really only five minutes away from the guards' place—if you knew how to find it. Through the illuminated hallway we could see a working soft drink machine sparkling through the windows. We fiddled our way into the hallway, the campus doors do have a strange opening mechanism, and finally had the chance to insert a coin into the machine. Ever since the first PONG arcade gaming machines had declared: "avoid missing ball for high score," inserting a coin into a machine was connected to high expectations on what might happen next.

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16. Damasio, A. R. Descartes' Error. G.P. Putnam, New York, NY, 1994.
17. LeDoux, J. The Emotional Brain. Orion Publishing Group, London, UK, 1998.

Crackle! Rattle! Clink! The coin was back, but the drinks remained inside. This cannot be! Joerg tried with a few of his coins. Nothing. We rubbed, polished and grinded our coins using potentially all furniture available in the hallway. Superstition did not help, still no joy. Mad laughter prevailed. Dammit! We went back to the guards' place and reported our peculiar story. The helpful lady called in the troops and in no time, we were back on our way to the building with the machine. The two lads accompanying us could not believe this. Back in the hallway, four people were now jumping around, fiddling, grinding coins, all trying to get the machine to give us what we wanted. Frustration set in. Too much challenge and no reward.

Nevertheless, we now had help. Similarly modern games provide a help system once they recognize the player is not succeeding as planned. This was made extremely popular by famous game design Shigeru Miyamoto with the "Super Guide" feature created for the game New Super Mario Bros. Wii (Nintendo, 2009): If a player fails a level eight times in a row, a green block appears, which allows a computer-controlled Luigi to show the player a safe path through the level. The player can interrupt this to take control at any time. After Luigi completes it, the player has the option to try the level again, or skip it completely. Thus, it is still possible to advance in the game, even if one part of it is too challenging. In our case, we were glad to have two campus guard super guides. The two lads remembered another building with machines and although on restricted premises, we might be able to sneak in. Like the hobbits in Middle Earth, we all marched further through the darkness on our quest for the one drink—all of us actually being pretty thirsty by now. As we cut through the coppice, we finally reached a building named after some German scientist (whose name we instantly forgot), which featured soft drink machines.

Our two newly-won friends declared that these machines were new and we were likely to be successful here. A final crackling and the machine started to rumble and spit out a soft drink. Quickly we deposited all

our coins into the machine and packed some bottles for the night. After thanking the guards for their assistance, we went on our way home and discussed this little adventure and how difficult it can be to achieve what you want. Sometimes life itself is like a great game designer, putting obstacles in your way so that you have to come up with creative solutions. Thus, designing a game can be as creative as playing one and the boundaries between playing and designing tend to blur the more the power is given to the player. Nevertheless, we were certain not to forget our campus quest for a drink, as the experience had settled deep in our brains through the affective experience that accompanied it.

About the Author

Dr. Lennart Nacke received one of Europe's first Ph.D. degrees in Digital Game Development from Blekinge Institute of Technology, Sweden. He is currently working on affective computing and applying game design methods to create entertaining interfaces as a postdoctoral research fellow in the Human-Computer Interaction Lab of the University of Saskatchewan, Canada. He frequently chairs and organizes workshops and panels with academics and industry experts on topics such as applying game design to user interfaces, affective computing, measurement of fun, joyful interaction design, game usability and UX at venues like CHI, DiGRA, Future Play, and GDC Canada.

As much as an avid gamer, he is a passionate researcher and consultant, whose scientific interests are affective player testing and physiological interaction for example with EEG (i.e., brainwaves) and EMG (i.e., facial muscle contractions) or eye tracking as well as gameplay experience in player-game interaction, technology-driven innovation, and interaction design in digital entertainment technologies.

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