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Extended Proceedings of the 4th International Conference on Fun and Games (Fun and Games’2012). Toulouse, France, September 4-6, 2012.
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FOREWORD

Welcome to the 4th International Conference on Fun and Games, in short FnG 2012!

FnG 2012 marries the best of academic writing with the most innovative play experiences in a single-track playful conference setting for academics and practitioners alike. Contributions come from a wide range including from designers, developers and researchers in computer games, digital play, experience design and fun. The Fun and Games conference series hosts an event every two years, featuring state-of-the-art academic as well as design work around the topic of digital games. This includes serious games, game theories, game design methods, measurement of player experiences, games for special target groups such as children and the elderly, games for health, persuasive aspects of play, mobile games, pervasive games, tangible games, exertion games, usability in games, game production, smart toys, play with robots, game engines, dynamic difficulty adjustment and sensors for games and play.

In 2012, FnG is placed in beautiful Toulouse, France. The extended program and hence the proceedings reflect the spirit of this wonderful location, with contributions celebrating the importance of food and place as important elements of playful lives. The extended proceedings also feature workshops and a tutorial, work-in-progress posters and game demonstrations. This year’s conference puts particular emphasis on the contributions students make to the field; firstly, student posters are specifically highlighted, and secondly, FnG 2012 features a student design competition that invites the future game and play talents of the world to exhibit their work at the conference and let everyone play them in order to determine the winner of the competition to be announced at the last day of the conference.

A big thank you goes to everyone who contributed to the conference: the authors who submitted their quality work to the conference, the chairs on the organizing committee, the reviewers on the program committee, the local organizing committee, the supporters and partners and the FnG steering committee.

It is thanks to these people that conferences such as FnG 2012 are a fun and exciting reality.

Let’s have fun and play some games!

Regina Bernhaupt and Florian ‘Floyd’ Mueller

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Antimatter: An adaptive brainwave music shooter

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ABSTRACT
Antimatter is a game engine framework for procedurally generated gaming adaptive to different input types. In this paper, we present the Antimatter gaming project that showcases some of the engine features such as adaptive content generation (more specifically adaptive sound and graphics alteration) influenced by brainwave input.

Author Keywords
Games, gameplay interaction, brain-computer interaction.

CONCEPT
When developing Antimatter, we wanted to create a game that adapts its atmospheric effects, such as sound and particle effects based on passive user input. We were looking for a system that would apply filtering functions to the audio used by the game and vary the intensity of the filtering based on the strength of different physiological input signals. The idea was born at the start of a game jam at the UOIT GAMERLab called the Dream Demo Days, so that essentially everything had to be implemented within two days, which posed some restrictions for the content.

A first design brainstorm revealed that the team would like to create a top-down space shooter (see Figure 1).

The initial idea for the game was to create this space shooter in which the player can control the music and number of bullets with their thoughts. Since music influences much of the mood of players, the team was really excited to influence this part of the game with passively sensed physiological data.

A first design brainstorm revealed that the team would like to create a top-down space shooter (see Figure 1).

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Brain-computer interface (BCI) devices, such as the Neurosky Mindband (see Figure 2) would provide the right kind of technology for this form of input. Neural feedback works under the idea that the game changes based off of information taken in from the user. For example, imagination of movement works by detecting information coming directly from the user, often using additional devices, to get reactions from the user before the user is even aware of their reaction. Another BCI method is evoked potential, which is essentially pushing mental buttons on a controller. This is the method that we decided to use in the game based on the states focused and relaxed provided by the Neurosky Mindband hardware.

The next step was mapping the BCI input to the filters provided by the engine and the number of bullets a player was able to fire. After some testing over night, the final game was ready to be played. Some minor Bluetooth connectivity issues with the BCI devices had still to be solved, but at the end of the second demo day, the game was ready to be demonstrated in public. We are looking forward to improving the game mechanics in the future to accommodate other input devices as well in Antimatter.
A Serious Game for Total Knee Arthroplasty (Replacement) Surgery Procedure Education and Training

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ABSTRACT
Total knee arthroplasty (replacement) is a commonly performed surgical procedure whereby knee joint surfaces are replaced with metal and polyethylene components that serve to function in the way that bone and cartilage previously had. Traditionally, orthopaedic surgery training in general has primarily taken place in the operating room. Given the growing trend of decreasing resident work hours due to political mandate, training time in the operating room has decreased. This has led to less operative exposure, teaching, and feedback of orthopaedic surgery residents. This paper describes a serious game that was designed to teach orthopaedic surgery residents the series of steps comprising the knee replacement procedure.

Author Keywords
Total knee arthroplasty, knee replacement, virtual simulations, learner-centered teaching, serious games, interactive learning.

ACM Classification Keywords

General Terms
Human Factors; Experimentation.

INTRODUCTION
Total knee arthroplasty (TKA) or total knee replacement is a surgical procedure whereby the painful arthritic knee joint surfaces are replaced with metal and polyethylene components that serve to function in the way that bone and cartilage previously had, providing patients with painful, deformed, and unstable knees reproducible pain relief and improvement in function [7]. According to Dr. Paul A. Manner of the American Academy of Orthopaedic Surgeons, approximately 400,000 knee replacements are performed annually in the United States alone [5] and the procedure has been rated among the most successful surgical interventions across all surgical specialties as rated by reliability of results and patient satisfaction [5].

Traditionally, orthopaedic surgery training has primarily taken place in the operating room. Given the growing trend of decreasing resident work hours in North America and globally due to political mandate, training time in the operating room has generally been decreased leading to less operative exposure, teaching, and feedback of orthopedic surgery residents. Virtual simulations offer a viable alternative to practice in an actual operating room, offering residents the opportunity to train until they reach a specific competency level. The rising popularity of videogames has seen a recent push towards the application of videogame-based technologies to teaching and learning. Serious games, that is videogames whose main purpose is not entertainment but rather teaching and learning, leverage the advances made in the video game realm along with the growing popularity of video games, particularly with today’s generation of students/learners, to overcome some of the problems and limitations associated with traditional teaching methods including surgical training techniques.

Serious games “leverage the power of computer games to captivate and engage players for a specific purpose such as to develop new knowledge or skills” [2]. In addition to promoting learning via interaction, there are various other benefits to serious games. More specifically, they allow users to experience situations that are difficult (even impossible) to achieve in reality due to a number of factors including cost, time, and safety concerns [10]. Further benefits of serious games include improved self-
monitoring, problem recognition and solving, improved short- and long-term memory, and increased social skills [6]. The term serious games (with respect to video games applied to learning) is rather new, dating back to the early 2000s (see [9]), but despite its relatively recent adoption to the field of game development, serious games and virtual simulations in general have been used by the United States military, medical schools, and in academia before the term was introduced [1].

A serious game for the purpose of training orthopaedic surgery residents the series of steps comprising the total knee arthroplasty (replacement) procedure using a problem-based learning approach was developed and is described here. Real-time, 3D graphical and sound rendering technologies are employed to provide sensory realism consistent with the real-world ensuring that the knowledge gained within the serious game can be easily recalled and applied when the trainee is placed in the real world scenario. Preliminary usability test results indicate that the serious game is easy to use, intuitive, and stimulating.

OVERVIEW

Users begin the serious game in the operating room taking on the role of the orthopaedic surgeon, viewing the scene in a first-person perspective (see Figure 1). Several other non-player characters (NPCs) also appear in the scene including the patient, assistants, and nurses. Currently, the NPCs are not animated and are not user controllable. Future versions will allow them to be controlled remotely by other users or controlled using artificial intelligence techniques. The user/trainee has the ability to move and rotate the “camera” using the mouse in a first-person style, thus allowing them to move within the scene. A cursor appears on the screen and the trainee can use this to point at specific objects in the scene.

Objects that can be selected will appear to glow when the cursor is placed over them (see figure 1). “Selectable objects” include the NPCs (assistants and nurses) in addition to the surgical tools. When a highlighted object is clicked on, a menu appears providing a list of selectable options for this particular object. For example, clicking on a nurse or an assistant allows the user to interact with them (e.g., ask them to hand over a particular tool or perform a specific task). The surgical tools are also selected using the cursor and once a particular tool is selected, the tool appears in the hands of the user’s avatar. Once the tool has been chosen, if the patient’s knee is selected using the cursor, a menu appears providing the user a list of options corresponding to that step. For instance, if the user chooses the scalpel and then clicks the patient’s knee, a menu appears prompting the user to choose how big the incisions should be.

Figure 1. Sample screenshot: The patient’s leg glows to show that it can be interacted with.

Figure 2. Sample screenshot: A pop-up window explaining why the user’s answer was incorrect.

Once the correct step is chosen, they will be asked a multiple choice question to test their knowledge of that step. Answering correctly results in a number of “points” earned which are added to an accumulating score. If the user answers the multiple choice question incorrectly, they are corrected in the form of text and/or illustrations (in a pop-up window) to ensure they understand why their answer was incorrect (see Figure 2). If they answer the question correctly, they are presented a short video segment illustrating a surgeon performing that particular step on a “real” patient with the surgeon narrating the details of the step). If the user chooses an incorrect tool for the corresponding step or performs a step out of order, they are corrected by a pop-up text-based monolog from an angry assistant surgeon. When the procedure is complete, the player is shown a score card listing the number of questions answered incorrectly, the number of tools selected out of order, and the overall score as a percentage of correct responses (see Figure 3).

The menus and pop-up windows are designed to look and behave similar to typical webpages to ensure the interface is intuitive and familiar to the majority of users. The “clickable” text appearing in a menu and pop-up window is blue just like typical links found on a webpage while non-clickable text appears black. Clickable text also changes to
a lighter blue when the mouse is over it, again imitating typical webpages. Users can click on the red “X” in the top right corner of the menu/pop-up window to close the menu similar to a web browser.

![Sample screenshot: The performance review screen shows the number of questions answered incorrectly and the number of times that the wrong tool was selected.](image)

**PRELIMINARY USABILITY STUDY**

The game was developed using an “iterative test-and-design” methodology whereby the final implementation accounted for the feedback from orthopaedic surgery residents, and game development students obtained via a usability study (institutional ethics approval was obtained for this study). Usability studies were carried out in a focus group setting in which the participants were provided a brief (five minute) overview of the serious game (purpose, how to use it, etc.), followed by a 30 minute exploratory period that involved using the serious game and freely exploring its interface/options. Finally, participants were asked to complete a brief questionnaire which comprised a subset of questions (32) from the Questionnaire for User Interaction Satisfaction (QUIS) [8]. QUIS is a tool developed by a multidisciplinary team of researchers to assess users’ subjective satisfaction with specific aspects of the human-computer interface and is highly reliable across many types of interfaces [8]. The questions measure the users’ overall satisfaction with some aspect of the interface, and the factors that make up that facet on a 9-point scale. In addition to the QUIS-based questions, the questionnaire contained several “open-ended” questions where participants were asked for any comments/suggestions regarding the serious game and more specifically, its graphical user interface.

The participants consisted of seven unpaid senior students from the Game Development program at the University of Ontario Institute of Technology (UOIT), and four unpaid orthopaedic surgery residents from the Department of Surgery, University of Toronto. All of the experiments abided by UOIT Ethics Review process for experiments involving human participants. Two separate sessions were held – one session for the game development students and the other for the orthopaedic surgery residents. In total, each focus group session lasted approximately one hour. A small sample size was employed in order to perform an “initial assessment” test to detect and correct the majority of usability issues (if any) early in the design phase prior to the final serious game implementation (i.e., to allow for an “iterative test-and-design” manner) [11,12].

The 32 QUIS-based questions were classified into four categories; Overall reactions to the system, Graphics and sound, Learning, and System capabilities. The majority of participants believed that the serious game was good, were satisfied with it, and believed that it was adequately stimulating and easy to use. Most participants indicated that the serious game had good graphics, found the highlighting feature (used to indicate a “clickable” object) to be useful, and found that the amount of information provided was adequate and logically arranged on the screen.

The majority of participants indicated that the serious game was adequate with respect to allowing them to learn how to operate it, to learn advanced features, to explore and discover new features, and to remember previously used commands. Moreover, participants believed that the serious game was properly designed to provide a logical sequence to complete tasks and that it provides feedback on the completion of particular steps. The majority of participants indicated that the system was fast enough with respect to response time for most operations and the display of information. They also indicated that the serious game was adequately reliable, failures rarely occurred, that it provided them the opportunity to correct mistakes, that it provided the ability to undo operations, and that it adjusted to the user’s prior experience level. A complete breakdown of the results from each of the focus groups is provided by Cowan et al. [3] and is therefore not provided here.

**Summary**

Total knee arthroplasty (TKA) is a surgical procedure whereby knee joint surfaces are replaced with metal and polyethylene components that serve to function in the way that bone and cartilage previously had. Here we described the preliminary development of a serious game to train orthopaedic residents to perform total knee arthroplasty procedures in a fun and engaging manner. In addition to meeting the needs of today’s technology savvy students, the serious game can be used on a standard PC allowing residents to learn the TKA procedure on their own time prior to entering the operating room. Future work will include a formal evaluation of the serious game with orthopaedic residents (using a pre- and post-testing model) to determine if learning the cognitive process of performing a total knee arthroplasty in a game environment can enhance retention of the surgical steps, decision making and troubleshooting surrounding the procedure as compared to traditional teaching techniques. We hypothesize that by
learning TKA in a “first-person-shooter gaming environment” trainees will have a much better understanding of the procedure than by traditional learning modalities and that trainees who are pre-trained using our game will perform better technically due to their better understanding of the cognitive process and ability to focus solely on the technical aspects of learning.

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REFERENCES
Blockhead: A Brain-Computer Interface Puzzle Platformer

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ABSTRACT
In this paper, we present BlockHead, a puzzle platforming game which uses brainwave activity to control properties of blocks in our puzzle world. The game was developed using a brain-computer interface (BCI) device called the Mindband. In this biofeedback game, we use the relaxation and focus values of the Mindband as puzzle solving mechanics, so that the player has to learn how to relax and concentrate as a solution to some puzzles.

Author Keywords
Games, gameplay interaction, brain-computer interaction.

CONCEPT
Brain-computer interface (BCI) technology was developed with the purpose of providing new methods of communication and interaction to persons incapable of doing this with regular computer interfaces. However, as this technology has advanced it has been picked up by video game developers to augment interaction devices for healthy persons.

When we began the development of our game Blockhead (see Figure 1), we considered so called natural user interfaces (NUIs) to work with. We decided to use an experimental Neurosky prototype called the MindBand, which works similar to the MindSet but it is easier to use, because it consists of a comfortable elastic headband. We wanted to develop a game that can feed back mental concentration and relaxation into a mentally challenging block puzzle game.

For our game to be fun we wanted to have a large variety of block types for the player to interact with. Each block needed to have a fairly unique overall puzzle mechanic that could be activated or modified by the player either being more relaxed or more focused. The types of blocks are focused on the four elements (earth, water, wind, fire) and other environmental types that worked with our puzzle mechanic (see Figure 2 for examples of different block types).

The main character of the game, the ninja was originally going to be a plain unmarked character that would go along with the polished look of the game. However, while trying out the MindBand for the first time one of our artists found the device to look similar to a ninja headband. The game also features moving and still platforms that the player has to navigate. The key is an entity that the player is required to capture in order to pass certain types of blocks (primarily the lock block). The key contains certain artificial intelligence behaviors to avoid the player, such as evade, hide, flee, arrive, and wander.

The blocks are a large part of this game, and based on the player’s focus levels they can do different things. Many of the block types only have one basic action depending on whether the player is focused or relaxed, leaving the opposing state without any characteristics. Some of the blocks require additional buttons to interact with, such as the air block, and the fire block will affect all blocks around it, even diagonal blocks. We hope this game provides a fun way to interact with BCI devices.
Bubble Popper: Considering Body Contact in Games

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ABSTRACT
Exertion games, digital games that involve physical effort, are becoming more popular. Although some of these games support social experiences, they rarely consider or support body contact. We believe overlooking body contact as part of social play experiences limits opportunities to design engaging exertion games. To explore this opportunity, we present Bubble Popper, an exertion game that considers and facilitates body contact. Bubble Popper, which uses very simple technology, also demonstrates that considering and facilitating body contact can be achieved without the need to sense body contact. Through reflecting on our design and analyzing observations of play we are able to articulate what impact physical space layout in relation to digital game elements, and physical disparity between input and digital display can have on body contact. Our results aid game designers in creating engaging exertion game experiences by guiding them when considering body contact, ultimately helping players benefiting from more engaging exertion games.

Author Keywords
Exertion games; exertion interfaces; exergames; movement-based interaction; body contact; sports; game design.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Human Factors; Design.

INTRODUCTION
Exertion games require players to invest physical effort in order to play the game [6]. Today the most well known commercial systems that allow for such interactions are Nintendo’s Wii, Microsoft’s Kinect and Sony’s PlayStation Move. Although some of the games supported by these systems enable social experiences, these experiences mostly require players stand side-by-side, where they do not experience, and are not expected to engage in body contact. We suspect that this is mostly a consequence of the limitations of the involved technology: The Kinect requires players to stay within separate physical spaces as occlusion issues could otherwise occur. Wiimotes and Move controllers are not designed for body contact and cannot be hit against other players. Although we acknowledge that body contact can be a cause for injury at times, we believe one of the reasons why these systems have been criticized...
for missing opportunities for rich social play [3] is because they do not consider body contact. We take inspiration from such rich body contact experiences ranging from the playful Twister to team sports such as basketball, where players push and block one another to gain an advantage in the game, experiencing the sharing of the physical space around them as a result of and a reason for body contact. We believe overlooking the potential of body contact in exertion games, as most current commercial systems seem to do, is a missed opportunity to support such rich experiences for players.

To explore this opportunity, we present Bubble Popper, an exertion game that considers and facilitates body contact. This is achieved without the need for sensing body contact, hence Bubble Popper also demonstrates how to consider and facilitate body contact with very simple technology. Through reflecting on our design and analyzing observations of play we are able to articulate what impact physical space layout in relation to digital game elements and physical disparity between input and digital display can have on body contact and how to design games that aim to consider and facilitate it.

RELATED WORK
We are inspired by the use of body contact in play and sports, as mentioned above, however, when it comes to digital play, body contact often seems overlooked. Nevertheless, a few digital play systems exist where studies have reported that participants encountered body contact as part of the play experience.

The users of TouchMeDare [2] engage and respond to each other’s body movements on opposite sides of an interactive canvas. The initial design focused on separating the players’ bodies by means of the canvas. However, when TouchMeDare was exhibited in a public setting (a large music festival) it triggered the opportunity for more than one player on either side to be present. These players then engaged in rich body contact actions, appropriating the system so that they could engage in intense body contact, even throw one another around.

Similarly, in the shadowboxing game Remote Impact [7] players hit one another’s shadows, separated by an interactive surface. During deployment it was observed that players like to play with additional co-located players, which allowed for body contact between them. These experiences, where users appropriated digital systems to support their desire to incorporate body contact suggest to us that players can enjoy body contact even if it is part of a digital experience.

A few game designers have recently presented games that suggest that body contact can be explicitly considered in the game design process. One of these games is Wilson et al.’s digitally enabled folk game J.S. Joust [12] that requires players to bump or push each other’s hands or bodies to eliminate them from the game. Move controllers were used to detect motion. From J.S. Joust we learn that digital games can be designed so that they facilitate body contact as a core game mechanic. However, we have yet to gain an analytical understanding of how game designers can support this kind of play.

Similarly, the digital game B.U.T.T.O.N. [11] also facilitates body contact through the game’s design, however, interestingly, the system does not sense it. Players must prevent each other from holding down a button on their controller for more than four seconds while trying to do so themselves. A video of the game in action suggests that the game can indeed facilitate very powerful body contact actions, all without the game system sensing it. We build on this idea of facilitating body contact without sensing it, and present an analytical account of how game designers can achieve this.

There have also been a number of art and interactive installations that have played with the notion of popping bubbles [9, 13]. While we are also inspired by the magical experience of popping bubbles, hence the name of our game “Bubble Popper”, our work differs as it deliberately considers body contact through game design as part of the game experience.

These related works suggest that considering body contact in exertion games could be beneficial for facilitating engaging experiences for players. However, how game design can support this has been analyzed only to a limited extent. Our work therefore explores how body contact can be considered and facilitated in exertion games. We do this by reflecting on the design of Bubble Popper and analyzing play observations.

BUBBLE POPPER
Bubble Popper (Figure 1), which emerged from teachings on Exertion Games [8], is a 2-player exertion game. Players are assigned a color, yellow or pink, and then must pop their colored bubbles that appear on the projected surface (Figure 2) by hitting the surface with an augmented glove. When hit, a switch within the glove triggers a mounted infrared LED, which informs a Wiimote positioned close to the projector of the glove’s screen position. The Wiimote is not used as an input pointer, but instead as a sensor for the gloves’ positions [5]. The Wiimote sends this information to a computer, similar to the work by Bencina et al. [1], which triggers the bubbles to pop with a rewarding sound. The rules of the game are simple; the player who pops the most bubbles of their color within 60 seconds wins.

To facilitate this we made sure the bubbles were not static and instead were moving around the digital projection space and bouncing off each other. This not only supported players to move around to keep up with the bubbles, but also afforded colliding with the opponent and their path. In this situation the players had to choose between moving out of the way and letting their opponent score a point, or...
blocking their path to prevent them from scoring while also giving them an opportunity to score a point for themselves.

INITIAL OBSERVATIONS
We can report on initial observations from three events where Bubble Popper was showcased. Bubble Popper was exhibited in a public shopping mall as part of a digital festival. From our observations of watching the general public play the game we noticed players would initially avoid interacting with one another physically and instead rather politely pop the bubbles closest to themselves. This however was slightly different when the two players were familiar with one another (e.g. those who approached us as a group). We noticed that the players who saw others play using body contact quickly picked up this style of gameplay. Another demonstration was during an International Game Developers Association local chapter meet, with an audience of over 100 game developers. It appeared they played more physical and were less reluctant to holding back. Our final showcase was at a physical health and education conference, we received comments on the potential application of Bubble Popper with children in schools.

FINDINGS
Through reflecting on our design process and observations of play with over 40 participants over the age of 18, we identified the following aspects designers should be aware of when aiming to consider and facilitate body contact in exertion games. We also articulate design strategies on how designers can use these aspects in their work to create more engaging exertion games by considering body contact.

Sensing body contact is not necessary to facilitate body contact and may not even be desired
We do not use complex sensors and tracking equipment to sense body contact as we thought it was not necessary. We believe that designing a game that rewards body contact (through assigning points for successful body contact for example) could take away from encountering body contact as a result of play, and instead may hinder the social experience. Another problem with using sensors to detect body contact is the possibility of the sensors not functioning as intended at all times (i.e. not registering body contact).

This could disrupt the game and may frustrate players. Lastly, designers might also need to consider different sensing scenarios such as skin-to-skin contact, skin-to-clothes contact and clothes-to-clothes contact, making successful sensing challenging.

Considering projection size when spawning digital game elements can facilitate body contact
Through testing and modifying the size of the projection screen in relation to the amount of bubbles spawning we found that no more than ten bubbles at any given time worked best with the projection of approximately 2.5 meters high by 4 meters wide. This provided players with enough room to move freely while also allowing for physically crossing paths when moving from one side of the space to the other. We programmed Bubble Popper so that the bubbles spawn in opposite locations across the large surface, so that players need to move around to reach all bubbles, requiring players to cut across their shared space.

Varying physical disparity can facilitate body contact
Physical disparity, being the distance between the input device (i.e. the gloves) and the display (i.e. the projection), is constantly changing and varies between approximately 0 meters (hitting the bubbles) to 2 meters (moving away from the wall), unlike with sensors such as the Kinect, where the physical disparity is usually quite constant (around 3 meters). Players have to move towards the display to pop bubbles, and away from it to see which bubble to hit next. This demand to alter the physical disparity facilitated players moving around, fueling the potential of body contact occurring.

Predispositions that digital games require players to refrain from engaging in body contact may exist
Our preliminary observations suggest that game designers need to be aware that players may have a predisposition that discourages them from engaging in body contact. We suspect that this could be due to the limited amount of digital games that have supported physical interaction between players in the past. One way of addressing this could be by showing depictions of players engaging in body contact whilst playing, for example as part of an introductory trailer. Another idea could be to dress players in sports uniforms, furthering the idea that body contact can be a fundamental part of the game experience.

Offering other contact opportunities might promote body contact
We believe that the tactile feeling of hitting a wall to pop the bubbles is one of the success factors of Bubble Popper. Unlike with a TV display, Bubble Popper’s projection system allows players to engage in contact with the wall without having to worry about any damage. Through this, players are constantly reminded that contact is “ok”, fostering the notion of engagement through body contact, working against the predisposition that digital games require players to refrain from engaging in contact.
**Familiarity between players**

Our observations suggest that body contact appears to be facilitated between players who are familiar with one another. Familiarity between players and an audience might also affect body contact, as players are performing when playing Bubble Popper; such a performance might affect and be affected by body contact as part of the experience.

**Body contact might lead to aggressive play, raising safety issues**

We also want to point out that designers should also consider any negative effects body contact may have, such as overly aggressive play. Previous research in sports science has investigated if body contact affects aggression in sports [4]. In sports such as soccer and basketball, a referee moderates overly aggressive body contact. At this stage we have chosen not to impose rules in this regard. Although research suggests that considering risk can be beneficial in exertion games, limiting the potential for injury should always be priority for game designers. Previous research in sports science suggest that there is a difference between contact and non-contact sports players when it comes to their pain apperception [10], suggesting that body contact in exertion games could affect the physical risk and the perception of this risk.

**FUTURE OPPORTUNITIES**

We believe further research that explores body contact between more than two players will expand the understanding we put forward. Furthermore, balancing players who have different physical abilities in body contact games could also be a fruitful avenue for future research, extending prior work on non-contact exertion games [8].

**CONCLUSION**

We have presented Bubble Popper, an exertion game that supports considering and facilitating body contact in digital games. Through reflecting on our design and analyzing observations of play we have articulated what impact physical space layout in relation to digital game elements and physical disparity between input and digital display can have on body contact and how to design games that aim to consider and facilitate it. Our results aid game designers in creating engaging exertion game experiences by guiding them when considering body contact, ultimately helping players benefiting from more engaging exertion games.

**ACKNOWLEDGMENTS**

We would like to thank the team that originally proposed the idea of Bubble Popper (Sevcan Ali, Daniel Beilharz, Luke Dominic-Butterworth, Paco Casarez, Nicolas Hower). Thanks also to Eberhard Graether, Andrew Lewis, Eric Dittlof, Wouter Walmink, Alan Chatham, Harry Lee, Danielle Wilde, Ho Hsin Yang, David Platt and Elise van den Hoven.

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CycloShoot: A first-person shooter fitness game on a bicycle

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ABSTRACT
In this paper, we present the game CycloShoot. It is a First-Person Shooter (FPS) that aims at increasing physical activity for one player when playing in cooperation with another player. The game’s design facilitates social interaction between the players by having them communicate strategies throughout gameplay.

Author Keywords
Games for health, fitness game, cooperative game.

CONCEPT
The game CycloShoot (see Figure 1) integrates an activity hardware called the PCGamerBike into a normal first-person shooter (FPS) based on Valve’s Source Engine. The PCGamerBike is able to recognize the activities of the player by recording the cycle direction, cadence and speed. Two players play this fitness game with different interfaces. The first player controls the game through a normal first person shooter keyboard and Mouse interface. She has to navigate the digital character through the game and faces different challenges. The second player has to support her by unlocking special and crucial powers through the biking interface.

Author Keywords
Games for health, fitness game, cooperative game.

CONCEPT
The game CycloShoot (see Figure 1) integrates an activity hardware called the PCGamerBike into a normal first-person shooter (FPS) based on Valve’s Source Engine. The PCGamerBike is able to recognize the activities of the player by recording the cycle direction, cadence and speed. Two players play this fitness game with different interfaces. The first player controls the game through a normal first person shooter keyboard and Mouse interface. She has to navigate the digital character through the game and faces different challenges. The second player has to support her by unlocking special and crucial powers through the biking interface.

The powers are unlocked via two different fitness modes. The first mode (cycle backwards) is a defensive mode, which provides the player with extra shield and health. The second mode (cycle forwards) is an offensive mode, in which the first player gets the ability to sprint and to produce ammunition for his equipped weapon.

While the direction influences which mode is active, the cycling intensity increases the effects of the mode by adding extra rewards such as faster healing rates (defensive-mode) or special ammunition (offensive-mode). Both fitness modes can only be used for a limited amount of time. The health of the first player is dropping slowly during the offensive mode, but she does not get new ammunition when in the defensive mode. So, both players have to figure out the right strategy and balance between the two modes. While the first player has to communicate which skills he needs at each moment, the second player has to be careful not to overwork himself if biking over his endurance limit. So he is in charge of balancing the amount of cycle power both players have, to solve the level.

Through the different input devices both players play the game with different skills and different interfaces. This and the social interaction between the players should make the game more fun. Our first observation of players playing the game shows that using different input devices with diverse tasks can connect players and foster social interaction as well as physical workout. In the future we will focus our research on measuring the influence of physical interfaces on games, on game experience and on the social interaction between players.
Dance! Don’t Fall - A Game for Promoting Exercise and Preventing Falls

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ABSTRACT

Dance! Don’t Fall (DDF) [2] is an Android application that monitors the users’ risk of falling while actively reducing it through a fun activity. Being a serious game, DDF invites participants to perform a dance, that is, a series of choreographed moves. Once the dance is finished, DDF gives feedback on the users’ dancing performance and risk of falling.

Author Keywords
Seniors; Games; Exercise; Fall Prevention.

ACM Classification Keywords
H.5.2. Information interfaces and presentation: User Interfaces

General Terms
Design; Experimentation.

INTRODUCTION

Falls are the most common cause of injury and injury-related death among people 65 and older [1]. To assess fall risk, doctors conduct clinical tests in which the patient must attempt simple movements like balancing on a chair, standing without assistance, and walking forward at least three meters (also known as gait test [3]); they also use questionnaires to assess other factors that influence fall risk. However, doctors typically only begin administering these types of tests when a fall has already occurred. Furthermore, the infrequency of the tests once every couple of months renders them ineffective for detecting sudden changes that may be dangerous. When considering how to adapt the fall risk clinical tests into something people can conduct by themselves, the idea of a dance initially arose as a way to incorporate the gait test (walking forward in a line). However, upon further reflection it became clear that the dance game could also have preventative benefits, since performing physical exercise regularly improve muscle tone, which in turn, reduces the risk of falling [1].

PLAYING DANCE! DON’T FALL

To play DDF, the user wears the mobile phone on the lower back to track the dance steps. Dance feedback is provided regarding accuracy, timing, stability and grooviness. For every dance, each of these dimensions can be LOW, OK or HIGH. The fall risk evaluation is based on the quality of the locomotion and on additional clinical questionnaires that are suggested when the data collected regarding aspects of balance and step length indicate a problem appears to exist.

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The application has three modes: 'Learn', 'Perform' and 'Compete'. The 'Learn' mode teaches users the dance steps and outlines the dance choreography. In 'Perform', users can dance along with the music by themselves. In 'Compete' users can challenge their friends in a group dance contest.

DDF is enhanced when a Google TV is used to display a dance coach that shows the steps the user should do. When a Google TV is not available, a tablet or similar device can be used instead. If no other device is available, the smartphone gives voice instructions to the 'newbie' dancer.

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HydroCarbon: A Game for Teaching Chemical Principles

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ABSTRACT
Within the recent trend in game research toward the analysis and design of games with a purpose, serious gaming and gamification of learning, we introduce a casual learning game called HydroCarbon. The gameplay is a cross between arcade-style gaming and memorizing educational content. As a serious game, it does not separate the learning activity from the playing activity, but integrates learning directly into gameplay.

Author Keywords
Education, Gamification, Serious Games

HYDROCARBON – THE GAME
We have recently seen an increase in learning games for hard sciences, such as fold.it (http://fold.it) or the Learning with Portals initiative (http://www.teachwithportals.com) that currently provides curricula for learning math, physics or language arts within the world of Portal. Inspired by these learning approaches embedded in a game environment, we set out to create HydroCarbon.

HydroCarbon is a cross between a serious learning game for the purpose of teaching users basic principles of organic chemistry as well as being a casual, arcade-style shooter game. In the game, the player controls an alkane molecule, beginning as methane, and must break the bonds of other molecules to collect carbon atoms for increasing the length of their own molecule chain. For this, players gain points and compete for earning a high score. The purpose of the game is exploring the integration of learning concepts into gameplay. In HydroCarbon, players will learn basic nomenclature of organic molecules, presented in the form of player character upgrades. By gathering additional carbon atoms, the player’s molecule upgrades into another alkane molecule with a greater number of carbons. Upon receiving the molecule upgrade, the player is presented with visual and audio cues indicating the name of their new molecule, with emphasis on the numerical prefix and “-ane” suffix. In terms of gameplay, having more carbon atoms in the chain increases the player’s firepower, making collecting atoms desirable. Additionally, the player’s health is represented by the chemical formula of their current molecule. Functionally, the number of carbon atoms indicates the amount of damage that can be taken. Each time the player takes damage, they will lose a carbon atom and return to the previous molecule, losing the game when they have no carbon atoms left.

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Making my dad into a video game character

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ABSTRACT
Cosmic Top Secret is a self-biographical animated documentary game about T, finding out about what her father used to work with during the Cold War in the Danish Intelligence. The game is played using mobile phone and the computer simultaneously. The project explores the possibilities of working with filmic narrative and the possibilities of gameplay and storytelling between the phone and computer platforms. Ways of playing with different layers of the story and the game world through the devices are explored.

Author Keywords
Transmedia; Documentary; Game; Storytelling.

ACM Classification Keywords
Design. Experimentation.

INTRODUCTION
The game is built using the Unity game engine and uses mixed media animation and real video and audio footage. The game characters are animated representations of real people, based on footage taken during the authors’ investigations into her parents past.

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Figure 3. Screenshot and concept

Figure 4. Screenshot and concept
space bastARds: An augmented reality iPad 2 space game

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ABSTRACT
Augmented reality (AR) allows players to superimpose a virtual world on top of the real world that we live in. AR has many purposes and potentials in games, but despite that this technology significantly costs and weighs less, current AR games are still limited in providing mobility. Space BastARds is a student game project that uses AR and the iPad 2 to bring freedom of movement to AR games. Instead of using the traditionally small fiduciary markers, space bastARds creates large markers that can be placed around an object, allowing the player to move around this object in to interact with the game world. This aims to provide a new experience of interacting with an AR game to players.

Author Keywords
Games, gameplay interaction, brain-computer interaction.

CONCEPT
Many games feature augmented reality (AR) as a core mechanic. However, only some integrated AR as a fundamental game mechanic rather than simply a technology demonstration. We wanted to create an AR game that goes beyond using markers on one flat surface to create a miniature world by having several marker surfaces that determine the orientation of objects in the game world.

With this problem in mind, we wanted to create an innovative game interaction experience that allows players to become a part of the game by using as much movement as possible. This can be achieved by using player movement as an integral game mechanic, where the world is tracked using AR. By moving around, the player can get different views of the world while advancing through the game. Our game project, Space BastARds, requires large markers to be placed around all sides of an object. As the player shifts from one side to the other, the world will also rotate in accordance to the direction that the player moved. This allows the users to interact with the device in such a way that they can feel physically present and move freely in the game world.

We chose Apple’s iPad 2 as the project’s platform because of the brand’s popularity. An iPad 2 for example uses a touchscreen, a camera, and features multi-touch gestures. Unlike the iPhone or other smartphones, tablets also have a much bigger screen, which is better for gaming. ARToolkit, a free software toolkit for AR applications was used in space bastARds on the iOS while rendering with OpenGL ES 2.0. This was to avoid the large overhead and output files produced by more popular game engines such as Unity. By programming our game engine from scratch in Objective C, we had access to the core libraries of iOS, such as video input, sound, and graphics.

First, we built a game using a single fiduciary marker that is placed on a wall. Once completed, we expanded into reading multiple markers. This was an essential step in the project because we wanted to create a game on a multi-surface object so that the player can rotate around the object to see the world in different angles. Then, multiple markers were placed around the object. The priority of each marker was based on distance, since the closer marker was the one that is in front of the user. When players rotate around an object, the distance of the markers changes. To rotate the game along with the player’s view, we had to implement an algorithm that interpolates between two markers smoothly without causing an interruption in gameplay. This enabled the mobility potential of space bastARds.

Space BastARds is a movement focused AR game using the iPad 2 to foster player activity in the real world. Therefore, we think we have taken a first step in creating an AR game that will engage player in movement as well provide a compelling gameplay experience.
The Development Process of the Game GreenTime: From Fun to Serious to finding the right balance for a challenging instructional game.

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ABSTRACT
As a group of students we developed the game GreenTime, a game that raises awareness to the sources and consequences of environmental problems and attempts to change attitudes of people by starting to resist the pollution of the world with little changes in the environment. The game is made by the team AVANTgarde and can be played at the conference. I would like to discuss the changes the game made because of the ethics present in the game, the fun-factor in the game and the visualization of the seriousness of the game.

Author Keywords
Serious Games, design patterns, ethics, learning outcomes

ACM Classification Keywords
Design, Documentation, Theory

General Terms
Theoretical perspective

INTRODUCTION
The game GreenTime is a single-player game. It puts you to live in a dark grey world because everything is polluted. However, you have a special gift: to go back in time! You embark on a mission to find out the cause of environmental issues, solve them and make the world brighter!

The message: In real life we can’t turn back time, so act now!

DEVELOPMENT
The development process for the game GreenTime followed the structure for making a game that can be read and followed in Tracy Fullerton’s book Game Design Workshop. A Playcentric Approach to Creating Innovative Games (2008). The first step of the game process was to ‘generate ideas’ (brainstorming with the whole team), then to ‘formalize the ideas’ (writing the game concept) and then to ‘test the ideas’ (play-testing events). (2008, p. 15) The team AVANT garde also made use of the iterative design concept. This means that play-tests of the game were held through all the development stages of the game, when we had a concept, it was already tested with several players. We noticed that the design of the game changed after each play-test event.

We followed the idea that first the game should be fun and second the game should be serious. The basis for this was the paper from Thomas W. Malone called ‘What makes things fun to learn? Heuristics for designing Instructional Computer Games’ The game GreenTime is about making people aware of environmental issues and instructing people how they can explain to other people to do right. It was for the team a challenge to mix fantasy and reality in such a way so that we could enhance our target group.

During play-testing events especially the question of the linearity of the game had to be tackled before the end of the development process of the game. Questions of linearity and ethics were firstly found in the overall game-structure concerning the position of the lead-character versus the non-player characters. Later it came back in the conversations of the game. Still the linearity of the game GreenTime was an ethical taken decision from the team. We wanted to have a linear game. This to have both the design patterns of the fun –factor of the game as the serious message of the game in the hands of the designers. This to find the right balance for the game.

CONCLUSION
The game GreenTime is a serious games that benefitted from having a iterative design process. During this process we found out that if the design structure kept its linear structure of the game this would benefit the message. The puzzles would help the player to learn-by-doing and therefore the team did not want to change this concept of the game.
VISUALISATION

Figure 1: The avatar starting in a grey polluted world. This is the start of the game.

Figure 2: An almost full colored world, representing almost the end of the game. Here you see that most of the puzzles have been solved and the non-player characters have round heads instead of square heads signifying the difference between a solved and a unsolved puzzle.


**AfterTime: Teaching Wellness Through Game Play**

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**ABSTRACT**  
*AfterTime* is an educational game that is being developed as an elaborative learning tool for the Child and Wellness Adolescent Scale (CAWS). Rooted in resilience research of positive psychology, the CAWS is a self-report instrument that provides psychologists a tool for evaluating the well-being competencies of children and adolescents. The game provides educators an engaging means for teaching wellness skills across ten domains that increase social competency. The CAWS and the *AfterTime* game allow psychologists and educators to collaborate in the teaching of pro-social behavior. In this paper, I focus on three table top prototypes that have informed the development of a computer game design.

**Author Keywords**  
Serious games; educational games; psychology; Child and Adolescent Wellness Scale, CAWS; game design

**ACM Classification Keywords**  
K.3.1 Computing Milieux: COMPUTERS AND EDUCATION: Computer Uses in Education  
K.8.0 Computing Milieux: PERSONAL COMPUTING: General: Games

**INTRODUCTION**  
There have been three table top prototypes completed in pursuit of the gameplay design of the *AfterTime* computer game. Early questions that plagued the design were as follows: How would my collaborators and I translate wellness skills into learning scenarios that would be fun to play? To what genre would the game belong? Should there be one winner or many winners? What type of story would provide all of the possible circumstances needed to teach wellness competencies? Each of the prototypes engendered different discoveries.

**THE FIRST PROTOTYPE, AFTERTIME: CHOICES**  
The first problem in Choices was the question of storyline. We needed a story that was open-ended enough to allow for creation of a variety of situations that would allow the players to explore possible solutions. We decided on a post-apocalyptic story because, not only did it provide a flexible framework, it holds a fascination for the age group we targeted (ages 14-18). In the back-story the players are introduced to Kai, a gender neutral fifteen-year-old who has been orphaned and must learn to survive and care for an infant foundling named Delia in a shattered world.

![Figure 1. AfterTime: Choices. Back of card design.](image)

The rules of the game begin: “Welcome to *AfterTime.* The world has ended; the apocalypse has come and gone. The people who have survived have decided to learn from the mistakes of the past. They have decided that [making good] choices are the key to building a new society after the apocalypse.” The game uses set collecting as the main game mechanic; each player accumulates wellness tokens according to the choices that they made in an “encounter.” The tokens are placed on a game board that has each of the CAWS domains explicitly labeled. By the end of the game the player can see a visual map of his or her wellness skills. The tokens can then be “spent” to build a village in the center of the board. The lessons that we learned in the development of this prototype were: (1) the story and the encounter cards were the most compelling components of the game; (2) we did not need to explicitly label wellness domains because doing so made the game feel didactic; (3) the players needed to face common challenges and build the village together in order to reach the learning goals of social competency and pro-social behavior; (4) set collecting in the context that we gave the players was not fun; and (5) the end of the game did not produce a strong sense of accomplishment in the players.
THE SECOND PROTOTYPE, AFTERTIME: ENCOUNTERS
With the second prototype, we decided to define the genre as a strategy, cooperative, and role playing game. Since the story and encounters were so compelling, we retained them, but decided to emphasize the encounter cards, collaboration, and facing a common opponent. The rules for Encounters begin with the same story as Choices, but the fourth sentence reads: “The way they[the survivors] handle their encounters with each other and nature in the new frontier will determine the strength of the new world.” The players earn community points and resources instead of wellness tokens. They can negotiate “buying” a more desirable outcome of an encounter by pooling their community points and/or resources. The players work together to build a village and to stave off storms that threaten it. The game is won when an individual player has (5) five buildings and possesses no deficit community points or resources, which represents his or her ability to manage individual success. The second condition for winning is: the community must share (10) ten communally constructed buildings, which represents the team's ability to work together to survive in the ever-changing world. The first player to meet both of these requirements is declared the winner. The lessons that we learned in the development of Encounters were: (1) The game took too long to learn to play, so the goal of teaching wellness was subsumed to learning the rules of the game; and (2) making the players compete to win conflicted with the learning goal of pro-social behavior.

THE THIRD PROTOTYPE, AFTERTIME: SURVIVAL
Simplification of the game design was the focus of the third prototype. The main game mechanic for Survival was determined to be roll and move. Since this mechanic is very familiar to the general population, it required no learning curve. The successful features of story, encounters, village building and negotiation were all retained from the first two prototypes but, in order to win, the players must ensure the survival and safety all of the individuals and the village. The emphasis in this game is to balance personal needs with community needs. This game is a non-zero sum game because the game is won when all of the community houses have been built, a signifier of all players winning. The tag line for the Survival game reads: “This is our chance to rebuild society the way it always should have been.” The lessons that we learned from this game were: (1) the gameplay must be intuitive; (2) the game must be cooperative, yet balance the needs of the individual with the community; and (3) the appropriate genre is a cooperative, strategy, role playing game.

CONCLUSION
The table top prototypes have revealed that a post apocalyptic, cooperative, strategy, civilization building, role-playing computer game is the best format for AfterTime. We are confident that this story and genre allows for the creation of learning scenarios that increase wellness skills and fulfill the goals of teaching social competency and pro-social behavior.

REFERENCES
Assessing Gaming Experience through Bodily Expression of Affect

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ABSTRACT
We present our ongoing research towards a user experience assessment tool based on gamers’ body movements. We describe how we are currently collecting movement data from children playing Nintendo Wii Sports games and which steps we plan towards a full recognition system.

Author Keywords
User Experience; Evaluation; Body Movement; Affect

ACM Classification Keywords
H.5.2 [Information interfaces and presentation]: User Interfaces - Evaluation/methodology.

ASSESSING GAMING EXPERIENCE
Many methods have been proposed for assessing user experience. Yet, as a review of empirical studies investigating user experience shows, most studies rely on questionnaires and to a lesser extent interviews.

We propose an assessment tool for evaluating user experience based on users’ bodily expression of affect, which holds three key advantages. First, it only requires a laptop as well as a movement sensor and is thus reasonably low-cost. Second, it is easy to set up and can be (within certain restrictions) deployed in the wild (in situ), which is important for ecological validity of evaluation studies. Third, it is also non-intrusive to the user. This tool could provide an easy-to-adopt way for making objective measurements of user experience. Combined with the popular self-report methods, this could result in richer evaluations of user experience.

APPROACH
We have built a motion capture system based on the Microsoft Kinect sensor. The Kinect sensor is a camera-based movement sensor, emitting an infrared grid and aggregating the reflected light into a skeletal representation of the body, similar to the postures shown in figure 1. It is fairly robust in terms of its ability to function in changing (indoor) environments and totally non-intrusive for the user.

At present we are using this system to collect a corpus of movement data in a local primary school. Here we can record data from children in an environment familiar to them and within their peer group. In our setup, the children play the Nintendo Wii Sports games. We chose these games as they do require a certain level of movement to play the games, while at the same time requiring very specific movements to steer the game. Also, many children are familiar with them.

Our next step will be an analysis of the captured movement data. Observers will rate recorded postures for emotional expression. Several studies have investigated movement analysis in contexts such as dancing [3] or knocking [2]. Feature extraction has been proposed on a low level (i.e., joint angles) and medium level (i.e., expressivity features). Building on existing models is difficult, as they not only differ in elicitation context but also in the underlying emotion model and coding scheme. The task here is to find the model most suited for the context of evaluating human-computer interaction and to validate our approach by comparing it to data retrieved from established user experience methods.

The motion capture system is then to be extended into a complete recognition system that analyzes the movements of users and provides UX evaluators with an assessment of their affective states. Apart from technical aspects of
implementation, the challenge here will be finding useful ways to represent the data.

**EXPECTED CONTRIBUTIONS**

For the HCI community, we see three main contributions. First, showing the feasibility of assessing user experience through bodily expression of affect. Second, creating a corpus of annotated affective movement data, which we plan to make available to other researchers. Finally, providing a tool that can be easily deployed in user experience evaluations, that can be used in the wild (in situ), and that is non-intrusive and does not influence the user experience.

**REFERENCES**


Challenges for the Gamification of Incident Reporting Systems

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ABSTRACT
This paper reports our ongoing work concerning the study and development of mobile applications for supporting incident reporting in cities. We provide a view at glance of incident reporting systems and the tools that we have developed so far in the context of the project FEDER Ubiloop. Our main goal is to explore the potential of mobile games for improving the overall user experience (UX) whilst reporting incidents which is often considered a dull and boring activity. On one hand, we want to make the task of incident reporting a nice and positive experience to users. On the other hand, we want to stimulate citizens to report incidents in their neighborhood so that the city administration would be better coverage of problems that should be taken into account to improve the quality of life in the city. More than a definitive solution, this paper identifies alternatives and discusses the challenges for the “gamification” of incident reporting systems.

Author Keywords
Incident reporting, User experience, mobile applications.

ACM Classification Keywords
H.5.3 Group and Organization Interfaces: Collaborative computing.

General Terms
Human Factors, Design.

INTRODUCTION
Incident reporting is a very well-known technique in application domains such as air traffic management and health, where specialized users are trained to provide detailed information about problems. More recently, this kind of technique has been used for crisis management such as the hurricane Katrina [1]. In the context of the project Ubiloop, we are investigating the use of mobile technology for allowing citizens to report urban incidents in their neighborhood that might affect their quality of life. By reporting incidents, citizens can improve their quality of life by influencing the quality of their environment. Figure 1 illustrates the overall scenario we are investigated in the Ubiloop project.

Figure 1 Overview of incident reporting with Ubiloop: users report incidents like potholes, tagging, or broken street lamps to the local government using a mobile phone application.

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be used as evidence of its occurrence. Figure 2 presents shows screenshots of the Ubiloop prototype.

Figure 2 Ubiloop prototype featuring: a) main menu page; b) textual description of incident; c) location on an interactive map.

The user interface of the Ubiloop prototype fulfills the most basics requirements for the usability and it supports the most important main users’ tasks for this kind of application: i) to identify incidents occurring in their neighborhood; ii) to report new incidents; iii) obtain feedback about reported incidents. Nonetheless, it remains a classic example of user interaction with mobile phones. Giving the fact that most users consider incident reporting a dull and boring activity, we are currently looking for additional features that can use used in the gamification of the Ubiloop prototype so that we expect to provide citizens with a better UX whilst reporting incidents.

PLAYFUL ASPECTS OF INCIDENT REPORTING
Incident reporting systems such as Ubiloop feature several playful aspects that can be exploited for creating different types of games. The idea is transform citizens and users in player so that the tasks associated with reporting incidents can become a playful UX. Hereafter we present some alternatives that we are looking at in the Ubiloop project.

Productivity aspects
Reporting an incident is a real-world task that can be encouraged by rewarding citizens/players with points in the game. The calculation of rewarding might include variable such as:

- Number of incident reported;
- Frequency of reports; this is particular important to motivate users to provide feedback on a long run;
- Level of details provided (ex. providing a photo illustrating the incident or providing the full address might be subject of a bonus);
- Different types of incidents can have different weights. Easy to report and common incidents (e.g. graffiti) could reward less than incidents that are rare or difficult to report accurately (e.g. potholes).

These productive elements can be emphasized by crowdsourcing specific incident reports. So that the number of points granted might depend on specific city administration interests on types of incidents and or incidents in specific geographic area.

Social aspects
A very interesting aspect of incident reporting systems is that even those citizens that are not fond of reporting incidents often declare to be interested in knowing what is going around their neighborhood. This aspect can be used for building a social game that could include social awareness if users are allowed to see incidents reported by other players. These social aspects should:

- Encourage competition between citizens/players for collecting points;
- Allow the creation of groups (or guilds) of players according their personal affinities or geographical area; This might create a feeling of awareness among citizens that could be notified about real-world incidents reported a group member;
- Reward most seen incidents; as this might be revealing of citizens’ concerns about specific types/location of incidents;
- Reward users that crosscheck incidents in real-life and inform the community whether the problem has been solved (or not yet);
- Implement reputation mechanisms for rewarding worthy reporting incidents; For example, users could vote for incident providing by other citizens that could earn/lose points accordingly; In order to encourage people to vote, voters might also receive additional points. Additional points could be granted by city administration for valuable incident reports. Many variables can be used to calculate the reputation including the quality of description, the precision of the location of the incident and the degree of severity/danger/importance give to the incident.
- Take into account the users’ profile for defining trust and reputation; for example, players can report incidents anonymously, provide contact information without identify, or have a full identity. The protection of players’ identity might be seen as two sides: other users/players and the city administration.

Edutainment aspects
Incident reporting is associated with civic and legal values in terms what citizens are allowed to do or not in their environment. So that these elements can be used in the games to:

- Show the consequences of incidents in real-life;
- Teach/learn laws and regulations associate to incidents;
- Inform about the penalties of causing incidents in real-life (e.g. graffiti, parking in prohibited areas).
AN EXPERIMENTAL GAME: GEOLOCALIZEDPROBLEM

In order to explore some of these ideas we have proposed to a group of master students in Informatics of University Paul Sabatier to plan a game using the basic infrastructure provided by the project Ubiloop. The resulting application is “GeolocalizedProblem” that is shown by Figure 3. This application was built on the top of an interactive map (build using the google maps API) where users can see where incidents have been located. The game is based on a crowdsourcing and reputation. Users can see all incidents include those reported by other users. Points are given according to the number of incidents reported and the quality of the description provided, which is judged by other players. Figure 3 shows what happens when a user selects a particular incident report. The arrows at Figure 3 indicates where are displayed the overall user score (1), the different types of incidents users can report (2), attribution of points by voting to an incident report (3), and bonus granted for the photo attached to the description of the incident (4).

Figure 3 Screenshot of the map view provided by the experimental game. "GeolocalizedProblem".

CHALLENGES FOR GAMIFICATION INCIDENT REPORTING SYSTEMS

Games based on crowdsourcing perspective [3] and games exploring geolocalization [4] in cities have been proved useful in several contexts. Nonetheless, we could identify several aspects that challenge the use of incident reporting systems as real-world games:

- Incident reports are deeply connected with the real user environment and might many important social implications. For example, whilst reporting incidents can be seen as a civic act that worth to be rewarded, an increasing number of incident reports might be negatively perceived as it show a city with “problems”.
- The act of reporting an incident is deeply charged of emotions. The gamification of incident reporting systems will touch with two types of the emotions: emotions that are raised by the act of playing a game and emotions that are recalled with user personal experience with real-world problems.
- Trust and privacy have a huge impact on the stimulation of users to use the game. Anonymous incident report protects user’s identity which might encourage incident reporting from citizens that associate the act of reporting as a public denunciation. However, anonymous reports also favor spams and might decrease the overall trust on reports provided.
- One of the most trick aspects of the game is that the game should prevent to put users in risky situations. For example, even if providing accurate location could be a good principle for rewarding users, the game should not encourage users to go next to a pothole in a road to improve the accuracy of the geolocalization.

CONCLUSION AND FUTURE WORK

This paper provides a view at glance of the research and the activities we are doing in the Ubiloop project. Despite the gamification was not our primary goal, we are actually exploring the alternatives for making of Ubiloop a game as it could improve UX whilst reporting incidents. Moreover, we believe that presenting Ubiloop as a game could stimulate some citizens to report incidents to the city administration. Nonetheless, our preliminary results show that there are many social technical implications that challenge the deployment of such kind of games in real-life situations. Our next steps will be to explore these challenges. We are planning some users studies in a controlled usability lab to check some of our hypothesis about the playability of games for reporting incident.

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REFERENCES

Computer Game Research and Industry in a Small Nation

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ABSTRACT
A games industry can be beneficial for economic and community development, knowledge and research at a national level. In this paper, we apply a methodology called structured dialogue design process (SDDP) in order to study how computer games can influence a small nation (using Cyprus as a case study) and what steps are required. We ran 3 workshops with key stakeholder groups, the results of which, along with our future studies, will ultimately form a strategic roadmap for games research and enterprise within a small nation and a computer games community.

Author Keywords  
Structured Dialogue Design, Computer Games

ACM Classification Keywords  
H.1.2 User/Machine Systems, Human Factors

General Terms  
Human Factors, Experimentation

INTRODUCTION
The computer game industry is the fastest growing entertainment industry globally [1]. Cyprus has a strong potential for the establishment of a computer game industry, mainly because of the high availability of university graduates and strong service industry. Cyprus is an island nation with a population of well under a million and therefore differs from larger countries with an established games industries such as China, Japan, USA and the UK [2] in terms of population and market potential. Despite this large potential there has not yet been a strong establishment of such an industry. We are particularly interested in involving the community to achieve this purpose. For our studies, we used brainstorming sessions, with dialogue between several participants whose input can be categorised and structured. For that reason, applied SDDP which facilitates dialogue and consensus among participants [3].

We ran three workshops using this process with key stakeholders in the gaming industry and research; namely, academics, businesses/government and higher education students interested in computer games. We also conducted a panel meeting with 45 participants including, ministry representatives, business leaders, marketing consultants, gamers, students and academics, all with specific interest in computer gaming industry or research.

FINDINGS
We compared the findings and used visual inspection to identify common points between all the studies. From these we created affinity diagrams to identify the factors surrounding each workshop (See Figures 1, 2 and 3):
Funding.
In order for any of the suggestions to be carried out there is a minimum financial requirement. Research institutions have available funds which can be used in collaboration with existing companies. Software development companies do not provide external funding for innovation in games development. It was recorded however, that businesses can be open to supporting such ideas if the return on investment is favourable.

Awareness.
Even if the interest and community to form games research and industry in Cyprus exists, the benefits, feasibility and abilities of such a market are not apparent. There is a need to raise awareness within the gaming and business community of the potential and actions that can be taken to develop this field.

Infrastructure.
There is currently no infrastructure to support individuals or companies who wish to involve themselves into computer game research and development in Cyprus. Interestingly, the lack of knowledge in technical ability was not the main issue. Support from a business perspective was highlighted as key as well as the ability to bring collaborators from different backgrounds together. We identify a requirement for a centralised hub to support all entities related to the games industry, initially in Cyprus but with the need to expand internationally.

FUTURE WORK.
In order to establish a concise roadmap, more studies are planned, both short and long term. For example, a fourth workshop, inviting gamers from all ages as participants will take place to add to the data pool, following the same methodology.

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Designing Digital Games for Public Transport

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ABSTRACT

Commuting on public transport can be a very unengaging experience that often involves sitting or standing for long periods of time. We see an opportunity to enrich the commuting experience by exploring digital play in this space, and in response aim to deploy a social exergame designed for public transport. Our game will act as a research vehicle to explore the ways in which digital games that incorporate both the commuter’s body and the social setting can enhance the experience of unconventional play spaces, in this case, public transport. We aim to provide guidance for game designers who consider play in unconventional spaces such as trains and trams, evoking playfulness in users of these spaces, allowing for more engaging experiences.

Author Keywords
Exertion games; exergames; play; unconventional play spaces; public transport; game design.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Human Factors; Design.

INTRODUCTION

Games generally occur in defined play spaces and are governed by rules. The act of accepting these rules and stepping into the space of play is sometimes referred to as entering the ‘magic circle’ – the metaphorical space in which play occurs [9]. This magic circle often also denotes a physical space, for example digital games have traditionally been confined to arcades and living rooms. However, the advent of recent technologies such as mobile devices allows us to play almost anywhere. Spaces that we consider playful are constantly expanding [6], for example, city streets [1], shopping malls [7], and public transport [14]. However, one of the problems that game designers may face when designing for these new game spaces is the conflict of the purpose of the space. Although the spaces may have the potential for play they may not be widely accepted as such. This may cause disruptions and discomfort for non-players in the space when a game is played. We focus specifically on public transport as one example of these spaces and refer to these spaces as unconventional play spaces.

The challenge with public transport, namely trains and trams, as a space for play is the fact that despite it being populated with people, no one speaks to one another, in fact ethnographic studies show that passengers go out of their way to avoid eye contact [5]. Our aim is to explore play in public transport in order to understand the behaviors and reactions of its users to the game. This will ultimately help us create better games that not only enhance the space by taking advantage of its unique opportunities but also work well with the space and its users.

RELATED WORKS

Organizations such as Everything Is OK [11], The Love Police [13], and the Copenhagen Game Collective [2] have hosted playful games on public transport in the past. Some of these are more like performative events than games, such as the subway sessions by Everything Is OK and The Love Police in which they board a train with a megaphone and announce the train carriage the “happy carriage” or the “love train” to amuse the passengers with humor and satire. The Copenhagen Game Collective play Train Mafia [14], an extension of the folk game Mafia with a modified rule set designed for train rides. We learn from these experiences that social play on public transport is possible if orchestrated correctly.

There have also been concepts that have considered augmenting the public transport space with digital systems, for example, by strapping a small display to the handles that passengers hold onto while commuting, allowing them to play simple games like Tetris through tilting button pressing [8]. We learn from this that handles and bars are important parts of commuting and can be augmented to create playful interactions. Unfortunately, this system is only a proposed concept and there is no study on how commuters would engage with or enjoy the system.

The London-based public transport game Chromaroma [4] uses commuter’s Oyster Cards [12] to track and record their locations and awards points for completing tasks and missions, such as visiting unexplored locations. Players are able to compete with one another on a national leaderboard. The game is accessed through a mobile device and provides
visualizations of the commuter’s travel routes. We find this to be an interesting way of engaging passengers during public transport rides, but not so different to existing iPhone and Android games that are commonly played during commutes. We understand that these methods of pastime are easily accessible and do not disturb or intrude on the privacy or comfort of others in the space, but we also believe there is a missed opportunity to incorporate both the passengers and the immediate physical space into play, and allow for the commuters to engage in play together in order to create more engaging experiences.

**CART-LOAD-O-FUN**

When we look at public transport, namely trains and trams, we notice two key features:

Firstly, the space is populated with people, so there is potential for social interaction, yet this rarely happens between strangers. Secondly, the train or tram is constantly moving and stopping, an interesting characteristic of the space and very different to most other play spaces such as living rooms.

We see these two features not as problems or challenges but as design opportunities. As such, we aim to design a game that makes use of these features.

Our project is called Cart-Load-O-Fun. We use two force sensors that are attached to the horizontal bars of the train or tram that passengers hold on to while travelling. Our current game involves two players collaborating in order to control a single character in the game. One player controls the character’s movement on the x-axis while the other player controls the y-axis by holding onto the bars that the sensors are attached to. Holding on tighter increases the x or y value. Players must work together in order to collect the gems that randomly appear in the level while avoiding enemy characters. Each gem collected adds two seconds to the timer. The game usually lasts 60 seconds and is high-score based. We project the game onto a flat surface in the space (either on the floor or ceiling), alternatively there is a screen that displays the game.

**STUDY**

We aim to explore the reactions of passengers to the games we deploy in the public transport space in order to understand how games for the commuting experience should be designed.

**Participants**

We invite the passengers in the public transport space to play the game. These include passengers who have just entered the space and who are already present.

**Measurements**

Participants will be observed during the game, which will be followed up with a discussion and an open interview process guided by key research questions using the laddering technique [3]. All game sessions will be recorded on video (with audio). These recordings will be used to assist the analysis, to compare previous reports, look for synergies and anomalies, as well as to inform ongoing game development. The primary researchers conducting the interviews will keep video logs of their findings and thoughts after each study. These will also be analyzed along with the recordings of the participants.

**Procedure**

The game is installed in an open area of the tram. Players are free to play alone or with others. Once players are finished playing the game, they are asked if they would like to be interviewed.

**Analysis**

We will look for common themes that arise throughout our data collection, these will be discussed with co-researchers. The researchers will also be keeping a video log where they speak about their opinions and findings after each study. This will also help us analyze our data.

**Challenges**

Due to the nature of the space that we are conducting our research in, there are several challenges that we face. For example, passengers constantly entering and leaving the space makes it hard to engage them in play and in conducting interviews afterwards. We address this by keeping the game simple and the play time and interviews very short while still being able to capture enough data to analyze. Our game is designed to be picked up and dropped by passengers with ease as it does not contain a story element or any other complex game mechanic that requires extensive time to understand.

**PRELIMINARY FINDINGS**

From our studies conducted on local trams so far, we can report on preliminary findings.

Playing on public transport is a performative activity as other passengers are constantly watching the players play the game. Therefore it is important for the display to be visible for not only the players but also for the audience as they also seem to enjoy the experience of being an observer. Thus the audience are engaged, allowing for observation or even participation [10].

Placing a game in an unconventional play space like public transport easily gains the attention of the people in the space, as it is not a common sight to see such events occurring in the space. However, we still find it difficult to engage even the curious passengers. As expected there is a social barrier to entry.

Several players have reported that the tram moving back and forth has an influence on the game, and that they sometimes try to resist the acceleration and deceleration of the tram. We find this to be unique to a tram, and the fact that the tram is able to manipulate the player’s control over the input to be a very interesting game mechanic that can be leveraged.
LIMITATIONS
Our research investigates the role of play in one particular unconventional play space (i.e. public transport, namely trams). Naturally, there are many more. However, this is only the first step into such an investigation. As such, this research only provides a snapshot of a particular unconventional play space. Nonetheless we believe our insights are a valuable starting point for researchers to investigate this domain further.

CONCLUSION
We have presented Cart-Load-O-Fun, a work in progress project. We report on preliminary findings from studies conducted on local trams. Our game acts as a research vehicle to explore the ways in which digital games that incorporate both the commuter’s body and the social setting can enhance the experience of unconventional play spaces, in this case, public transport.

We aim to provide guidance for game designers who consider unconventional play spaces such as trains and trams, evoking playfulness in users of these spaces, allowing for more engaging experiences, ultimately allowing players to rethink where, when and with whom we play. We aim to further enhance our study and therefore enrich our contribution.

REFERENCES
Designing Floor-based Games for Young Children

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ABSTRACT
This paper describes the design of floor-based games for children aged between three and six years. We outline the key design criteria that were used to guide development of these games. The resultant game experiences are discussed briefly.

Author Keywords
Game-based learning; young children; game design.

ACM Classification Keywords

General Terms
Design.

INTRODUCTION
Stomp is a floor-based system that allows users to interact with digital environments. The Stomp platform effectively turns the floor into a 2m x 3m multi-touch computer screen. Stomp can be used by a single participant, pairs and larger groups. Users interact with experiences through stepping, stomping, pressing, jumping and sliding. Initial developed for adults with intellectual disability [5], the technology has recently been adapted for use by very young children. Our floor-based games are designed around the premise that all experiences must be developmentally appropriate [1]. Our aim is to create experiences that naturally engage children in physical, cognitive and social activity.

DESIGNING FLOOR-BASED GAMES FOR YOUNG CHILDREN
Child autonomy and the creation of an environment where entry level knowledge and experience is kept to a minimum were also high priorities during design. We endeavored to ensure that provision was made for children’s varied skill and ability level. We looked to create experiences that do not rely on the acquisition of specific kinds of competencies before interaction and engagement can occur. Importantly, the physical form of the Stomp mat suggests a certain way of interacting. It affords actions like standing, walking, jumping and stomping.

The Stomp system can be considered in terms of whole body interaction [4] and as an example of reality-based interaction [3]. The system is designed so that stomping, stepping and sliding in Stomp are like stomping, stepping and sliding in the real world.

Design criteria used throughout the development process recognise that young children draw on direct physical and social experiences to construct their own understandings of the world around and that they construct knowledge in environments that allow opportunities to explore and play [2]. Our designs also acknowledge that at this age children are largely sensory dependent, with learning occurring best when they have something to see, touch and hear [1].

The games we’ve developed build on the knowledge that there is a complex interplay between physical, social and cognitive development during the preschool years and that development and learning are integrated across domains [1]. All games incorporate elements to encourage a combination of physical, cognitive and social activity. The games fluidly become more and less complex and challenging to match the abilities demonstrated by the children.

STOMP GAMES FOR YOUNG CHILDREN
With the Stomp platform we have made over 18 games for young children, carefully designed to support whole child development and learning. The following examples demonstrate how we achieve this objective.

Trap-a-Turtle
Turtles appear at random locations across the floor (Figure 1) and players are required to touch them to stop them from moving. When a turtle is “held down” it will go into its shell and stop moving. The aim is to hold down all of the turtles at the same time before time runs out. The ability to successfully hold down all of the turtles at the same time relies on a coordinated approach by children. While clearly a physical game, this also requires problem solving, cooperation and communication as players decide who is in the best position to stop each turtle.

Jungle Garden
Children are provide with stamps, e.g. flowers, vines and leaves, that they can use to create their jungle garden (Figure 2). The stamps available change frequently, providing children with interesting choices. The current stamp can be placed at any location on the mat through a child’s actions (e.g. stepping, jumping, banging). Stamps of a particular kind can be spread by the child standing near or on that stamp and then moving around to create a spread of...
identical plants/leaves. Stamps will fade over time, and children will have to keep creating stamp pattern to keep their jungle active and interesting. Jungle Garden seamlessly blends creativity with cooperation and physical activity.

Figure 1: Trap-a-Turtle

Figure 2: Jungle Garden

Bush Bugs
Children touch walking bugs to divert them into the bush that matches the symbol on each bug’s back (Figure 3). The match can be a shape, letter, or number. In the latter case, the number on the bug must match the number of spots on the bush. Children work together on these challenging tasks to get the bugs home.

Figure 3: Bush Bugs

STOMP FIELD TRIAL
A user study has been carried out in a kindergarten with 31 children aged between three and five years. Video data was collected across six, 90-minute sessions. While complete analysis of data has not yet been undertaken, preliminary viewing of the video footage of four children playing Jungle Garden (Figure 4) demonstrates the type of interactions enabled. Children were constantly stepping, tapping and jumping to create jungle patterns. One child liked kneeling and lying in the garden and did so repeatedly. Comments like “the leaves follow us”, “flowers!” and “look at mine” show the children’s attentive interest in the experience. The following exchange demonstrates the type of social interaction that occurred:

S: [stepping quickly across the mat] *Get some more leaves.*
B: [lying on the mat, jumps up and starts stomping] *Yeah, run and make a big pile.*

Figure 4: Young children playing Jungle Garden

DISCUSSION AND CONCLUSIONS
We have designed games for young children that are open-ended and discovery-oriented, supporting autonomous, child-initiated play. Early analysis of field trial data indicates that young children are able to independently interact with Stomp experiences, free from adult guidance or intervention. Children’s experiences are highly physical and social interaction occurs frequently. Future work involves further analysis of user studies to assess each game’s effectiveness in promoting physical, social and cognitive activity.

REFERENCES
Familiarity of challenges and Optimal Experience in Movement Interaction Games

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ABSTRACT
This paper reports on a project that is investigating the way challenge affects optimal experience or flow in movement interaction games.

There are three important conditions to promote an optimal experience: a balance between the player’s level of skill and the challenges that she/he has to face, goals that are clear and compatible and immediate feedback on the gaming session. The challenge-skills balance has been considered as the most important condition. It has also been proposed that the challenges of the game are composite in the sense that they can include cognitive, physical and affective factors. However, one key question that remains to be addressed is: what makes a challenge suitable? This paper addresses this question by investigating the role that familiarity plays when players consider how suitable a challenge is, and therefore how good a game is. This investigation is performed in an empirical way. A prototype of a movement interaction game is employed to compare familiar with unfamiliar challenges and also to investigate the effect that motivating an unfamiliar challenge has in its acceptance by players.

Author Keywords  
Player Experience, Flow, Movement Interaction

ACM Classification Keywords  
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms  
Human Factors; Design; Measurement.

INTRODUCTION
Challenge is consistently identified as the most important aspect of good game design. Games should be sufficiently challenging, match the player’s skill level, vary the level of difficulty, and keep an appropriate pace. [1].

Romero & Calvillo-Gamez [2] have proposed a view of flow that proposes that challenges might be composite in the sense that they are associated with the cognitive, physical and affective parts of the person. This view opens up a new way to consider, analyze and evaluate challenge; however, one key issue still to be addressed has to do with investigating the characteristics that make challenges suitable for an activity. We consider that one important factor in this respect is familiarity. Video game genres have types of challenges that regularly appear in them and players are already familiar with some of them. We hypothesize that players will prefer familiar challenges, unless unfamiliar ones are of a suitable degree of difficulty and are properly motivated. In order to evaluate our hypothesis, we are developing a prototype of a game. We have analyzed the game’s challenge, identifying those elements that could easily be modified, introducing unfamiliar aspects to the game. We have also implemented a module to dynamically adapt the level of challenge, in order to ensure a challenge-skills balance.

We focus mainly on elements of challenge that have to do with coordination, as this factor covers both cognitive and physical aspects. Three versions of the game implement familiar challenges, unfamiliar challenges, and unfamiliar challenges with a justification for their introduction. The evaluation of those versions will try to ascertain whether familiar challenges and properly motivated unfamiliar challenges are more likely to promote optimal experiences in players.

This paper is organized as follows: in the first section we briefly mention some of the principal concepts in the flow theory, and highlight the importance of the balance between the player’s skills and the challenges present in the game. In the section 2 we talk about the characteristics of the prototype developed and our hypothesis about the challenges and their relation with flow states. In section 3 we will discuss the module in charge of adapting the difficulty of the game to the player’s performance, implemented by a neural network. The fourth section will be about the design of the evaluation’s method. Finally, we present some conclusions and discuss further work.

Flow and Movement Interaction
The concept of flow has been used to describe psychological states of optimal experience that are characterized by a deep and effortless concentration in the task at hand [3].

There are three conditions that are necessary to achieve the flow state:

- Clear set of goals. This adds directions and structures to the task [3].
A balance between the perceived challenges of the task at hand and the player’s own perceived skills. One must have confidence that one is capable to do the task at hand [3].

- There has to be clear and immediate feedback. This helps the person negotiate any changing demands and allows him/her to adjust his/her performance to maintain the flow state [3].

The most important condition to promote flow is that the challenges of the task are commensurate with the person's skills. If such balance doesn’t exist, the player could be experiencing other states, like apathy, anxiety or boredom (see Figure 1). Therefore, it is necessary for a system to be able to regulate the difficulty of the challenges presented to the player according to his/her performance in the game.

We propose an adaptive system using a neural network, which will learn from the responses of the player to different patterns of parameters that impact directly on the difficulty of the game. This neural network will be in charge of setting those parameters in the game. We will discuss this implementation after explaining the main features of the prototype.

The study is investigating the factors that make challenges suitable for games (deemed by players as good challenges and able to promote an optimal experience). The hypothesis put forward is that ‘familiar’ challenge elements will be more suitable than ‘unfamiliar’ ones, unless the former elements are properly motivated. In order to evaluate this hypothesis, three versions of the game modify specific elements of the composite challenges. The first version requires for the player to coordinate both hands to destroy the enemies, there will be 2 enemies active at any given moment, and each cursor must be over one enemy to damage them (See Figure 2); the second, instead, provides players with forward and backward views, and requires them to control each view with each arm. The enemies will be in a “sleeping state” until the player lay a cursor over an enemy, then they will be activated and will try to attack or flee from the player depending on their life. There are two types of enemies, red ones and green ones. The green enemies can only be harmed inside the left screen and the red ones on the right screen (see Figure 3). Finally, the third version is exactly the same as the second with the difference that the need for the double view is motivated introducing it by a narrative describing the game story.

The study supports the idea of composite challenges by illustrating how a challenge can be modified through its elements. The use of this approach will allow us to establish whether familiarity with a challenge element plays a role in flow promotion and whether this factor can be addressed by properly motivating its introduction.
ADAPTING THE CHALLENGE

Regarding the adaptive module of the system, we propose an implementation using a neural network that will be in charge of setting the parameters that will impact directly on the difficulty of the game depending on the performance of the player. This network will be retrained constantly so it will adapt to changes in the player’s performance. The architecture of the network is as follows: perceptron’s based layers consisting of an input layer, a single hidden layer and an output layer. There is a neural network for the first version of the game and another for the second and third versions.

For the first version, we defined these parameters:
- Size of the enemies
- Speed of the enemies

Consequently, we want the network to predict how many enemies the player will destroy and how much damage she/he will receive. This will set the number of output neurons to two. Using this heuristic formula:

\[(1 + I) H + (H + 1) O \approx S / 3. \quad (I)\]

Where: 
- \(I\) = number of neurons in the input layer,
- \(H\) = number of neurons in the hidden layer,
- \(O\) = number of neurons in the output layer,
- \(S\) = size of the training data set.

We obtain 66 neurons in the hidden layer (considering \(S = 1000\)).

For the second and third version, we defined these parameters:
- Size of the enemies
- Speed of the red enemies
- Speed of the green enemies
- Number of red enemies
- Number of green enemies

And we want to predict:
- Number of red enemies to destroy
- Number of green enemies to destroy
- Damage to receive from red enemies
- Damage to receive from green enemies

Using equation I, we obtain 33 neurons in the hidden layer.

The methodology of the adaptation will be the same for the two versions and consists of:
- Defining a large range for the parameters mentioned above (for example, the speed of the red enemies must go from very slow to very fast)
- Proposing a first phase of training by increasing linearly all the parameters and presenting them to a human, so we can cover all the range and determine the range for the playable settings
- Proposing a second phase of training that will take the results obtained from the first phase, will calculate randomly several combinations of patterns, and choose...
the best (the one with the greater weighted sum of enemies destroyed and damage received) and present it to a human player. After some time, the network will check the performance of the player and retrain itself from this new information and will calculate again several combinations of patterns and keep the best, and so on.

When we consider that the network has a suitable performance, we will deploy it on the actual gaming sessions, but the training loop from the second phase will continue to learn, so that the system keeps adapting to new users.

**EVALUATION**

The game will be exhibited at a popular science museum. Visitors of the museum will be asked to play the game and answer a flow questionnaire to evaluate their experience. The flow questionnaire will be derived from well-known and widely used instruments in flow research [4]. The evaluation will compare the answers to the questionnaire for the three versions, looking for differences in the participants’ experience. As mentioned above, it is hypothesized that players will prefer the version implementing familiar challenges and the one implementing unfamiliar ones that are properly motivated.

**CONCLUSIONS**

The goals of the development of this project are on the one hand, determining how modifications of the elements related to a challenge (in this case, coordination) can impact on the potential of the game to promote flow states and a characterization of these modifications; and on the other hand, determine if the proposed adaptation’s system is able to maintain a balance between the player’s skills and the level of challenges.

We have mentioned the importance of challenges in the design of the game, particularly if we expect it to promote flow states. From the results of this project, we hope to build a better understanding of the design of the challenges of a game.

At this moment we are finalizing the development of the prototype. Its evaluation will take place at the end of the summer both through a controlled conditions experiment as well as exhibiting it at a science museum.

**ACKNOWLEDGMENTS**

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**REFERENCES**

Game Rules And Their Effect On Team Cohesion

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ABSTRACT
Multiplier games (both face-to-face and online) frequently feature teams. This study aims to investigate whether it is possible to use the rules of a game to alter the team cohesion. Game rules from two face-to-face games have been analyzed using Social Identity Theory to predict which will create the more cohesive teams. These rules are also being implemented in two versions of an online game. Team cohesion in all four games will be measured to determine which set of rules is likely to foster cohesion.

Author Keywords
Game design; Teamwork; Social interaction

ACM Classification Keywords
H.5.3 Group and Organization Interfaces: Theory and models

INTRODUCTION
Face-to-face games are predominantly multi-player and, since 1999, there has been an explosive growth in online multiplayer gaming [8]. However, designing for teamwork and cooperation seems mostly to consist of making the games either too difficult or physically impossible to complete alone [7]. This does not necessarily lead to strong, cohesive teams. In World of Warcraft the longevity of many guilds has been shown to be less than a month [3]. Is it possible to use the rules of a game to increase the cohesion of the groups or teams that form within the game? If so, game designers could have much more control over the strength of the teams, allowing them to choose whether player movement between teams becomes more or less of an issue in their games.

An online, multiplayer game called “African Farmer” is being designed as a learning tool for students of international development and future policy makers. This game will be run by a game manager and played by 15-35 players. These players will form small teams of up to 3, and each team will be responsible for a farming household consisting of a growing number of non-playing characters (NPCs). These NPCs range from babies to adults and if insufficiently cared for they may get sick or even die. Over a series of annual cycles the players make decisions about what to plant, grow, buy and sell to sustain their households through a variety of hazards, such as drought or pest attack.

Although the farming element is important, player interactions are also a key learning opportunity [9]. Both inter- and intra-household interactions can have a large impact on the strategies chosen and therefore the success (or otherwise) of the players.

African Farmer is loosely based on two pre-existing face-to-face games:

I. The Green Revolution Game (GRG) [1] provides a simple yet sophisticated model of rice farming in Bihar, India. The game allows players to choose between planting normal or high yield rice to sustain their household members.

II. Africulture [2] provides a model of gender roles in an African rural community. The players have a greater range of crops to choose from, but the farming model is less sophisticated.

These games have very different social models (see table 1). Social Identity Theory (SIT) [6] considers the way that group membership affects personal identity, and how different factors affect the strength of group identification. The factors identified in Table 1 leads to the prediction that GRG will produce a higher level of team cohesion than Africulture. The group identity should be more salient to the players than their personal identities [10], and not being able to change teams reduces the impact of group performance on in-group identification [4]. The increased information available during team formation in Africulture may mitigate this to an extent [5], but not enough to offset the other factors.

<table>
<thead>
<tr>
<th>GRG</th>
<th>Africulture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teams form before resource allocation.</td>
<td>Teams form during first round after resource allocation.</td>
</tr>
<tr>
<td>Teams fixed for game duration</td>
<td>Team members may leave and join a different team.</td>
</tr>
<tr>
<td>Players have team goals</td>
<td>Players have individual goals</td>
</tr>
</tbody>
</table>

Table 1: Differences in the social model
**APPROACH**

The research will investigate the relationship between game rules and team cohesion in four settings: GRG, Africulture, and two versions of African Farmer. The core African Farmer game will use the GRG social model. A second version will also be built, featuring the social model from Africulture. The farming model and interface will be the same as far as possible between the two versions. The study will use a between subjects design, due to the length of time the games take.

In order to measure the team cohesion in each game an instrument has been constructed consisting of 10 items, based on a pre-existing in-group identification scale [c.f. 4]. This will be administered in paper form at the end of the playing time for each of the face-to-face games, and in online form at the end of the online games. This data will be analyzed to compare the team cohesion in the games.

**EMPIRICAL WORK**

The first study has been completed, with GRG being played by 16 players (10 female, 6 male). The players were asked to sit at any of the pre-arranged tables before the initial family and farm sizes had been allocated. They played for 3 hours and completed 5 annual cycles. A high value of team cohesion was found for all players (61.88 out of 70, SD = 4.72), which is in line with the prediction made using SIT.

The Africulture game will be played with a group of student participants in the near future. The survey results will be analyzed and compared to the results from GRG.

![Figure 1: The household screen with communication panel at the bottom.](image)

African Farmer has undergone extensive prototyping. The game will be based around a series of locations, including household, farm, village, marketplace and bank, with different activities and information available to the players on each screen (see figure 1). Text-based communication has been built into each screen, and can be used to simulate face-to-face chat, mobile phone calls, or SMS communication.

Separate groups will play the two versions of African Farmer for a minimum of 5 annual cycles. This will allow strategies chosen by the players to come to fruition and the relative success of the team to become apparent.

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**REFERENCES**

Improving Physical Health via Social Media and Gamification Principles

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ABSTRACT
The Improver app is build to engage and guide people into physical activity. It allows users to log physical activity, food intake, mood and weight, increasing their sense of autonomy and competence. In addition, it motivates people to share results, by using social media and via gamification principles. The app gives immediate feedback and allows unlocking of rewards that are easily shareable with media such as Facebook and Twitter.

Author Keywords
iOS; Gamification; Social Media; Physical health

ACM Classification Keywords
H.5.2. Graphical User Interfaces (GUI).

General Terms
Human Factors; Design

INTRODUCTION
In Western society, obesity is a serious life-threatening evolution [2]. The goal of this SIXPAC-project [3] was to create an iOS application that will help the user obtain a healthier lifestyle, by logging his physical activity, food intake, mood and weight. These logging of the activities of the user result in an overall health score. These activities, the results and the health score can be also shared using social media and gamification principles. The application is build on the principle of self-determination [1] and stresses autonomy (the user can decide when and how to execute these activities), competence (the user is guided and rewarded for his actions), and relatedness (the user can share his results).

THE APPLICATION
The main window, shown when starting up the app, gives an overview of how the user is doing (Figure 1, left). At a glance the user can see his progress but also messages from friends or unlocked achievements.

Adding data
The app enables the entry of all kinds of data (physical activity, food intake, mood and weight). When the user presses the central orange add-button in the tab bar (see Figure 1, right and Figure 2.) the choice is offered to add data to one of the four data types (activity, food, mood or weight). When the user clicks on one of the buttons, a custom popup will appear that handles the data entry for that data type. We allow manual data entry but the user also has the option to use the internal hardware for location tracking. In addition, users can set goals, and when attaining these goals, they can unlock achievements or share their progress with others (see Figure 3).
Gamification principles
The leaderboard ranks the users by health score, since this represents a good overview of the activity and overall health of the user. The application implements 44 achievements that reward the user for a variety of actions within the application. Some achievements are unlocked easily while others will take a long time to unlock. The idea is to motivate the user from the start, while keeping things interesting in the long run and providing a sense of distinction for the veteran users. We integrate the social aspect by allowing every unlocked achievement to be shared on Facebook and Twitter.

USER TESTING
We invited 9 people familiar with iOS (people who are used to interact with an iPhone, iPod Touch and/or an iPad). The tasks contained in the user test are shown in Table 1. During the tests we did not answer any questions nor did we interfere with the tester, yet we encouraged to think aloud while completing the tasks.

Table 1. An overview of the tasks during the user test.

<table>
<thead>
<tr>
<th>Task Description</th>
</tr>
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<tbody>
<tr>
<td>1. When the application starts, finish the welcome flow</td>
</tr>
<tr>
<td>2. Enter the following goals:</td>
</tr>
<tr>
<td>2.a Drink 2l of water every day</td>
</tr>
<tr>
<td>2.b Eat 300g of vegetables 5 times a week</td>
</tr>
<tr>
<td>2.c Run 3 times a week for 30 minutes</td>
</tr>
<tr>
<td>2.d Lose 5kg of weight</td>
</tr>
<tr>
<td>3. Edit the goal of drinking water from 2l to 1.5l a day</td>
</tr>
<tr>
<td>4. Favorite the running goal</td>
</tr>
<tr>
<td>5. Enter your weight as if you would have lost 7kg</td>
</tr>
<tr>
<td>6. Remove the weight goal</td>
</tr>
<tr>
<td>7. Enter that you ate 280g of vegetables today</td>
</tr>
<tr>
<td>8. Go running and let the application track you</td>
</tr>
<tr>
<td>9. Remove an item from the wall</td>
</tr>
<tr>
<td>10. Share an item from the wall on Facebook</td>
</tr>
<tr>
<td>11. Share a goal on Twitter</td>
</tr>
<tr>
<td>12. Have a look at your achievements</td>
</tr>
<tr>
<td>13. Share an achievement on Facebook or Twitter</td>
</tr>
<tr>
<td>14. Check your profile</td>
</tr>
<tr>
<td>15. Edit your profile</td>
</tr>
<tr>
<td>16. Look at all available data for Aerobics</td>
</tr>
<tr>
<td>17. Display the help screen at the home tab</td>
</tr>
<tr>
<td>18. Display the graph on the home tab</td>
</tr>
</tbody>
</table>

Most users were able to accomplish all tasks. Only two of the nine people we tested failed in only one of the 21 tasks given; both users were not able to show the graph on the home screen. We received some feedback during user tests, which lead to minor changes to the interface of the app.

DISCUSSION
When testing, we focused on the usability of the application and the feedback of the test users. However, we did not test whether the application is going to fulfill its real purpose: to help the users to become healthier. Therefore, a test group of sufficient size should use the app for a longer period of time. Unfortunately, such a test is beyond the substantive and time scope of this project.

CONCLUSION
User testing indicated that we succeeded in developing a user-friendly application to engage and guide people into physical activity. However, the real question still remains: does this application help one to improve his/her health? This remains for future research.

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Storytelling for Games User Researchers

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ABSTRACT
With big data becoming an important concern for major game publishers, an important game research problem is the meaningful analysis of quantitative data. One solution from user experience (UX) design is to create data-supported stories that keep users in the centre of the design process. Data-based storytelling helps designers putting their work in a meaningful context, showing design concepts or connecting ideas. An UX focused design process is critical for the development of video games and using stories to interpret quantitative data helps gain design insights. While players are usually not part of the game development process, we think that combining user-generated data with storytelling helps game developers to keep the focus on their players. We briefly present our own storyboarding solution that makes use of the points discussed in this paper.

Author Keywords
Storyboards; Storytelling; Video Games; Player experience; Visualisation.

ACM Classification Keywords
K.8.0 [General]: Games – Personal Computing; J.4 [Computer Applications]: Sociology, Psychology;

INTRODUCTION
Storytelling is at the heart of the human experience. Once we experience something great, we often cannot wait to tell someone about it. Stories help us shape our perceptions and consolidate our feelings. User experience (UX) researchers have leveraged the power of storytelling to drive observation-based and focus group research for improving websites and interface designs, which has been discussed in depth in the web development design community [1, 2, 3]. Our goal in this paper is adapting the points raised in this related literature for storyboarding in games user research. In this paper, we focus on stories that have the goal of describing and communicating player experience aspects to the game development team.

STORYBOARDING PLAYER EXPERIENCE
We use stories in games to gather, share and distribute information about players, tasks and goals (e.g., their motivation for playing a game). Stories can be a powerful tool in game development for encouraging collaboration and innovation of new design ideas across the whole design team (from programmers to publishers).

The limitations of stories – if they are not data-supported – can be that they are a personal and subjective account told from consumer’s perspective. Therefore, recording and assessing experience can become fairly intangible with subjective narrative accounts. However, stories can become useful when we generate player stories or storyboards based on data collected during a game user research observation session. For example, these data may include player comments, observational notes, gameplay metrics as well as a player’s physiological state. The seemingly elusive narrative experience of traditional storytelling becomes more tangible when game user research data is used to support the narrative outlines.

Analysing large-scale or high resolution player data (e.g., analytics or biometrics) can be daunting for novice researchers and presenting results from these studies is often not straightforward. Using stories and storyboarding would help understanding the human aspects in these data. These data-supported stories would help game developers understand games user research reports better.

Game development includes many disciplines, each with its own interpretations, rhetoric and formalities. We can use storyboarding for bridging these disciplines. Storyboards help building a shared vision and interpretation by providing examples and a common vocabulary for everyone in a development team.

In our research, we currently use storyboards to point out game user research observations and their impact on player experience. These storyboards could also visualise an impact of an improved design on players’ feelings. For example, we could use the storyboards to visualise positive and negative player emotions during gameplay as well as player engagement. Matching player reports to these observations can provide a powerful overview of game levels and help uncovering game design weaknesses. We also see storyboarding as a powerful tool for triangulating or combining different data sources, bringing together the power of quantitative data as well as the depth of insight gained from qualitative inquiry and observation. Our
storyboarding approach aims to help game user researchers to visualise game design intentions, player experience reports, and physiological responses. We are currently experimenting with the integration of physiological data annotated by player-defined experience points in the game (see Figure 1).

![Figure 1. An early prototype of a biometric storyboarding tool.](image)

We call these integrated storyboards that annotate physiological data: “Biometric Storyboards”. They can help visualising meaningful relationships between design intentions, change in player’s psychophysiological states and game events. We are currently working on building a tool that allows rapid creation of these biometric storyboards for game user researchers.

BIOMETRIC STORYBOARDING TOOLS
Developing and testing a new method is not a quick process and usually can take many years of evaluations [4]. For a better understanding of user needs and requirements, we have evaluated our Biometric Storyboards prototypes based on three case studies with game publishers [5, 6] and six interview sessions with game developers [7]. These case studies and interviews provided a foundation for developing a biometric storyboarding tool as a hub for game user researchers using mixed qualitative and quantitative methods. The tool allows them to collect data and generate Biometric Storyboards on the fly. We are currently at the stage of refining this tool and designing further studies to evaluate the benefits and limitations of the biometric storyboarding approach.

CONCLUSION
Through storyboarding we can visualize different player data into a single graphic representation. This would help game user researchers and game development teams to achieve a shared view on critical game design events. Biometrics storyboards are in our experience not only a powerful tool to explain game design problems but also provide a way to discuss their solutions. They can help the whole team to visualize the design problems, the potential solutions, and gameplay areas that need improvement.

Creating data-driven storyboards supports design arguments, so that the game designers can see how players would experience their intended designs. These storyboards provide an analytical connection between players and game designers. With biometric storyboards we can provide engaging and actionable arguments explaining player experience issues to the game development team.

Game events (we call them game beats) and emotions resulting from those events are at the heart of creating a great player experience. Biometric storyboards will allow us to visualise events in gameplay where player’s actions or behaviours lead to change in their emotional states. We hope to be able to present our biometric storyboard tool for game and player evaluation soon.

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Suspending Disbelief in Virtual Game Stories

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ABSTRACT
The work accommodates Espen Aarseth’s concept of virtuality and Samuel Taylor Coleridge’s concept of suspension of disbelief to the context of story-driven digital games. The premise is that suspending disbelief at narrative improbabilities is a skill required to construct coherent readings of stories. This skill has a special form in digital games, the stories of which involve virtual elements.

Author Keywords
Virtuality, suspension of disbelief, narration, aesthetics.

ACM Classification Keywords
J.5. Arts and Humanities.

General Terms
Theory.

INTRODUCTION
In his article “Doors and Perception: Fiction vs Simulation in Games” Espen Aarseth presents virtuality as a descriptive term for simulated story world objects [1]. In Biographia Literaria Samuel Taylor Coleridge presents suspension of disbelief as a descriptive term for readers’ inclination to overlook narrative inconsistencies because of their willingness to create a coherent narrative construct [2]. This work introduces suspending disbelief as a skill that is required to construct coherent readings of stories. Virtuality is introduced as a component that requires specific suspension of disbelief in a story context, suspension of virtual disbelief.

VIRTUALITY
When a story is considered fictional, its objects are typically considered fictional as well. Some story world objects, nonetheless, seem to involve properties of simulation that separate them from purely fictional objects. Aarseth terms these simulated objects virtual, as they have an additional “dynamic model, that will specify [their] behavior and respond to our input” [1].

SUSPENSION OF DISBELIEF
The concept of suspending disbelief was put forth by philosopher poet Samuel Taylor Coleridge, who sought a way through which he could express fictitious elements in his poetry so that they would not break the work’s poetic coherence. For Coleridge, a well-written poem was able to convince readers to overlook improbable elements, such as supernatural characters, so that they would willingly suspend their disbelief in front of the improbabilities and have “poetic faith” in the story as a whole. [2]

In this interpretation, suspending disbelief in reading, watching, listening or playing a story is to assume an attitude that is required to overlook its improbable components that threaten the truths and logics in question, the coherence of the narrative work at issue.

SUSPENDING VIRTUAL DISBELIEF
Gordon Calleja suggests that suspension of disbelief is needed more when the audience is limited to “interpreting what we are given by the writer of a text or a film’s script than in digital games, where belief (if the term still applies at all) is created through action, movement, navigation, communication and other forms of interaction” [3]. The augmented credibility of digital games, however, only concerns the sensation of inhabiting the story world. From a poetic-narrative perspective, game realities actually ask players for an additional belief: belief in simulated behaviors, that is, suspension of virtual disbelief.

REFERENCES
With the Hands in the Past: a tangible cooking game

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ABSTRACT
This paper introduces With the hands in the past, a tangible cooking video game that uses Palla, an innovative input device, to ensure good playability and achieve fun- and learning-related goals.

Author Keywords
Cooking game; Input device; 4-DOF sensing; Tangible User Interface;

ACM Classification Keywords
H.5.2. Information Interfaces and Presentation: User Interfaces

General Terms
Design.

INTRODUCTION
With the hands in the past is a cooking game that allows players to simulate the preparation of dough recipes which our grandmothers once traditionally made by hand: for example, pasta, bread, pizza and sweet dough, such as short dough. The title of the game in fact suggests a culinary trip to the past; moreover, the sound of the word “past” recalls “pasta” and “impasto” (the Italian word for “dough”), which are among the subjects of this game. The goal is to teach players how to prepare these traditional recipes, thus also contributing to preserve gastronomic cultural heritage and educating to a healthy and genuine diet. Moreover, since With the hands in the past is a game, it primarily aims to provide a fun and engaging experience.

Users interact with this game through Palla [4], a spherical input device that is used in this context as part of a Tangible User Interface (TUI) and that represents the main technological innovation in the designed game.

PALLA
Palla is a prototype input device consisting of a spherical rigid plastic case which contains a control unit (Arduino Duemilanove¹) and various sensors and actuators such as a gyroscope, a barometer, a magnetometer, an accelerometer, a light Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. sensor, an RGB LED and a small vibration motor. These components make Palla able to: 1) detect motion with 4 Degrees of Freedom, which are yaw, pitch, roll and elevation; 2) intercept the proximity of users’ hands to its surface; 3) recognize single and double taps on its surface; 4) send optical and tactile feedback; 5) understand when it is moved in the air (however, it cannot measure the distance traveled precisely). Palla does not require any type of external tracker for detecting its orientation and position, or any other detectable event. Communication with the host computer happens wirelessly by means of a Bluetooth module.

In our game, Palla is used mainly as part of a Tangible User Interface: its spherical shape allows Palla to embody multiple digital information from time to time; for example, it stands for both cookware and food. Users can interact with the digital information embodied by Palla by physically manipulating Palla itself, exploiting their perceptual-motor skills. We expect that user enjoyment can be increased as a consequence of their sensory involvement in interaction [2].

WITH THE HANDS IN THE PAST
The game setup is constituted by Palla, by a display that shows scenarios and activities that simulate the various culinary preparations, and by a horizontal plane, placed below the screen, which allows players to move Palla and ideally reproduces the table or worktop which can be found in any kitchen.

At the beginning of any game session, a menu of possible recipes is provided. Players choose the recipe to prepare, rotating Palla and touching its surface to select an option (in this case, Palla is used as a remote controller). After that players have read the ingredients of the selected recipe, a countdown begins and the proper game starts. Each recipe is divided into several steps and each step can consist of one or more actions. Players must use Palla to mimic the actions required by the game and thus to complete the preparation of the selected recipe. The game display is divided into three areas (see Figure 1): the left area shows all the preparation steps, with the current one highlighted.

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¹ http://arduino.cc/en/Main/arduinoBoardDuemilanove
The current preparation step also appears in the top area, while the main area shows tools and products used in food preparation and graphically reproduces the movements users perform with Palla by means of virtual animations. The central area is also characterized by other elements: written tips that suggest players what actions to do, a timer that indicates the time available to complete the current action, evaluative feedback that assesses players’ ability at the end of each action, and help videos. The latter show the correct movements to perform each game action with Palla. Each video can come in two formats: the first is small and does not prevent user interaction, while the second is larger and interrupts the game for the few seconds needed for its visualization. The time taken to complete a recipe and the evaluative feedback are used to give a score to each player, so that a ranking can be established for each recipe and users can compete to lead it. According to [1], in fact, competition can make user experience more fun.

Figure 1. The screen of the game.

In order to assure players the necessary awareness and control to manage the interaction, a virtual animation is activated whenever they move Palla in a detectable way. In case the movement is incorrect, the proposed animation will show a gesture that will not allow to proceed with the recipe, thus giving a realistic profile to the game. Incorrect movements can also be indicated by a vibration of the small motor. Similarly, missing actions can trigger corresponding animations. For example, in the preparation of Gnocchi, step 1 Boil the potatoes includes the action Put some water in the pot (see Figure 1): players must turn Palla clockwise to turn the tap on, but if they do not remember to turn the tap off the water will continue to come out until it pours out of the pot. However, errors do not preclude the realization of a recipe. When the time for an action has expired, evaluative feedback is provided and the game can proceed to the next action or step. Obviously the use of Palla in ways that are not detectable does not trigger any specific animation, but only the appearance of help videos.

All the input capabilities of Palla are exploited within the game: some actions require to hold Palla in an hand and turn and tilt it with respect to the three axes, or to move it vertically; others require to roll it on the worktop to mimic dough kneading. Still other actions require the surface of Palla to be touched, using either one’s hands or the worktop, for example to simulate the action of breaking an egg. Finally, players can cover Palla with their hands so as to stimulate the light sensor, for example to peel potatoes. Since Palla represents both food and kitchenware, it can change its color (thanks to RGB LEDs) to help players to correctly associate it to digital information. For example a white Palla is associated with flour, a yellow Palla with egg pasta and a gray one with knives and forks. In this way, players can easily understand which “objects” are embodied by Palla, and which actions to do.

RELATED WORK
Palla is used as a TUI in the context of this game. Most TUIs, such as the Urp [3], separate the elements that can be grasped by users from the technological components that complete the tangible interface. On the contrary, Palla is an active object that can be manipulated and at the same time communicate digital information independently from external devices. As far as cooking is concerned, the best known commercial game is probably Cooking Mama, developed for the Nintendo platforms, especially for the Wii. The main differences with respect to our application depend on the controller: Wiimote can realistically represent most kitchenware and it can be moved in space in all directions. On the contrary, Palla can roll on a plane and then simulate the movements performed to knead and stretch dough; moreover, its spherical shape makes Palla closer to food and to elements such as gas knobs and water taps.

DEVELOPMENT STATUS AND DISCUSSIONS
In this paper, we presented With the hands in the past, a tangible cooking game. Up to now, we have designed and paper prototyped each possible step in the game. We also performed a preliminary user evaluation with 10 participants to check whether the gestures we expected players to make were natural and intuitive, and corrected the game design based on our findings. As future steps, we are planning to implement a subset of the designed game to assess its overall playability and acceptability.

We envisage that the here presented game could be hosted by wine and food exhibitions to provide a recreational space where people can have fun and be together, but also learn how to cook traditional dishes. First-hand simulation of recipe preparation is expected to facilitate learning, so that users can recreate recipes at home. Due to its educational component, the game could also be used in food-related museums and possibly at school.
REFERENCES


Blackout: Proposal for a Game about Accessibility Awareness

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ABSTRACT
Action games where avoiding objects is one of the main challenges for the user are common and include some very well-known classics. However, most of them rely on visual stimuli. “Blackout”, the game that we propose also deals with this kind of interaction, however it differs from most of its predecessors in that it has a strong auditory component and only allows partial vision of the environment, thus involving multisensory alertness and a high degree of mystery. Through this, we try to convey a sense of fear and the kind of impotence that a person whose vision is impaired temporarily or permanently might feel when being confronted with a potentially very dangerous and life threatening situation. Our aim is thus, to alert our potential user’s (children from 7 to 14 years old without severe hearing or visual impairments) in a fun way about the importance of accessibility awareness.

Author Keywords
Game design; sound design; accessibility awareness; road safety education

ACM Classification Keywords
K.8 PERSONAL COMPUTING  
K.8.0 Games  
K.8.m Miscellaneous

General Terms
Design, Experimentation

INTRODUCTION
Action games where avoiding objects is one of the main challenges for the user are common and include some very well-known classics. However, most of them rely on visual stimuli. The game that we propose also deals with this kind of interaction, however it differs from most of its predecessors in that it has a strong auditory component and only allows partial vision of the environment, thus involving multisensory alertness and a high degree of mystery. In this it relates to the subgenre called “survival horror” [1]. Although darkness is not a necessary element in this category of games, there are examples (e.g. the Silent Hill [2] series or Alone in the Dark [3]) where it plays a protagonist role. Blackout the game that we propose differs from the previously mentioned examples in its goals: the game aims to convey a sense of fear and the kind of impotence that a person whose vision is impaired temporarily or permanently might feel when being confronted with a potentially very dangerous and life threatening situation. Our intention through this is to trigger accessibility awareness as well as empathy for the people with disabilities, and more specifically, the visually impaired.

Our potential users are children from 8 to 14 years old without severe hearing or visual impairments.

OVERVIEW
Story Synopsis:
The player has been robbed and is chasing the burglar across a street with several bike, car and tram lanes and vehicles circulating in different directions. The environment is completely dark and cars don’t use light because of an energy crisis. Therefore this chase happens in almost total darkness thus being very dangerous for the player’s character.

Genre
The game is an action game since it requires the player to utilize quick reflexes, accuracy, and timing to overcome obstacles.

Typical user profile
The target players are adventurous and like to be challenged in dark, maze-like environments, and react to unexpected enemies (cars, thief) and situations (traffic). They should like to solve the proposed problem even in limited conditions like lacking health, light or speed in the virtual world. They should not feel too uncomfortable in an environment filled with street and traffic ambience sound.
Premise
There’s a general blackout and not even cars use lights. You have been robbed and lost your night-vision glasses along the way. All you have is a flashlight. You must run after the burglar almost blindly across a very busy street before his accomplices pick him up.

Player motivation
The player will relate himself to the main character in the game (avatar), and therefore he will want to retrieve his belongings as soon as possible. To explore the surrounding environment, the player mostly depends on his sense of hearing and one flashlight. The player will be driven by the empathy with the main character, the anger of losing his treasures and curiosity of exploring in the dark.

Target Platform and Hardware Requirements
The game will be initially created for being played in a PC with either Windows or Mac OS as long as it’s provided with a keyboard, a sound card, an audio output device and a graphic card capable of displaying graphics with enough accuracy and speed. The game will not be very resource consuming and therefore an average PC configuration is expected to work. In the future mobile and multiplayer versions of the game would also be developed so that the game can be played through networked devices.

GAME AND INTERACTION TECHNIQUES

Backstory
(As explained in the introductory game screens)
Because of the great energy crisis in year 2020 streets are completely dark and cars circulate without lights. Cars have sensors to obey signs and avoid each other but can’t avoid living creatures. Pedestrians must therefore use night vision devices and zebra crossings. Your night vision glasses have been stolen by a pickpocket as well as your wallet and personal belongings. He is hiding in the dark and mocking you from the other side of a very busy street. You must use a tiny flashlight to cross as soon as you can and get your things back. He dropped the glasses in the middle of the street, so if you’re lucky you might find them. Let’s hope they still work. You have 2 minutes left before the pickpocket’s buddies come to his aid.

Character and descriptions:
The only “living” characters or characters representing living beings are the user, represented by a small cartoonish round guy seen from the side (Figure 2), and the burglar who will be represented by a similar character with a hat.

Concept Art
The main action that the user’s avatar will perform is walking. When he is run over, his tongue will appear out and his eyes will turn into a cross. In terms of personality, the game is too short to develop it in detail, but in terms of behavior the burglar will be mocking and teasing the user all the time while the user will just make sounds reflecting anger, fear, surprise or relief depending on the situation.

Art and audio features
The game will have a cartoonish appearance. Graphics will be depicted in color. However, most of the space will be in darkness all through the game. The framing will be a still bird view. The graphics will be two dimensional. Audio will be a protagonist in this game where the lack of visual information should be complemented by auditory information. Panning and changes in volume will be used as strategies to convey distance, speed and directionality.

Gameplay

Scenery:
A very busy street composed by bike lanes, car lanes and tram rails going from east to west or vice versa. The street is dark and cars don’t use lights. Sound is what mainly fills the space. (Figure 1)

Characters:
An almost bold, generic guy representing the desperate user and a mocking character representing the burglar.
Challenge:
To cross the street and capture the burglar without any visual aid other than a small flashlight, and to do so within the given time and without being killed by traffic.

Dangers:
Vehicles are always circulating and don’t stop to let pedestrians pass unless there is a traffic light or a zebra crossing. The user can easily get run over by them.

The threats are:
- Bicycles and scooters for bicycle road, cars and trucks for highway, trams for tram tracks. If hit by a bike player loses 10% of his life, if hit by a car 30% and if hit by a tram 100%.

Helping elements:
- Zebra crossings: they are safe crossing areas, however, they constantly change place.
- Flashlight: Lights a small area around the user
- Glasses: Light the scene for a short time (5 sec.)

Interaction:
- User moves/navigates the space by pressing the 4 arrows in the keyboard. The mouse is used to change the direction of the flashlight’s beam and to click over helping elements.

Tasks
- Move in space (with keyboard arrows)
- Avoid traffic (by listening to sound alerts and looking for information under the flashlight’s beam)
- Chasing and stepping on zebra crossings to safely cross the street.
- Finding and collecting helping objects (by flashing the beam on them, moving the avatar towards them and clicking on them)
- Activating helping objects (by clicking on them when necessary)
- Recovering wallet (by reaching towards the burglar and clicking on him)

CONCLUSION
Raising awareness about disability, accessibility, and social inclusion is one of the concerns of contemporary education. However, children tend not to be easily interested in this subject and they may even be prone to bullying their disabled peers. We think that playing is a good way to teach and it is one that children don’t oppose for it “talks their language”. With this in mind we present “Blackout”.

“Blackout” challenges the player to defend him/herself against an attack thus placing him or her in an interesting critical situation. It doesn’t unveil the environment at first sight so the user’s curiosity is triggered. In this way, we believe that “Blackout” will be successful in attracting our targeted audience. The game includes action, and calls for different skills including speed, strategy, and wit as well as luck and knowledge of the rules therefore it should be able to keep the players involved. Proficiency in this game is reachable, but winning at the first try is almost impossible, therefore, facilitating recurrence of players and therefore a good chance to deliver the intended message in a seamless thus effective way.

NOTE
“Blackout” is in its initial developing stages and exist now as a demo which shows the most important features. The technology of the current version is html 5.

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ABSTRACT
Affective game experiences can be created through exploiting the use of social norms and the emotional responses people have to crossing social norm boundaries themselves and seeing others do it. This paper describes a rapidly prototyped puzzle game that uses “kissing ass” or fake flattery in an office environment as its premise.

Author Keywords
Affective Gaming; Game Design, Puzzle, Storytelling, Humour

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. H.5.2. User Interfaces: Prototyping. K.8.0. Personal Computing: General ---Games

General Terms
Human Factors; Design;

INTRODUCTION
Affective experiences can be designed through the use of social norms. Societies and cultures create guidelines, or social norms, to define what they find acceptable and what they do not. People raised in a particular culture can have a strong emotional reaction when those social norms are broken or boundaries are crossed[1]. Dogs and cats are considered vermin in a number of Asian cultures, and thus the idea of keeping one of them as a pet inside one’s home seems repulsive. In Western Europe and particularly in North America there is a strong cultural believe that in the workplace you should climb the corporate ladder through hard work and the fruits of your labour alone. However, everyone knows that this is not always the case and that people step outside the bounds and use all forms of fake flattery. Stepping into a taboo area such as this one is the basis for our game.

GAME PREMISE
The premise of the game playfully revolves around kissing ass (flattery) and people’s emotional reactions to when people use it successfully (or not). It is an engaging puzzle game, wrapped in an environment that our target player base can identify with: the working environment. In addition to the challenges of solving puzzles that involve social relationships, players will follow the funny lives of the game characters and get to know their background stories and quirks.

TARGET GROUP AND ITS MOTIVATION
The main target group of the game is office workers, early in their career, who own a smartphone and perhaps travel to work by public transport (playing the game while on the move).

Humour can relieve stress [2]. Players can identify themselves with the KissAss game, and its humour, because of the dramatization of a common phenomenon. We know someone who has done it and we have done it ourselves. It reminds us of our humanity within the context of familiar social norms.

GAMEPLAY
The player starts the game as a new employee at a company where it is common practice to flatter people to get things done. The user is introduced to the game by a short text that is told from the perspective of the company secretary (See Figure 1). She gives players the first scenario (puzzle) to solve. Players then have to move their own character around in the game to speak to people. The other characters respond with a joke or a clue to solve the puzzle. When players think they have found the correct person to flatter (kiss ass of), they have only one action to take: press the kiss ass button and receive feedback: win this level, or lose and restart.

DISCUSSION
Exploring using social norms for affective gaming can be done quickly. The KissAss game was rapidly prototyped in HTML5. To enhance the comedic nature of the game we added light music and recorded quirky character mood utterances.

A couple of user tests were run, and the results indicate that the puzzles were quite hard for some users to solve. The game play was quickly adjusted, by adding a bit of staging, and adding story feedback when you win or lose. Currently, the game allows players to repeat the puzzle till they figure
it out. As part of future work, limiting the number of tries by adding “lives” and adding a scoring system will be explored.

Using social norms in the comedic fashion, as in the KissAss game, readily allows players the guilty pleasure of crossing the social norm boundary without serious consequence, and thus can help relieve stress. However it is a guilty pleasure, and thus there are opportunities to use the emotion of shame through reminders of their actions and the implications in real life. Allowing users to create their own scenarios and simulate their real life could lead to many different implications. All of which would definitely effect the emotions of players! Further work would include validating the affective gaming potential in using social norms.

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Tree: A multimodal system to stimulate children to save energy and water.

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ABSTRACT
The present report introduces a design concept that aims to increase environmental awareness among children of the age 8-12. The proposed system involves a virtual pet that projects the energy consumption behavior of the children.

Author Keywords  
Energy, consumption, motivating, interaction, children

ACM Classification Keywords  
H.5 User interfaces; K.3 Computers and Education; K.8 Personal Computing; J.9 Mobile Applications.

INTRODUCTION
The waste of our valuable resources is a known societal problem. Although the consequences of the wasting of water and electricity are clear for adults, children are often unaware of the impact of energy and water wasting.

The proposed system aims to establish awareness regarding eco-friendly behavior among children between the ages of 8 and 12. The system design employs different perceptual modalities to engage young children in an educative and playful exploration that eventually leads to a more eco-friendly. Recent literature describes several examples of systems that provide insight in energy consumption. [1] describe the ‘Power-Aware-Cord’ that displays electricity consumption of electric appliances by visualizing the flow of electricity in the power cord. Another study indicates that visualizing the use of energy by using graphs and numerical data, has a small positive effect on energy consumption [2]. Both of the studies focus on adult energy consumers, whereas it is equally important to educate children on that matter.

INITIAL IDEA
To engage children, the system has to be integrated into in their perceptual world. To compensate for the communicative capabilities of young children, the system should accommodate a natural interaction on the appropriate level. By designing a multimodal system, we aim to fulfill the interaction requirements of young users [3].

The multimodal system that was designed can roughly be divided into two parts. First, every user owns a virtual dog. The dog ‘lives’, for example, on the wall of his or her bedroom (Figure 1).

Figure 1. The virtual pet environment.
Just as with a real-life pet, the user has to take care of the virtual pet by feeding and caressing it. It is likely that the child will get emotionally attached to the virtual pet [4], and will therefore feel the urge of pampering and caretaking. Proper care, results in better physical and mental health of the virtual dog. One of the system features is that the amount of available food depends on the child’s consumption of water and electricity, in that way, we intend to promote the second part consists of a dedicated device that allows users to keep track of the consumption of resources in real time (Figure 2). Instead of showing the actual amount of water that they use or the money that they have wasted, the resource usage is translated to the resources that are available for the dog.

**Figure 2. The device showing the remaining resources.**

The pet’s behavior reflects the child’s consumption behavior. Research has shown that rewarding good behavior works best for children from 8 to 12 years old than punishing bad behavior [5], and hence the system is designed in such way. The system rewards children whenever they manage to keep their virtual pet in optimal condition by unlocking special interaction features.

**Interaction with the system**

For practical reasons, user-system interaction will mainly occur around bedtime; at the end of the day, the system has a clear view of the energy and water consumption of the user. Besides this practical issue, it was considered important to limit the amount of time the children interact with the system in order to ensure that the interaction with the virtual pet will maintain a rewarding role. The user-system interaction is spread over multiple modalities. Just as with a real dog, users can interact with it by using speech. Then, the interactive wall itself is a multi-touch interface. It allows users to caress the dog and play with it and feed it.

**Food**

Users can feed their pet using four types of food: water, dog-food, meat or bones. In the designed system, we linked every type of food to one particular energy-consuming source. The amount of water available to feed the dog is dependent on the amount of water that the child has used throughout the day. The more water has been used, the lower the amount of water is available to give to the dog. The dog-food that the user can use to feed the dog is less when the electricity consumption is high. The number of bones are computer-specific and will be greater when the user has not used the computer much throughout the day.

**Rewards**

To stimulate children to use less energy, the system rewards users when their dog is very healthy. Since the users will interact with the dog before going to bed, this is the moment they will receive their reward. The reward can consist of the virtual pet performing a magic trick, reading a story to the child or the system playing some music to which the child and dog can dance together. If the child is rewarded, an icon representing this reward appears in the reward-section on the wall. By touching the icon, the user activates the reward. The rewards will only take a few minutes and can therefore be considered a substitute of a bedtime story.

**EVALUATION**

The evaluation of our initial idea consisted of two parts. An expert in social behavior research for robot and robotic toys design of children was consulted to review our design in order to gain insights in how effective our system would be. For the second part of the evaluation, we invited a potential user to comment on our idea. With this session, we intended to get more insight regarding the visual language, usability and user’s motivation for use. One semi-structured interview was conducted with a boy aged 10 years. A simple paper prototype that visualized the user interface was used to introduce the initial idea to the participant.

**Expert evaluation results**

The concept was expected to be a useful way to establish awareness and motivate energy-saving behavior among children. The metaphor of the pet is likely to increase the effectiveness of the system since children will easily become attached to it and will cherish it as if it is their real pet. Moreover, the implementation of social behavior would promote a feeling of competition between the different users since they will compare the different pets and the way they raise their virtual pet. Competition is considered a great mechanism for motivation and will increase the likelihood of continuous usage of the system.

Regarding the target age-group, the expert suggested children between the age of 6 and 10 years old. Initially, we aimed for children till 12 years old, but the expert explained that older children are more likely to misuse the system (for example by making the dog starve instead of taking care for it). The portable dedicated device was not considered to be very attractive to the children. A suggestion was to make
the projection of the pet mobile, so that it can be used in different rooms within the home. To make the children more aware of their energy consumption, the animal could be projected on the products that consume most energy. The visualization of the interface should be improved to simplify the mental model of system usage by using simple icons to convey the status of the system.

The expert mentioned that the system could be seen as a platform for parent-children communication. It encourages parent involvement and the parents can play an active role in explaining the system to the kids. This might contribute to the extend to which children can link the virtual pet to the real world which will increase their motivation to take good care for it and thus being more eco-friendly.

User evaluation results
The participant preferred a natural way of interacting with his pet like using gestures or by speaking to him, for instance to “throw a stick and play with a ball” like one would do with a physical dog. While asking for feedback on sharing the portable application, most focus was on sharing the results with friends over parents. The user responded “It would be funny to show that you have this at home”. Moreover, several ideas were given indicating the importance of sharing the experience associated with the application, like “you can let the dogs run together”.

The participant had more difficulties when he was asked to come up with possible rewards when the energy saving goal was met. Although he was able to come with some examples of things he would like to do with his virtual dog, such as playing a board game and dancing we believe that the difficulty of giving suggestions regarding the rewards relates to the low fidelity of the prototype we introduced. Last, several symbols proved not to be logical to the participant. Mapping different types of food to particular energy-consuming products in the home was difficult.

IMPLEMENTATION
Using the insights gained during the evaluations, the design was improved during a second iteration. The final version of the concept of two parts: a dedicated bracelet and a docking station. The bracelet allows for very simple interaction with their virtual pet and is a tool for social interactions and sharing between users. The docking station can be placed in the bedroom of the user at home and can be used for richer interaction with the virtual pet. This section will explain the bracelet and the docking station into depth.

Bracelet
The bracelet is a portable device that helps children to monitor the usage of water and electricity at home (figure 3). It is connected to sensors that are installed on the meters in the house and exchanges information with the meters online. The bracelet reflects the amount of resources that are consumed by the whole family. The functions of the bracelet can be divided into three different categories: checking the mood and needs of the pet, interacting with the pet and sharing and interacting with friends. Below all three different categories are described

Figure 3. The bracelet

Checking the mood and needs of the pet
The first and foremost function is to provide children with the information of water and electricity usage. In order to make it more playful, these metrics are expressed through the pet’s physical condition and mood. Thus, the pet would have different behavior according to the energy usage in the house.

Taking the number of family members into account, the parents can set the limits for water and electricity consumption. If the use of water and electricity is low, the pet is extremely happy and runs around the bracelet, waving its tail. If the usage of electricity and water are close to the limits that were set up by parents, the pet is be calm and stays still. In the worst case, if the consumption is over the set limit, the pet will lie down, have a sad expression and make sound of complaint when the child tries to interact with it.

The child can always see on the bracelet two bowls with the amount of food and water for the pet. The bowls are animated dynamically and represent the amount of electricity and water in real-time. The more electricity is used, the less food the pet has and the same goes for the bowl containing water. If the child uses too much electricity, the amount of food will decrease and as soon as some of the electrical devices are turned off, the amount of food will start increasing. As an extra notice, the bracelet will change its color to orange whenever the consumption of resources exceeds the determined limits. The pet will react to this by moving to the empty bowl that represents particular resource and tries to draw the child’s attention.

Interacting with the pet
At all times, a ball is represented on the bracelet. The ball is gray and active until the user touches it. When ball is touched, the user can swipe to ‘throw’ the ball and play with the pet. However, the pet reacts differently to the initiated play depending on its mood and physical condition. This means that the extensive use of resources
would result in the reluctance of the pet to play with the user.

Sharing and interacting with friends

Competition can be a way to motivate children to save more energy and water. Therefore, the bracelet also allows to interact with friends who also own a virtual pet and compete with them. The bracelet contains Bluetooth technology that enables connection to other bracelets. Depending on the physical state of the pet an interaction between different pets can occur. If two bracelets are close to each other, the pets start making sounds, for example barking, to notify the users that they want to play or compete with each other. The pet in the worst condition will ‘jump’ to the bracelet of the strongest one and the owner can interact with both of them. After a certain amount of time the pets will ‘jump’ back to their own bracelets.

Docking station

A docking station was developed for both charging the bracelet and collecting the rewards that the user earned throughout the day. The docking station will be placed in a room of choice of the user and consists of a charging unit, a PICO-projector, 3D-camera and speakers (figure 4).

Finally, the 3D-camera tracks the movements and location of the user and transforms the projection on the wall into a touch interface. The virtual pet reacts to the user by walking along with him. The touch interface allows users to stroke the projected pet and to drag the earned rewards to the pet. By doing so, the reward is executed and the pet will, for example, sing a song or dance to music. The speakers on the sides of the docking station support the representation and interaction with sounds.

CONCLUSION AND FUTURE WORK

A benchmarking session would reveal more opportunities and challenges for our design and research comparing applications for the different modalities should be performed in order to optimize our design proposal. Furthermore, the needs and the wishes of the young user of the system should be defined by a thorough ethnographic exploration.

The suggested solution has to be validated with experts and potential users. For the user tests an interactive prototype needs to be developed. Letting users experience the concept first-hand within the intended context will result in valuable insight regarding user-system interaction, the functionality and the perception of the system.

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ABSTRACT

Videmus Inc. is a browser game which gives the player the possibility to hack the electronic surveillance system of a firm with his computer, in order to help a young woman avoid all the cameras from the complex where she is being locked up. During his journey, the player will have opportunity to learn more about the identity of Videmus, the mysterious kidnapping firm and the reasons why Lisi is being held in the complex.

The player will have to keep her outside of the cameras fields by observing carefully their behavior from the point of view they offer.

In 2011, the game participated a French student game contest, the "Hits Playtime", and won first prize.

AUTHOR KEYWORDS

Student Game ; Puzzle ; Stealth ; Cameras ; Panoptic

ACM CLASSIFICATION KEYWORDS

K.8.0

GENERAL TERMS

Design

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GAMEPLAY

You can play the game here (Windows only):

http://videmus-inc.com

The gameplay experience is close to the one delivered by a Puzzle-Stealth game.

The player’s view to the world is provided by the multiple surveillance cameras of each room in the complex (up to 4 for one puzzle).

Figure 1. Point of view of the cameras.

Two types of cameras can be found: the first ones, called “cameras of observation” are harmless, and act for the player as fix third-person cameras. The second ones are “cameras of detection”: if, at any time, the avatar is seen through them, a game-over, represented by the electrocution of the character, is triggered, and the player has to re-start the room (there is no “lives” system, the
rooms can be done any number of times needed to get through them).

Figure 2. Two types of cameras (observation, top left, and detection, top right and bottom left).

The player guides the avatar with her mouse and keyboard. The mouse is used to place and remove waypoints on the ground to create a path.

Figure 3. The path.

The spacebar is used to make the character start and stop her way through this path. 3 buttons on the keyboard are linked to the control of the cameras (to go to next and previous camera and show a control panel with all cameras).

Creating the path and making the character walk through it requires the player a meticulous observation of the rooms through the static point of view of the cameras, plus a sense of scheduling and timing to avoid cameras of detection: visual and audio clues have to be found and well analyzed to comprehend the situation and make the girl get out of each room.

LEVEL DESIGN
The game is divided into 4 chapters, each one composed of 4 levels, plus intermediate “narrative rooms”. The game’s length lies between 1 to 2 hours.

Figure 4. A narrative room.

To constantly renew the interest of the player and provide an optimal gaming experience, the progression of the difficulty has been rationalized with several variables, evolving all along the game.

- The movement of the cameras: some cameras offer a fix point of view to the level, and others move (rotation, traveling, zoom, etc.); and the speed of the movement: most of the time, the faster the cameras move, the more the game is difficult.
- The difficulty of spatialization: the identification of the place and movement of the cameras – especially the dangerous ones – is more or less easy, depending on the level.
- The number of synchronizations: the player has to take into account one or more cameras when she creates the path.
- The type of synchronizations: sometimes, the player can stop and rest when dodging multiple cameras. Sometimes she can’t, and time windows are shorter.

Figure 5. This level has 4 synchronizations.

New gameplay elements are also introduced all along the adventure to enrich the experience. For instance, moving Monoliths (killing blocs) are met only during the last
chapter. They are a new threat to the player (touching them is lethal), but also a new tool to obstruct the field of view of dangerous cameras. Another feature, called “the jump”, allows the player to electrocute the character to make her move faster during a short period of time, but with a recovery time.

Nevertheless, in the third part of the game, this relationship begins to evolve. The young woman confesses that she is unable to find the file which was supposed to give her the control of her body back. Strange events begin to disturb the player’s experience: some messages announcing Lisi’s imminent execution pop up on the game screen; the control of Lisi becomes slightly rougher, the player is suddenly sent to a camera filming a previous level for a short moment while visual and audio signs tend to show that something happened during that time...

The gameplay takes fully part in the construction of this ambiguous relationship. There is an asymmetry of information between the player and the young woman, since only the player can identify each level’s obstacles with the help of the cameras. This asymmetry makes the player vital to the young woman.

But as one goes along the experience, the player becomes aware that she is literally playing with this young woman’s body, who’s reduced to the role of a puppet, and that her failures (to place Lisi in the field of an hostile camera) as much as her achievements (downloading data files) drive her to suffering. To the feeling of all-power succeeds an impression of uneasiness or even guilt.

**THE RELATIONSHIP BETWEEN THE PLAYER AND LISI**

The project’s originality lies mainly on the work done on the relationship between the player and the young woman. The player’s nature is never denied: he is not playing an avatar; he is himself helping her, with the help of his own web interface. She can talk to him directly with the help of a text window, but without the possibility of receiving the player’s answers.

At the beginning of the experience, the player adopts the role of a *deus ex machina*, which possesses a right to life and death on the young woman. Several moments of complicity enhance their relationship: for example when Lisi breaks down and the player has no choice but to force her to move.

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**Figure 6. A room with 4 monoliths.**

**Figure 7. Trying to find the exit...**
ABSTRACT
The development of games not only for but also with children is a very challenging topic. The goal of this one-day workshop is to share experiences, best practices, lessons learned and to explore the future potentials on how to guide the involvement and participation of children in the design and development process of serious games. Thereby, we reflect on the pedagogical opportunities as well as challenges in the development of games with and for pupils.

Author Keywords
(Serious) Games, Children, Methods, User Involvement, User-Centered Design, Opportunities, Challenges

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

INTRODUCTION
Children are emerging as a rather frequent and experienced user population [6]. They are more and more becoming primary users of software and technology (also beyond entertainment products). They encounter and use software technologies in their daily lives, such as cellular phones to communicate, computer games for individual or collaborative entertainment, and educational technologies for learning [1].

The game industry has been expanding exponentially in the past decades, mainly by making games more appealing to a wider audience. Initially, computer games were designed for the mass market, relegated solely to informal environments with few educational connections. However, there is a rapidly growing new generation of games, built specifically for use in the classroom, namely educational serious games. They are typically problem-based with the focus on learning first and provide enjoyment, pleasure, motivation, gratification and emotion, in order to achieve learner engagement and involvement. Game-based learning (GBL) motivates the combination of games with curricular goals and content [8], similar to the goal of the serious educational games (SEGs). They aim at connecting real-world scenarios with school content, in order to allow pupils to find out why the school content matters in the real world [1].

Apart from the kind of game to be developed, there is still a lack of profound knowledge of how to involve children in the different stages of the game development, in particular in the early phases of conceptual design and evaluation afterwards. Garzotto [2] performed a case study with 10 to 11 years old children in the educational domain, concluding that besides the traditional roles as users (e.g., [7]), testers (e.g., [4]) and informants (e.g., [9]), children can also act as design partners (e.g., [3]). Hong et al. [5] explored the development of games as a pedagogical activity. They state that in order to promote the effectiveness of the games development, pupils should be actively engaged in the meaningful activities of computer programming, game design, game development, and individual cultural identity integration. Additionally, the creation of games allows them to develop their learning skills by solving problems that result in meaningful learning experiences. In order to work with pupils it is necessary for the researchers and game developers to try to enter the children’s worlds of understanding and for the pupils it is important to get familiar with them.

TOPICS OF INTEREST
This one-day workshop brings together not only researchers from a wide spectrum of disciplines and research communities (HCI, interaction and user interface design, game development, educational sciences), who share a common interest in understanding the opportunities and challenges to get children involved in development or evaluation processes, but also game industry and education. This workshop addresses the following topics, but is not limited to:
• Opportunities and challenges of the educational domain, considering pedagogical constraints and potentials (intra and extra curricular activities) for the design of games, especially of serious games;
• Benefits and methodological challenges to get children involved as informants, designers and evaluators in an intergenerational design team (e.g., as part of the school subjects in school for the development of serious games);
• Lessons learned from methods or approaches that involved children successfully in the development process of games; Lessons learned about the development of games for children;
• Exploration of future and advanced interaction concepts for games (e.g., physical play with digital technologies, pervasive technologies), which are adapted to the children’s needs and preferences;

The goal of the workshop is to share experiences, best practices but also challenges on the above topics of interests as well as to explore future potentials on how to guide the development process of games (e.g., through the involvement and participation of children) during break-out sessions. In the wrapping up of the workshop highlights are be collected on a poster to be displayed and explained during the poster presentation session.

ORANGIZERS’ BACKGROUND

Christiane Moser is a research fellow at the HCI & Usability Unit of the ICT&S Center. She is currently working on her dissertation in the area of Child-Computer Interaction, on the topic of child-centered game development. In the HCI & Usability Unit of the ICT&S Center she is working in the Games4School Project (a national project in cooperation with a secondary school), in the AIR Project (Advanced Interface Research) and in the field of Ambient Assisted Living.

Verena Fuchsberger is a research fellow at the HCI & Usability Unit of the ICT&S Center. She is currently working on her dissertation in the area of Ambient Assisted Living and is finishing her study of Psychology at the University of Innsbruck. Currently she is working in the field of Ambient Assisted Living and in Games4School.

Ivana Randelshofer just started to work in the HCI & Usability Unit of the ICT&S Center and is be involved in the AIR Project (Advanced Interface Research).

Manfred Tscheligi is full professor for HCI & Usability at the ICT&S Center of the University of Salzburg and is directing CURE (Center for Usability Research & Engineering) in Vienna. In Salzburg he initiated and is directing the Christian Doppler Laboratory on Contextual Interfaces with the topic on contextual user experience.

Jörg Hofstätter is founder and managing partner of ovos GmbH at Vienna, Austria. He is responsible for Business Development and Creative Direction for both online projects and games. Currently he is involved in the development and evaluation of a physics educational game.

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The Scaffolding Mechanism in Serious Games

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ABSTRACT
This paper discusses the notion of scaffolding as it relates to serious games and presents a scaffolding mechanism to aid developers of serious games. Scaffolding is based on the Vygotzian Zone of Proximal Development (ZPD) concept which refers to the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers. The scaffolds can be designed to either be embedded in the game or detached from the game. The serious game scaffolding mechanism assists the player-learner in attaining the learning and game objectives. The elements of scaffolding in the current use of the scaffolding construct in serious game and their application are uncovered in this paper. A conceptual model of scaffolding elements, exploring the relationship between individual scaffolding elements is proposed. Emphasis is laid on adventure games, as research reveals these to be the most widely played among children.

Author Keywords
Serious Games, Children, Instructional design, Scaffolding, Frameworks

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
A serious game is a term that has evolved to describe the use of games in education, training, health, and public policy. Serious games do more than add window-dressing or fun to an otherwise serious (and potentially dull) learning task. They recast a learning task into one that is game-like and fundamentally alters the experience of the learner. [1].

In recent times, the notion of scaffolding has been an issue of debate. Its role in the serious game learning process cannot be overemphasized. Originally, scaffolding described interactions between a parent and a child or between a tutor and a student.

The adult (parent, tutor) provided just enough support based on the progress made by the child on an ongoing basis [2]. Scaffolding is no longer restricted to interactions between individuals - artefacts, resources, and environments themselves are now also being used as scaffolds [2]. Scaffolds develop learners’ Zone of Proximal Development (ZPD) [3]. Vygotsky defined ZPD as the difference between a child’s actual and potential levels of development [i.e., what a child can do alone and with the assistance of an expert/computer agent] [3]. Regarding the learning process, providing guidance to students has been necessary to enhance their learning experience. In that sense, scaffolding techniques are often needed to help students succeed in their learning and to achieve the expected learning outcomes. [4]

Specifically, this paper focuses on the implementation of key elements of scaffolding in serious games. The next section covers the techniques and elements of scaffolding. This is followed by the proposed Cognitive Serious Game Scaffolding Model.

THE TECHNIQUES AND ELEMENTS OF SCAFFOLDING
The effective application of scaffolding elements in serious games should challenge the children when they are correct, explain their missteps when they are wrong, and provide prompts and supplementary information if children have difficulty following the task [5].

Based on research by Melero et al. [4] the techniques of scaffolding include Social-guidance and System-guidance scaffolding, depending on whether an individual or a tool is responsible for providing support to students; macro-scaffolding and micro-scaffolding define activity flow and render the support needed to perform specific activities respectively; tool-enveloped scaffolding - when a tool is used as part of a scaffolding learning process and tool-embedded scaffolding – when the scaffolding is applied within a specific supporting tool.

Of interest in this paper are the macro-scaffolding and micro-scaffolding techniques. This is because effective scaffolding requires clearly articulated goals and learning activities that are structured to enable learners to extend their existing levels of understanding [15].
scaffolding (micro-level scaffolding) refers to support provided at a micro level of interaction (at a task level) [15] while macro scaffolding is the activity flow resulting from the synchronization of the tasks aimed at the learning objective. The scaffolding elements associated with these techniques include formative feedback and hints (for micro-scaffolding) and summary feedback and debriefing (for macro-scaffolding). These are further explained in the following:

**Feedback:** From an educational perspective, feedback provides an opportunity to support children's learning of unfamiliar educational content by “scaffolding” them into successfully solving a problem. To scaffold children's performance and learning, feedback for each wrong answer should be designed to provide a bit of additional support for children as they continue to try to figure out the solution [5]. Good feedback can significantly improve learning processes and outcomes if delivered correctly [6]. There are two distinct types of feedback, the task-level feedback and general summary feedback which are often referred to as the formative and summary feedback respectively.

**Formative Feedback:** This typically provides more specific and timely (often real-time) information to the student about a particular response to a problem or task compared to summary feedback, and it may additionally take into account the student’s current understanding and ability level [6].

**Summary Feedback:** In order to produce feedback that is relevant and informative teachers themselves need good data about how students are progressing [7]. The summary feedback is useful for teachers to modify instruction for the whole class and for students to see how they are generally progressing [6].

**Hints:** Hints like automatic feedback, should support both game-play and children’s learning of underlying educational content; rather than simply revealing the solution, they should lead children in the right direction to help them discover the solution for themselves [5]. Hints should be leveled – that is when children ask for a second or third hint; the hint should be bigger than the first one they required (because, presumably, requests for additional hints signal that the children are more stuck) [5].

**Debriefing:** This is the role played by the teacher in reviewing and reflecting on the data from the summary feedback in order to take action towards closing up the students’ learning gap [7]. Debriefing is a fundamental link between game experiences and learning [8]. Debriefing may include a description of events that occurred in the game, analysis of why they occurred, and the discussion of mistakes and corrective actions [8].

**THE SERIOUS GAME SCAFFOLDING MODEL**

Any scaffolding model must take into account the process of bridging the gap between the child’s initial competence level and target competence level. More importantly in serious games, teachers should be able to monitor the player-learner’s game progress, in order to take action towards closing this gap.

Figure 1 presents a conceptual model of the scaffolding mechanism in serious games that synthesizes current thinking by researchers into this topic [8][9][10].

![Figure 1. The Serious Game Scaffolding Model](image)

In the model, learner profiling (in the context of use) is the starting point for the scaffolding cycle. This is important because the learner’s initial competence in relation to the required competence is vital to the determination of the level of guidance required by the learner. This guidance is given through the game-play and coaching. The learner also requires an identity prior to an immersion into the game fantasy onto which the instructional content has been embedded. This instructional content is embedded based on suitable pedagogical principles. Researches in pedagogical approaches with regards to video games reveal that well-designed video games adhere to the constructivist principle [11]. Constructivism, which has its root in the ideas of Jean Piaget, takes the point of view that individuals actively construct the knowledge they possess [11]. The focus is on knowledge construction rather than knowledge transmission. The ability of serious games to assist in knowledge construction lies in its potential to modify the learner’s existing mental model thus altering the experience of the learner in incorporating the experience in the game world. Active learning is a part of the constructivism principle. Active learning assumes that meaningful learning occurs when learners engage in active cognitive processing, which includes attention to incoming words and images, mentally integrating them with prior knowledge [12].

With the player-learner having acquired an identity and immersed in game-play, they look out for hints that could lead them to finding answers they need in order to conquer the game. These hints should support the learning of underlying educational content [5]. There is also the feedback which provides an assessment of progress toward
goals that drives the motivated performer (player-learner) to expend more effort, to persist, and to focus attention on the task [8].

Also in the model is debriefing which is an external process of the scaffolding mechanism in serious games. This usually entails the teacher’s feedback response (based on their monitoring and assessment of student performance). Ivanic et al. cited in [7] states this must be internalised by the student before it can influence subsequent action. On re-entry into game-play, the student draws on the knowledge acquired from the debriefing and previous game-play and construct a personal interpretation of the requirements for game progression. The summary feedback shows the student’s game-play performance upon which debriefing is based. This summary feedback is an indication of how close the player is to the game/learning goal.

CONCLUSION

The cognitive framework of the serious game scaffolding mechanism shows the major components that enable effective scaffolding through game-play. All the components in the framework work together to ensure the learning goal is attained while playing the game. We propose this framework for productive serious game design and effective mentoring.

The next stage in this research is to apply the scaffolding mechanism to an adventure game, then evaluate and refine the framework.

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DYSL-X: Design of a game-based tool for early risk detection of dyslexia in preschoolers

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ABSTRACT
The goal of the DYSL-X project is to develop a tool to predict whether a preschooler (5 yrs) shows high risks for developing dyslexia. This tool is a computer game that incorporates tests to take specific performance measures that allow for this prediction. The game will thus serve as an assessment tool to be used in school psychology services and clinical diagnostic and rehabilitation centers. During the first phase of the projects several existing games for preschoolers were evaluated using a ladderling method. Based on the outcomes several minigames were designed. The results of this first phase will be presented at the Fun and Games workshop.

Keywords
Games for preschoolers, Games as an assessment tool, Game Design

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Dyslexia refers to specific problems to acquire reading and spelling skills despite adequate intelligence and instruction. It has a prevalence of 5-10% in the population[9,16]. The first signs of dyslexia are typically observed during the first year of formal reading education (age 7 yrs), but very often the diagnosis is only made at an older age. However, dyslexia is a developmental disorder that should be detected and treated as soon as possible. The younger the age of the child at the start of a therapy, the larger the long term effects. Early risk detection allows for taking preventive measures, which has been proven to be effective, even at preschooler age.

Recent scientific studies by research groups of the KU Leuven did provide us with a better understanding of predictive variables for dyslexia that can be measured, even in a preschool population [2,3,4,5,6]. The aim of DYSL-X is to integrate these predictors in a computer game. The objective of DYSL-X is twofold. First, by using a game, preschoolers will display a higher motivation, a longer attention span, and as a result a more accurate measurement can be taken. Consequently, incorporating these measurements into a game will improve the quality of the tests and result in a more reliable and more valid prediction. Secondly, the DYSL-X game-based application will come with automated measurements and scoring. Therefore, no qualified personnel is needed to administer and score the tests. This allows for the deployment of DYSL-X at a wider scale, increasing the utilization potential.

RATIONALE OF THE PROJECT
Existing dyslexia tests with preschoolers [2,3,4,5,6] already made the user interface more attractive and added animations in order to increase the motivation of the child [4,13]. However, the researchers conducting the tests mentioned that it was still difficult to keep the child’s attention at a high level throughout the test. Therefore, the test results still contained a lot of variability, certainly for threshold values where the ‘best performance’ of the child is to be measured. It was suggested that a higher accuracy can be achieved by finding better ways to motivate the child. One possible way to increase the motivation of the preschooler is by incorporating these tests into a fun, challenging application, such as a computer game.

By offering interactive and immersive audio-visual worlds, game designers realize an environment that rouses a child’s senses and interests and stimulates exploration. But more
importantly, well-designed games tailor to the skills of individual players, by continuously assessing performances and adapting the difficulty of the task. By offering challenges that match the abilities of the players, game designers create a psychological state known as flow [7]. During a flow state, a player loses his sense of self and his sense of time and place. Flow is gratifying in and of itself; it is an intrinsic motivation that keeps a player playing. This characteristic additionally ensures that players deliver their best performances. As aforementioned, best performance measuring is also necessary for increasing the reliability of psycho-acoustic testing. By further adding specific reward schemes, game designers condition the player to exhibit preferred behavior within the game. These characteristic of game-based applications – immersive worlds, flow triggering tasks and rewards – transform repetitive testing into entertaining interactions. They become even more important when designing likeable applications for preschoolers [19,21,24].

Whereas serious games are an interesting approach to captivating the interest and to augmenting the motivation of adults, they might even be more promising to engage the enduring attention of our target group, namely preschoolers. User evaluation and user testing of fun and usability of applications, with preschoolers, has been under the recent scrutiny of several researchers [1,12,14,24]. This research has demonstrated that traditional user tests with preschoolers should last no longer than thirty minutes [12], but that this time can be doubled when testing games [24]. It is therefore a valid assumption that administering ‘boring’ tests via a game will lengthen the attention span of the preschooler. Furthermore, research studies indicate that when testing games with children, directive prompts or assigning clear cut tasks are superfluous. The intrinsic motivation of preschoolers demands less direction and steering from test administers. Therefore, administering tests via game-based applications is likely to augment the reliability and the validity of the test results.

However, creating a good serious game is not straightforward. On the one hand, there is always the threat of sugar coating: a superficial embellishment of what is actually a boring task with a couple of fun animations and a little bit of shallow game play. Good serious game design requires a seamless integration of the external goal and game dynamics. The aim of serious games is ‘stealth learning’ or in the case of DYSL X ‘stealth testing’: the children are unaware of the fact that they are tested, the overall game experience should simply fun. On the other hand, the fun factor should not intrude upon the serious goals.

In the case of DYSL-X, special care should be taken that possible confounding variables such as prior game experience, spatial skills or problem-solving skills do not interfere with the test outcomes and affect the validity of the tests. The test outcomes should only depend on the child’s ability to perform well on the auditory and speech perception tasks.

Therefore, the challenge remains to elicit a rich game play experience while offering a reliable and valid test platform. The DYSL-X project will therefore yield new insights on how to design and to evaluate such game-based assessment tools for this specific target group of young children.

PROJECT OVERVIEW
The first step in the DYSL-X project is to design and implement a game in which the game experience – being motivating and inviting (due to the X-factor) – is aligned with the purpose of the game – measuring the performance on a certain task. To achieve this, we adhere to a participatory design process where all stakeholders are continuously involved in the design process, from the generation of initial ideas until the final user tests. This process is according to the PIII framework, involving 1) player-centered design, 2) iterative development, 3) inter- and multidisciplinary teamwork, and 4) seamless integration of play and learning [18]. The stakeholders of DYSL-X are comprised of the creators of the game, the players of the game (the preschoolers), preschool teachers, and the administrators of the game as an assessment tool (the staff members of the specialized centers and school psychology services).

The second step in the DYSL-X project is to compare the newly developed game with the classical methods used in the aforementioned scientific studies through an intra-subject analysis in a preschool population. Correlations between the measurements of both the game and the classical methods will be investigated, as well as differences in attention span, reaction times and attitudes of preschoolers towards the game and the classical tests.

The third step is to define the critical values of the performance measures that are obtained by playing the computer game. Therefore, the game will be played by children from four groups: a sample of five-year olds that are hereditary predisposed, i.e. children having at least one first-degree relative with dyslexia, a sample of five-year olds having no close relatives with dyslexia, a sample of eight-year olds with a diagnosis of dyslexia and a sample of eight-year olds without a diagnosis of dyslexia. From these data, the critical values will be distilled, and hopefully, the validity of the game will be proven.

CURRENT STATUS OF THE PROJECT
The first step of the project (designing and implementing the game) consists of three phases: Explorations and Observations, Game Design, and Game Development. We will describe the methodology of the first two phases as these are completed at the moment.
**Explorations and Observations**

During the Explorations and Observations phase, the entire core team first became familiar with the problem domain, i.e., dyslexia. This way, everyone has an understanding of the outcomes of the previous research projects on which this project is based, and the methodology that was used.

Also during this phase, more specific knowledge was gathered on the target group, the preschoolers, e.g., on the way they experience the classical tests used in the previous studies. Therefore, sessions were organized during which the preschoolers took the classical tests as well as played popular, commercial-of-the-shelves games for preschoolers. These observations contributed to a further understanding of the specific tests and measurements that were taken, but also provided insight into the specific developmental (cognitive, behavioral and affective) limitations of preschoolers and how these might impact the game design of the DYSL-X game. 25 preschoolers were involved in these sessions, divided over 3 classes. In order to analyze their experience, the preschoolers were interviewed in order to find out what they did and did not like about these tests according to the This-or-That method [22,25]. More insight into the motivations of their choice was gained using a laddering method [20,23].

The outcomes of this phase are currently processed and will be presented at the Fun and Games workshop.

**Game Design**

In the Game Design phase, the game concept was defined. Two brainstorm sessions were organized with all stakeholders to obtain a list of ideas for the games, taking several constraints into account:

- the results of the first phase, i.e. the knowledge on how preschoolers experience the classical tests and the representative computer games,
- the motivational factors of a computer game for preschoolers and
- the goal of the game, i.e. taking accurate psycho-physical measurements

From these ideas, the creators of the game (Game Designer, Game Developer, and Digital Artist) generated three different concepts (see fig. 1). Every concept was a one-page document which contained a splash image with the title, the protagonist(s) in their environment, and an antagonist where applicable. Furthermore, every document contained a brief description of the narrative and the goal of the game.

These concepts were again evaluated by the users (preschoolers) of the game via focus groups. In particular, 20 children (15 girls, 5 boys) of one kindergarten class participated. These children were divided in to three focus groups of each six or seven participants. The focus groups interviews were adapted to the characteristics and developmental limitations of preschoolers [10,15]. Firstly, the evaluation took place in their class room. This natural context increases the reliability and validity of the data [11,17] and minimizes the power differential between researcher and the preschoolers [8:183] as the preschoolers are in a familiar place whereas the researcher is not. Secondly, at the start of the focus group, the researcher presented the three different prototypes, by means of a story of each approximately five minutes, accompanied by some illustrations (see Fig. 1). The children were each handed out three cards, each card containing a picture of the respective game concept. After explaining the three game concepts (i.e. listening to the three stories and looking at their respective artwork), the children were asked to choose the concept card they liked most, but in such a way that the other children and researcher could not see their preferred game concept. Upon a signal of the researcher, the preschoolers unveiled their choice, all at the same time. With the chosen card in front of them, preschoolers were prompted to explain their choice. This process mitigated the risk for group influences and/or social desirability with respect to the researcher.

The game concept at the left side (see fig. 1) was preferred by 18 out of 20 preschoolers, who described it as “a nice story” and “It’s funny” and provided explanations such as: “The dog can do it, he’s strong”, “I want to be the girl”, “It’s funny cause the cat is made of iron”, etc. While these justifications lacked depth, the dominance of preference for the first game over the other two game concepts was surprising. Again, a more extensive rationale behind the three game concepts as well as an account of the focus groups will be given at the Fun and Games workshop.

**Game development**

Currently, the game is being developed, with two iterative playtests after approximately three months and six months of development.
Again, the latest results of the play tests as well as the game in its latest format will be presented at the workshop.

SUMMARY
To summarize, the final goal of DYSL-X is the use of the game as an assessment tool for detection of children with high risks of developing dyslexia, in all school psychology services and clinical diagnostic and rehabilitation centers in Flanders. At the moment, we are in the middle of the game development process. During the workshop, we will present the intermediate results of this phase in the project.

REFERENCES
**PIII – A Player-centered, Iterative, Inter- & Multidisciplinary, Integrated framework for Serious Game Design and Development for and with children**

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**ABSTRACT**
In this paper, we introduce PIII, a framework to assist in the design and development of serious games for and with children. The PIII framework emphasizes four characteristics that are essential to successfully design and develop serious games for children: 1) player-centered design, 2) iterative development, 3) inter- and multidisciplinary teamwork, and 4) seamless integration of play and learning. The PIII framework prescribes in detail how these four characteristics can be put into operation during the different phases of the serious game design and development process. In this workshop paper, these four characteristics as well as the different methodological phases of the PIII process are outlined. During the workshop presentation, a concrete research project on serious game design and development for children will be presented.

**Author Keywords**
Serious games; methodology; framework; game design; game development; user-centered design; child-centered design

**ACM Classification Keywords**
H.5.2. User Interfaces: User-centered design

**General Terms**
Design; Human Factors

**INTRODUCTION**
The use of interactive game technology in non-entertainment sectors has become a trend. Unfortunately, many of these ‘serious’ games have been criticized for being unable to achieve the goal of offering a compelling game experience [11,22,29], even though well-designed games are considered to be intricate learning experiences [22,29]. While reconciling a creative game design process with a complex software engineering process is already a daunting task, serious games add another ingredient to an already volatile mixture: the challenge of crafting an effective learning experience. Moreover, from the perspective of the child player, certainly if playing voluntary, gaming is an end in itself rather than a vehicle to learn. As a result, the child learner should enjoy playing the game for the activity itself. To realize this, the player should perceive the game as a fun and engaging activity rather than an artifact that is to be used to obtain an extrinsic serious goal. Based on our experiences in projects on the design of serious games for and with children [e.g. [41], we provide a first attempt to integrate the fragmented insights on theories and methods for player- and child-centered serious game design into one coherent framework. This framework relies on four pillars, resulting in a player-centered, iterative, inter- and multidisciplinary, integrated (PIII, pronounced as P triple I) framework that provides concrete methodological guidance.

**THE PIII FRAMEWORK**
The four pillars of the PIII framework will be described in the following paragraphs. Clearly, these four pillars are intertwined and reciprocal.

**Player-centered design**
In the field of digital game development, player-centered design has mainly been advocated as involving players in play tests from the very moment that the first prototypes have been created [33,40]. In the domain of child-computer interaction, the roles that users can take in the design process have been described in Allison Druin’s [11] onion model. Four roles have been distinguished, namely user, tester, informant and design partner, here listed according to their representation in the model from the interior of the ‘onion’ to the outer skin. The outside skins of the onion include the more interior ones, implicating for instance that the role of design partner encompasses the functions of a child being an informant, tester and user too. Even though each role is typified by another level of engagement, they all promote an active participation of the child in the evaluation of newly designed products. The ambition of the PIII approach is to look further than the role of the child as merely a ‘user’ of a commercialized product with no or only limited impact on product improvements. The minimal role to talk about true child-centered design is involving the child as a ‘tester’, given a voice to comment upon sketches,
prototypes or nearly finished products. Although such tests do involve the eventual child player into the (late) design process, it rarely offers players the opportunity to participate in the creative part before the materialization of any prototype. In excluding the eventual players from bringing in any creative input in the early concept and design phases, game designers risk ending up with a self-referential design. Such an ‘I’-methodology is a dangerous proposition, especially when the target audience of the game differs from the game designers [20,38]. Yet, for serious game design to lead to a worthwhile game experience, tapping into the particular wishes and expectations of the target group is a necessity [23,26]. Therefore, the PIII framework foresees in specific methods (discussed below) to involve the child player right from the start and throughout the entire design and development process as a design partner who participates from the definition of the game concept, informing the iterative game design to testing the final prototypes.

Iterative development
The PIII framework prescribes an iterative and incremental approach to game design and development, which is necessary in the process of designing games [18,27,28,37]. In the child-computer interaction community, design practices with children have been extensively documented [5,12,25,32,44]. In PIII we strongly advocate to rely on these design practices in an participatory design process in which iterations are conceived as feedback loops that exist and inform the shaping of serious games not only at the end of the development process but already from the very start of the design process onwards. Gaining insights into the target group, and incrementally working out design ideas in a multidisciplinary team is crucial to achieve the goal of a game that is both effective and fun.

Inter- and multidisciplinary teamwork
Ever since the era of the bedroom coder has ended, the game industry has been home to a heterogeneous crowd. From software engineers to visual artists, project managers or game designers, the game industry consists out of many contrasting profiles. Player-centered game design clearly asks for inter- and multidisciplinary teamwork [28]. Serious game development requires an even broader range of expertise. Its serious goals necessitate the involvement of user researchers, as well as experts from the serious domain of the game. In order to develop a game that is both fun to play and effective in reaching its serious goals, domain experts such as teachers, coaches, therapists, counselors, etc. and game designers need to collaborate [13]. The PIII framework takes this philosophy as a premise, advocating a genuinely multidisciplinary approach in which all members, not just the designers, participate in every aspect of the design and development process in order to learn from each other’s field of expertise.

User researchers are necessary to guide and coordinate this iterative and player-centered process, and ensure that exchange between the child players, the domain experts and developers take place at regular intervals. In order to realize this, these user researchers should be familiar with the target group and their particular developmental possibilities and interests. When doing research with children, it is always important to critically analyze what information we desire to obtain and how, compared to what information children are capable dealing with and what information they can and will provide us. The younger the age group, the more challenging it is to find appropriate methods. In this context, it is the user researcher who is responsible for selecting the right child-centered design method to successfully involve the children as design partners.

Integrated play and learning
Aside from the educational potential, the most intriguing promise of serious games is their motivational quality [14]. To retain the motivational aspects and the flow experience [15] of digital games, academic literature has indicated that play and learning need to be integrated as close as possible [16,19,22]. According to PIII, a successful serious game provides a seamless blend between the game fantasy and core game mechanics on the one hand, and learning principles on the other. The PIII framework further advocates that game designers and domain experts exchange knowledge in order to choose those game mechanics that not only provoke the desired emotional responses from players, but also additionally align with the serious objectives. Hence, the PIII approach goes hand in hand with methods and techniques that facilitate bringing the complementary expertise from each partner together.

THE DIFFERENT PHASES OF THE PIII FRAMEWORK
Besides highlighting the four pillars of serious game design and development, the PIII framework prescribes a detailed process with clearly delineated phases, as illustrated below.

Concept Design
This phase aims to understand the player group and the problem domain resulting in a first concept of what the serious game should be. Four sub phases can be distinguished.

Figure 1. PIII framework
Ethnographic inquiries
As a first step to familiarize with the serious topic at hand and get to know the target group, the PIII framework suggests performing ethnographic inquiries. Qualitative, creative and ethnographically inspired user research methods are particularly suited when designing for user groups that are little understood [6,39,43]. The following methods are popular to inform the design and get insight into children’s likes and dislikes: diaries, cultural probing [21], Mission from Mars [9] and participatory design [12]. Performing ethnographic enquiries also brings advantages at the fuzzy front end of the design process when requirements are still vague and when the social context of an application needs further investigation [34].

Co-design sessions
After the ethnographic inquiries have taken place, the PIII framework recommends starting with co-design, also referred to as participatory design [12] in which different stakeholders create things together, throughout a process of exploring ideas and concepts, creating, evaluating and communicating artifacts as concrete materializations of ideas. These artifacts can be considered lo-fi prototypes of the future product. In general, the team should be stimulated to create multiple artifacts, as it has been proven to be more effective than creating a single prototype in terms of design outcomes, exploration, sharing, and group rapport [10]. These created artifacts are no end products, but rather serve as a valuable asset in discovering the needs of end-users.

Clearly, the design of serious games benefits from co-design sessions as it brings the different stakeholders together as equal design partners with all direct influence on design decisions [36]. Co-design can remediate some of the shortcomings of the ethnographic inquiry phase that is typically carried out by those team members with a background in social sciences and or user research. Consequently, grasping the true meaning might still be difficult for the other members of the development team. In contrast, co-design sessions establish a direct link between developer and player, and between designer and domain expert, which clearly facilitates intense multidisciplinary teamwork.

Game Concept Definition
In the third step of the PIII approach, the design and development team, with the exclusion of the player and problem owners, work towards a game concept document. The game concept document describes the game concept at a high level, and focuses on the meaning that the game should take on, the learning objectives, and the user and contextual requirements. Contrary to a game design document, the game concept document does not yet describe the specific game mechanics, characters and game world, artistic style or levels unless this is of direct relation to the user requirements. To exemplify such an exception, a user group with diminished visual acuity might demand an artistic style that is bright and simple.

Before moving from concept to game design phase, the experts, i.e. the players and domain experts, are asked to review the game concept document. This is unique for PIII, because the players and domain experts, and not the game designers, are determining whether the game design process can proceed or not. They have a final say in conceptualizing the game, and hence the project can only move forward upon approval by these experts. This contrasts the more conventional game design practices in which the game designers and developers determine the game’s concept.

Game Design
In the ‘game design’ phase the game transforms from a game concept to a detailed game design that can serve as input for the game developers and digital artists during the development phase. The PIII approach foresees four steps to arrive at the final game design.

Scenarios, storyboards and focus groups
Firstly, game designers transform the game concept into scenarios and storyboards. Empathy with the users can also be realized via personas [2]. This is a common practice in game design (see e.g. [28]). Scenarios have gained currency in bridging the gap between users and designers [7]. These scenarios can find their materialization with storyboards [8,14].

Paper prototyping
The second step of PIII’s game design phase foresees in iterative prototyping. We hereby advise that, 1) each iteration of prototypes should only address a limited number of specific design questions to prevent having to prototype the entire game at once, and 2) prototypes should be developed as quickly as possible, starting with iterations of non-digital (paper) prototypes before moving on to digital prototypes, 3) both experts and players are involved in the prototype testing [8,13,28,36]. Popular techniques to be used in this phase are formative usability testing, often in the type of Wizard of Oz-evaluation [4].

Game Design Definition
The completion of the game design document comprises a large document that describes the game to the fullest, including concept art, user and contextual requirements, game mechanics, character design, narrative structure, interface design, design of the game world, the learning objectives, and so on. Note that this document is never totally finished. The team should update this throughout the entire project, and document every new design decision that is made during the further process. Consequently, any member of the team should always have easy access to and be informed about the evolutions in the game design.

Expert discussion
Similar to the concept phase, PIII’s game design phase ends by asking an outside team of players and domain experts to review the game design document. These ‘outsiders’, yet still representatives of the targeted player audience and domain experts, can provide a fresh view on the project and help review the game design document without bias.
Game Development

Finally, the actual game development process starts.

Digital prototypes and play testing

The actual game development builds further on the insights from the prototyping testing, which already started in the game design phase. The only difference is that by the end of the project, the prototypes will evolve towards digital prototypes leading up to a final proof-of-concept that can be assessed. From this phase on, the actual play testing can be performed. Techniques that can be used are co-discovery [1], peer tutoring [24], robotic intervention [17], think aloud [30], User Experience Laddering [42], Problem Identification Picture Cards [3] Fun toolkit [35]; This or That [45].

Expert discussion

Similar to the concept phase and the design phase, towards the end of the development, the multidisciplinary development team should ask for the help of an outside team of players and domain experts to review the game. At the end of the project, we recommend implementing the final prototype or proof-of-concept in the natural environment of several stakeholders for a longer time period.

CONCLUSION

This paper provides a framework and practical guide for all stakeholders who participate in the design and development of a serious game for and with children. More particularly, a framework is introduced that relies on four important pillars for the success of a serious game, namely player-centered design, iterative design, inter-/multidisciplinary teamwork and integration of play and learning. This framework, referred to as the PIII framework can be used as a practical guide in taking informed decisions during the elaboration of a game concept, game design and during game development.

By no means do we claim this as a finalized framework. In contrast, we call upon other researchers to use this framework and discuss their experiences. We have special interest in sharing the best child-centered methods for each of PIII’s phases, as we aim to build a more extensive list of techniques from which the serious game design team can chose. Besides, further research should investigate the parallels with other child-centered game design approaches such as for instance the CCGD-approach [31], and create a comprehensive comparison of the strengths of both frameworks, possibly integrating these into one refined theory and evidence-based serious game design approach for and with children.

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Mobile Visual Game Programming by Children

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ABSTRACT
Mobile phones become more and more prevalent among children on a world wide scale, largely due to the availability of attractive but low priced smart phones that offer a plethora of advantages to children compared to traditional PCs. Our Catroid system allows casual and first-time users starting from age eight to develop their own game apps solely using their Android phones or tablets. Catroid even allows integrating the wireless control of external hardware such as Lego Mindstorms robots via Bluetooth, Bluetooth Arduino boards, or Parrot’s popular AR.Drone quadcopters via Wi-Fi into the mobile games developed by children for themselves and their friends. Thus Catroid provides the ingredients to motivate kids to acquire software development skills in a fun and playful way from early on, mainly through the development of mobile games of their own choice.

Author Keywords
Games, visual programming language, mobile, smart phone, tablet, programming, educational, kids, children, teenagers, pedagogical

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI)

INTRODUCTION
There is a worldwide shortage of qualified software developers. This is due to rapidly increasing demand together with stagnating or even declining number of computer science students. This decline has been even more pronounced for females over the last 25 years, and it seems that even though younger girls can be interested in programming to the same degree as boys of their age, girls consistently seem to lose interest in their late teens [1,2]. At the same time our society increasingly relies on software which is thus less and less understood by the general population. Moreover, software development skills are not only of interest for obvious professional but also for philosophical reasons: Developing software is a skill that helps understanding the fundamental mechanisms and limitations underlying rational thinking.

Visual programming predominantly consists in moving graphical elements instead of typing text. We use visual programming because, based on informal experiences, it seems aesthetically to be more attractive to kids than simple text, and the success of MIT’s Scratch programming environment undeniably has proven in practice more than 2.6 million times that it is very appealing to kids 1. Note that visual programming is not easy but that if children are motivated, they are ready to spend the necessary time: Visual programming is not about dumbing down programming but instead about motivation by avoiding frustration due to, e.g., spurious syntactic mumbo jumbo, unnecessarily complicated work flows, or hard to spot syntax errors as frequently encountered in mainstream programming languages.

Visual programming has been criticized to not scale well to larger and more complex programs. However, practical evidence from visual programming environments shows that large and complex programs such as a 3D chess engine with an AI based machine opponent, multi level jump and run games, complex physics simulations, Sudoku solvers, and much more are possible with a hierarchical organization of program elements.

Smart phone sales are soaring on a worldwide scale2, and 23% of teenagers in the U.S. own smartphones as of 3/20123. One’s smartphone can easily be used everywhere without preparation, e.g., when commuting to one’s school using public transportation or at the backseat of the family car. Being able to program mobile devices also has become an important job qualification. Cheap smartphones from China are increasingly becoming available on a worldwide scale. Sony Ericsson’s Xperia Play Android smartphone, a PlayStation based portable game console, is particularly attractive to kids.

RELATED WORK
There is a plethora of research papers about visual programming: The ACM digital library lists more than 14,000 papers about the topic, and Google scholar reports more than 20,000 documents related to visual programming. I limit myself here to previous work regarding visual programming languages intended for the use by children, and in this set of languages to those

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1 http://scratch.mit.edu/ and http://stats.scratch.mit.edu/
2 http://goo.gl/D4Gpy
3 http://goo.gl/SdHE0
featuring community sites supporting and encouraging the sharing of interactive animations and/or games created by kids. Beside Scratch and Catroid, other visual programming systems (with varying expressive power of the language) include those associated with Nintendo’s Wario Ware D.I.Y.\(^4\), Microsoft’s Kodu\(^5\) [3], Flipnote Hatena\(^6\), and Game Maker\(^7\) [6]. YouTube can also be seen as a platform to share user contributed multimedia content though it is not primarily oriented towards children and the contributed content cannot be made interactive.

FEATURES OF CATROID

Catroid\(^8\) runs on smartphones and tablets, is intended for the use by children, and has been strongly inspired by the Scratch programming language, environment, and thriving online community\(^1\) which were developed by the Lifelong Kindergarten Group at the MIT Media Lab \(^4\). As known from Scratch or Google/MIT’s App Inventor\(^9\), Catroid programs are written in a visual Lego-style, where individual commands are stuck together by arranging them visually with one’s fingers.

Catroid also differs in important aspects from Scratch and App Inventor. Compared to both, with Catroid there is no need for a PC – the apps can be written by solely using smartphones or tablets devices. Scratch is intended for PC use with a keyboard, mouse, and comparatively large screen size whereas Catroid focuses on small devices with multi-touch sensitive screens and thereby very different user interaction and usability challenges.

As Figures 1 to 6 show Catroid in action, thereby illustrating some of the features mentioned so far.

Figure 1 shows parts of a Catroid program that allows controlling a Lego Mindstorm robot. On the left a list of sprite objects is shown, each possessing its own scripts and images. On the right scripts are shown that are associated with object “turn left” which is the one at the bottom on the screenshot on the left.

Figure 2 shows the resulting user interface and the robot. The necessary Bluetooth connection handshake between the robot and the Android device occurs when first executing the program. The possibilities for creative applications are infinite, especially when attaching the phone to the Lego robot and using the many sensors built into the phone such as acceleration or gyro sensors, or GPS for location based programs. Voice synthesis, voice recognition, as well as image recognition all can equally easily be used to build, e.g., autonomous intelligent soccer-playing robots. Using the similarly controlled Arduino hardware, arbitrary external devices can be controlled using Catroid.

Figure 3 shows how Parrot’s popular and inexpensive AR.Drone quadcopter can be controlled from Catroid via Wi-Fi. The quadcopter has two video cameras that transmit their data to Catroid for image processing. Catroid uses Intel’s OpenCV computer vision open source library running as a service on the Android device to follow simple patterns such as the helipad in the photo on the left side of Figure 3. A video showing how it follows the moving helipad is available at http://goo.gl/1CcBK. Being able to quickly use such powerful but very simple to use features is a tremendous motivator to acquire the necessary programming skills for users of all age.

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\(^1\) [http://www.wariowarediy.com/](http://www.wariowarediy.com/)
\(^3\) [http://flipnote.hatena.com/](http://flipnote.hatena.com/)
\(^5\) [http://catroid.org/](http://catroid.org/)
\(^6\) [http://appinventor.mit.edu/](http://appinventor.mit.edu/)
Figure 4 shows Catroid running on Sony Ericsson’s Xperia Play Android smartphone, a PlayStation based portable game console. We plan to support the gamepad keys of such phones in the near future. Parents will most likely be much more willing to buy such gaming smartphones for their kids when they know that their children will not only be able to play games but moreover also be empowered to creatively build their own games, animations, simulations, or other programs.

Figure 5 shows the screen one sees when executing a Hannah Montana interactive music video animation programmed with Catroid (the animation was originally created by Scratch user Tyster and remixed by the author from project http://scratch.mit.edu/projects/tyster/443306). Creating interactive music video animations is tremendously motivating both for boys but equally for girls even though a lot of programming is required and kids can spend days on their creations. Being able to upload such animations as videos to YouTube is an additional strong motivator as kids in general love to show off their creations to their friends regardless of what mobile phone or PC their friends are using. A YouTube recorder for Catroid programs is currently being developed, and kids will soon be able to upload their videos to YouTube in high quality. In order to allow the recording also on low-end Android devices and to decrease the amount of data that needs to be uploaded from one’s Android device, only the play data is transmitted from the phone to our server. It then will be interpreted on our server in exactly the same way with the same user interaction and additional input such as random seeds. Our server records it in high quality and optionally uploads it directly to YouTube.

Similar to Scratch, Catroid is an interpreted programming language with a procedural control flow. Objects communicate via simple broadcast messages and have a set of scripts that are all executed concurrently, with each script running in its own thread, thus allowing real parallelism to take advantage of the multiple cores of recent smartphones. Because children, from their experience in real life, easily can think in terms of objects, actors, and messages, this style of multi-threading and process synchronization feels totally natural to them (e.g., 27% of the 2.6 million projects uploaded to Scratch’s community website use message passing commands\(^\text{10}\)). The main design objective of the language is to make it as simple to understand and use as possible.

CATROID’S COMMUNITY WEBSITE

The Catroid system includes a community website allowing children to upload and share their projects with others. It is an important and integral part of our Catroid system. All projects uploaded to the community website are open source and published under a free software license. Everyone can download and edit every project from the website, add new functionality or change the current behavior of the project, and upload the new version again.

\(^{10}\) http://stats.scratch.mit.edu/community/blocks.html
This is called “remixing” and was a core idea behind the Scratch online community [5]. See Figure 6 for some images of the community website on a smartphone. On the left a list of projects on Catroid’s community website is shown. On the right the details page of a project is shown. From there the project can be downloaded directly into Catroid or reported as inappropriate, as not all inappropriate content can automatically be detected. Regarding the latter, names of projects, descriptions, comments, and user names are compared to an extensive multilingual set of cuss words as well as their creative spelling variations and, when recognized, automatically rejected.

In order to serve the needs of children on a worldwide scale, both the smartphone parts as well as the website of Catroid are available in many languages. A crowd sourcing localization / internationalization support site based on Pootle allows adding further languages. We currently support several languages, with speakers of English, Mandarin, Cantonese, Hindi, Arabian, German, Turkish, French, Japanese, Urdu, Russian, Rumanian, and Malaysian in the team.

DISCUSSION AND FUTURE WORK

The current version of Catroid as of March 2012 is not yet a full programming language as, e.g., no variables and formulas are supported at this time, though we are working hard to extend it in that direction. The project started in April 2010 with a small team. Our aim was to quickly produce a working partial solution with the most important features implemented first, and continue from there on. We started to implement some minimal functionality that is sufficient to emulate the highly popular creativity tool Flipnote that is preinstalled on many Nintendo DSI game consoles: Only a background image that can change according to a prespecified timeline while an audio file is playing. We then went on to implement the bricks most used in Scratch programs around the world, based on statistics published on the Scratch website. All of those are now implemented, and a lot more are currently being implemented to eventually make Catroid a general programming language.

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REFERENCES

The Games we have built make it Fun to Sit Safe!
But are they Serious Games?

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ABSTRACT
In a current project at the ICT&S Centre at Salzburg University, Austria, we are exploring how we can make it fun for a small child to sit safe while driving, i.e. sort of still, upright and leaned back in his/her child seat. For this purpose we have built three games: RainbowBalance, emoCar, and GhostCatcher. Our user studies show that all of them more or less do what we want them to, i.e. have the children sit safe as a result of enjoying playing the games we have built. But is it correct, to call these games we have built “serious games”? And do our games belong to the category of edutainment or exergames? Or are they just entertaining games that, at the same time, do some good?

Keywords
Automotive Gaming, Serious games, Edutainment games, Exergames

ACM Classification Keywords
H.5.2. User Interfaces

INTRODUCTION
Being intrigued by the possibilities to design for physical experiences of having to freeze or stay still, and also by the interesting design space of the car, we set up a project to see if we could make it fun to sit safe, i.e. sort of still, upright and leaned back while driving. During an explorative design study three games were designed and implemented that explored this task in three different ways; focusing on three different body parts and using three different potential digital set ups. [8]

The three games are RainbowBalance, emoCar and GhostCatcher. RainbowBalance is a game where we focus on balance and where we play with the small forces anything in the car is exposed to, while driving. In this game, the task is to balance a virtual ball on one’s head that changes color over time. This way a child can collect the colors of a full rainbow and get hold of the treasure at the end of the rainbow, see Figure 1a) emoCar is a game where the car gets emotional from how it is driven, i.e. angry when breaking too much, happy when speeding up, and sad when nothing happens, just as standing still in front of traffic lights. The player is supposed to “catch” the car that is by its’ emotional state driving between happiness, anger and sadness, using still but expressive face expressions, see Figure 1b. Differently from the other two games, The GhostCatcher is a game that does not use an ordinary screen display. Instead, it is a jar that expresses through vibration and sounds how many ghosts it holds, see Figure 1c). The gameplay consists of the player, opening the jar when the car is exposed to darkness, e.g. a decrease in light due to shadows the car is exposed to, or darkness in the form of a tunnel. Through opening the jar in this “darkness” the player lets the ghosts in and the jar starts to make sounds and to vibrate. But if the player does not
manage to close the jar before hitting the light again, the ghosts will all run away.

All three games have been extensively evaluated and on a general level, they have all successfully fulfilled their purpose. The children like them, find them entertaining and they sit still and thereby more safe while playing them, see Figure 2 for an example. For this position paper, we take these results as facts, as they will be extensively published in another paper. But what kind of games are these? They have been designed for a good cause but a good cause is neither relevant for the children playing the games, nor for their parents, who are the ones wanting their children to sit safe. The games are all three designed the way that safe seating is part of the gameplay, but it would not happen if the experiences designed for were not “strong” enough. The focus lies on the experience and because the games were cleverly designed, safe seating comes as an effect of this. Now our question is, would that be the same thing as what is usually referred as Serious Games?

SERIOUS GAMES

A serious game is a game that uses the artistic medium of games to transport values not inherent in traditional game approaches [3]. Basically, serious games are designed to make the player acquire certain skills or knowledge. While there might be entertainment involved, it is primarily an instrument for industries and institutions like education, health care, science, management, politics, advertising or defense, to get some educational messages across.

For our work, two sub-categories\(^1\) of serious games could potentially be relevant: edutainment games [6] and exergames. [Erreur ! Source du renvoi introuvable.]. Edutainment games are designed to fulfill educational purposes, most often at the level of primary and secondary academic level. Usually, edutainment games try to educate the target group on a certain topic, give information about historical, political, or cultural events, or train and/or reinforce various skills. Besides edutainment games there is also the category of exergames that focus on exercise and movement during gameplay. Originally, exergaming was designed to enhance a more active lifestyle. But this genre has evolved rapidly and has become an important part of gaming that now reaches various target groups, such as elderly [e.g.Erreur ! Source du renvoi introuvable.] and everyday sportsmen/women [e.g.Erreur ! Source du renvoi introuvable.].

Often, serious games have been criticized for failing to integrate the desired effect of the game and also for failing to evoke the intrinsic motivation that is the crucial factor for successful gameplay [e.g. 2].

Egenfeldt-Nielsen proposes how we first need to define games and learning for edutainment games and from that then figure out how to aim for better combinations of the two factors. The same could potentially be done for exergames.

Defining Games and Learning

“The first precondition is to conceive what a game is: I define computer games as virtual worlds with a conflict. Virtual worlds are finite, rule-based problem-spaces that offer players different means to solve problems with a precise feedback and reward system.” [1]

Egenfeldt-Nielsen discusses three important factors that help to create a successful and strong learning game; integration, motivation, and focus. And again, the three factors could potentially be valid for exergames as well.

1) Integration

“When you play a learning game you need to make sure that learning and play are integrated. This means that to succeed in the game you also need to master the learning goals behind the game.” [2]

What Egenfelt-Nielsen states here, is that both elements, learning and play, need to be equally staged within a game. And how none of them shall be dominating the other one. In our experience (and most likely in the experience of Egenfelt-Nielsen and many others) many games have got their gameplay experience cut short. The reason might lie in the fear that the message or the learning aspect would be lost if the gaming experience is too entertaining. The ideal solution, as suggested by Egenfeldt-Nielsen, is to make the learning effect an essential tool for mastering the game mechanics. This way, both issues could become an irreplaceable and meaningful part of the game.

\(^1\) Sub-categories according to the references provided. It can also be argued though that these are no sub-categories but in fact game-categories themselves.
2) Motivation

Furthermore, the key to create an intriguing game and an engaging user experience is to motivate the player intrinsically. From the perspective of edutainment games, learning takes place when there is enough motivation to exercise the task and enough positive challenge within the game.

“Motivation should be in tune with the requirements of good gameplay like good balancing, a well tuned rewards system, varied consequences, and quick user feedback. This can also be summarized into the concept of ‘challenge.’”

[2]

3) Focus

Finally, for an optimal learning experience, Egenfeldt-Nielsen lists the focus as being crucial: as it is a delicate task of finding the right balance for a game in terms of focus and how it is the only way to ensure, a game transports the right message. Even more important, the game mechanics have to reinforce the learning effects and must do not distract the player/s.

“If you are constantly spending time clicking the ground to walk around, examining surroundings to identify small boxes and then picking them up, the verbs may not be relevant to the learning experience. You will basically learn to walk, identify boxes and pick stuff up, which is not relevant beyond the game.” [2]

DISCUSSION & CONCLUSION

So could the three games, we have built be described as what the community refers to as serious games? And can we perhaps use Egenfeldt-Nielsen’s definitions and factors from edutainment games to determine that issue? From this perspective it needs to be stated that our aim has never been to educate children in the reasons for sitting safe (not that that is not important), neither it was the aim to change their behavior at other times than during gameplay. The aim has been to design and create engaging experiences where safe seating is part of the game experience itself. What we have built are, in our point of view, serious games, as they transport some important issues i.e. making children sit safe. And regarding the factors important for our games listed by Egenfeldt-Nielsen, is not up to the children to understand the real focus of the games. On the contrary, we believe that it would ruin the game experience for them and thereby what we wanted to achieve with the games. Still, there might be an, for our purposes, important difference between edutainment games and exergames, in how exergames do not need to make the user understand the real focus, and how it can be ok for a exergame, as Egenfeldt-Nielsen states it, “to walk, identify boxes and pick stuff up” [2].

In our design process it was an explicit choice of ours to stage the experience first and let the rest of the work be a result of that experience. We stuck to this method throughout the whole process, even though we had distinguished design goals in mind, such as the fact that children playing the games should sit safe, i.e. sort of still, upright and leaned back in their child seats. From that perspective we would say, we managed to make sitting still an integral part of gameplay. Then again, our games are different from exergames, as we do not want children to exercise at all.

Perhaps what we have done so far belongs to a less common category of serious games? Because what we are aspiring should definitely be regarded as a serious matter; having children sit safer while being transported by car.

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REFERENCES


Child-Centered Game Development (CCGD):
Developing Games with Children at School

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ABSTRACT
Children represent an increasingly relevant target group of the game industry. Nevertheless they are rarely involved in development processes. In this paper we aim to introduce child-centered game development (CCGD) approaches for user-centered design of games within the context school. Therefore, suitable HCI approaches from user-centered and participatory design as well as educational principles were used as a foundation. The CCGD approaches illustrate how to guide the involvement and participation of children in school classes in the development process of games.

Author Keywords
UCD, CCI, game design, education pedagogy

ACM Classification Keywords
H5.2. Information Interfaces and Presentation (e.g., HCI): User Interfaces (Evaluation/methodology)

INTRODUCTION
The reasons why children play games are manifold and there are various ways how they play. Thereby, children's enjoyment is the most important goals for games, because if children do not enjoy the game, they will not play it [19]. In order to meet children's needs, they need to be considered adequately in the development process of technologies [1]. For game developers, it would thus be an advantage to work together with children to satisfy their range of desires [25] and not to see them only in the role of game consumers. However, children are rarely involved in the game development process, as they are a challenging target group (e.g., they might have different levels of motor skills or shorter attention spans). Furthermore, the development of games already requires a lot of cooperative effort of at least software and sound engineers as well as user interface and domain experts (e.g., world builders or writers).

Integrating children in development processes has benefits, but also provides challenges: On the one hand they come up with creative and innovative ideas; on the other hand many of their ideas are technically unworkable [24]. Nevertheless, following the principles of UCD, the creative and innovative ideas are a valuable and necessary resource in the development of games. In the context school there are further issues that have to be considered: The organizational structure of schools necessitates not only the involvement of the children but also of their parents, as well as teachers, principals etc. [1] Furthermore, it is necessary to try to enter the children's worlds of understanding and they need to get familiar with the researcher to work in a confidential setting [13], which is easier in the school context as they are used to adults being around them.

CHILD-CENTERED GAME DEVELOPMENT (CCGD)
Children are a very specific target group and as there are only few methodological approaches for child-centered design available, and even less for the development of games with children aged 10 to 14 years, we aim to introduce some methodological approaches for CCGD. The approaches will be developed for the analysis, conceptualization, design and evaluation phase. The implementation phase was left out, as there are already enough existing approaches like Scratch to involve children. In the different phases of the CCGD current educational content of school classes is taken up and integrated in the approaches for practice based learning.

Through this integration a win-win situation emerges. On the one hand, the children benefit from learning informatory content not only in class but also from practically applying it in the game development process, i.e. knowledge is transferred. On the other hand, informatory content can help the researchers or game designers to explain to the children, what they are expected to do within the different CCGD approaches, e.g., personal descriptions can be used to explain the child-game-persona approach.

Combining educational principles and HCI
Bruner [3] describes learning as “an active process in which learners construct new ideas or concepts ... The best way to create interest in a subject is to render it worth knowing, which means to make the knowledge gained usable in one’s thinking beyond the situation in which the leaning has
Good and Robertson [6] believe that allowing children to design and develop their own games will lead to a deeper learning experience where skills will be transferred. This should be achieved within the CCGD approaches through linking traditional HCI approaches with educational principles and learning content. Hinze-Hoare [8] introduced educational principles for evaluating virtual learning environments, which build on the components of effective learning from Bruner [3], namely 1) collaborative learning, 2) active learning, 3) reflective learning, 4) cultural learning and 5) reinforcement.

Collaborative, active and reflective learning are addressed explicitly in the CCGD approaches, as well as the cultural environment that enables children to develop games together with researchers within the context of the school. Robertson and Good [22] stated that by enabling children to create computer games, learning opportunities are provided, for example, developing narrative skills through character creation, plot planning, interactive dialog writing. In the following, possible CCGD approaches will be described briefly, which refer to those educational principles and/or represent modifications of HCI and pedagogical methods. More detailed descriptions can be found in [16] or [14].

Analysis Phase

Idea Cycle

The goal is to get an understanding of a topic by creating and discussing ideas in a group. The idea cycle is a modification of the World Café method [2] (also called Knowledge Café). In order to work with 11 to 13 year old children it is necessary to reduce the complexity of the original approach described in [2]. Posters with different questions (or statements) are put on tables in the classroom for four children each (e.g., questions for the analysis phase can be: What is an analysis?, How can we analyze something?, What do we need to know about gamers, games, etc. to develop our own games?). Each group is asked to write down its ideas (responses) on post-its in order to answer the provided questions. Using post-its allows discussing, arranging and re-arranging the ideas. After every 10 minutes, the groups rotate (without splitting up) until every group provided input for each poster.

The advantage is that the children do not only mention their spontaneous ideas but also create ideas out of the others. This is especially important for the analysis phase, as the children can come up with lots of ideas and examples of what needs to be analyzed and how, before the development of the games can start. The researchers need to sort the post-its in order to use them afterwards for explaining to the children the different activities within the phases.

W-Question Cards for Games

This approach aims at figuring out questions, which need to be investigated within the analysis phase. Therefore, the W-questions (Who When What Where Why and How) are used, which are often referred to in educational settings (e.g., for learning grammar [12] or for comprehending stories [0]). The children should form groups of two in order to support group dynamic processes. The children are given a stack of cards with a W-question word to complete different questions, which aim to collect answers on the users’ behaviors, needs or preferences in regards to games. The children create W-questions for collecting user needs (requirements) and should provide exemplary answers.

Afterwards, researchers start to summarize similar questions, and sort out the ones that are not appropriate/unimportant for the overall game goal. If there are still too many questions, they select the most suitable ones from the remaining to investigate end users’ behaviors, needs, or preferences with regards to games (e.g., Which games are children playing?, Where do children like/dislike to play games?, How often do children play games?, or How long do children play games?). Additionally, if needed the researchers add missing questions to cover all important aspects for game design. The advantage of this approach is that the questions are authentic, as they are phrased by children, address children and can also be used in other approaches to collect data (e.g., interview or probes study).

Short Feedback Questionnaire

In order to define user requirements regarding favored game input devices (controllers), the perceived fun of the game input devices can be analyzed with children. This helps to find out which are preferred game input devices that should be considered in the development of games. Therefore, we developed the SFQ that builds on a one-page, pre-structured questionnaire used to evaluate the experienced fun in games [18].

In order to engage children to fill in the SFQ and not lose patience by filling in more than one to rate several game input devices, the design follows guidelines of Read and MacFarlane [21], such as “keep it short”, “limit the writing”, “make it fun” and “use appropriate tools and methods” (e.g., by using parts of the Fun Toolkit as they have already proved to be suitable [21]). The questionnaire for the evaluation the experienced fun of game input devices consists of three parts: 1) the question “How much did you enjoy the game input device?” to be answered with the “Funometer”, 2) pre-defined opposed attributes describing the experienced fun of the game input devices, and 3) demographic data (age and gender).

Probes Study

The probes study aims at investigating children needs regarding games. Iversen and Nielsen [9] state that the probes approach is useful when working with children as the probes material provides access to children’s everyday lives. The children are enabled to be in control of when, where, and how to provide their feedback [14]. The W-question cards approach (explained before), can be used to identify questions for the study. Different probes material
can be introduced to the co-designing children, and they are asked to assign the questions to the material

The material can then be deployed by the children. It needs to be appropriately designed in order to be self-explanatory and serve as inspiration, as well as motivation, for explaining and documenting practices and experiences with games. Once the data is collected, it needs to be analyzed by the researchers in order to guarantee a proper research standard. Afterwards, it can serve as input to create child-game personas within the conceptualization phase. Nevertheless, the children should also be given the possibility to take a look at selected probes material in order to make their own experiences in analyzing data. This especially supports the active learning of the children.

**Conceptualization Phase**

**Child-Game-Personas**

Personas are used to represent the target users in the conceptualization and design phase. They are “*fictitious, specific, concrete representations of target users*” [20], enhance making assumptions about users explicit and place the focus on specific users rather than on all. Our child-game personas focus on school children that are between Antle’s child-based personas (children aged 8 to 12 years) [1] and Cooper’s “adult personas” 0. The data to create the personas can, for example, be gathered with the above described probes study or other approaches described in [15]. Depending on the used approach, the mapping for qualitative data to create personas needs to be done by the researchers (see 0) or for quantitative data the mapping can be done by applying a cluster analysis (see [14]).

In the next step, the children are responsible to create fictive personal descriptions with the summarized data for each persona. This approach could be integrated in the writing and reading class, if the teachers are willing to. Thereby, they are actively involved and take over responsibility. The researchers use these personal descriptions to create the child-game personas using the narrative phrasings of the children in order to make the personas authentic. The personas can be used afterwards to focus on children’s behavior, needs, preferences, etc. in the game concept creation.

**Game Idea Booklet**

In order to develop a game concept, the game idea booklet was developed. It is based on the brainstorming method [26], which is an individual or group process for generating alternative ideas or solutions for a specific topic. A booklet is chosen as it looks more proper than pieces of paper that are simply stitched together. Furthermore, it is designed to look like a manuscript in order to motivate the children to carefully think about their game idea, and document it in an appealing way.

In the game idea booklet, brainstorming ideas are written down or drawn in small groups of two to three children. These relate to different topics concerning a specific game idea (e.g., title, idea, goal, course of the game, motivation, rules, characters, opponents or obstacles, controller). The game idea booklets can be used in the following to create PowerPoint presentations to explain the different game ideas to the other children. Afterwards a voting can be done to find one game idea that will be refined, designed, implemented, and evaluated.

**Concept Creative Thinking**

After one game idea is chosen, the game concept needs to be advanced (extended and reconsidered). Therefore, the concept creative thinking approach is applied that builds on the mixing ideas technique [7] and also the brainstorming method [26]. This approach can be seen as the follow-up to the game idea booklet approach that enables reflective learning. Before the children start with the brainstorming, future game developers (e.g., master students) can give an inspiring lecture about how complex game development and design can be. Afterwards, the children can again be provided with trigger questions for the next round of brainstorming (e.g., game goal - what is the goal of the game and how can it be achieved?; game character – what abilities does the different game characters have?). They can take notes, make drawings or write texts on alternatives for the discussed topics. The children in the groups of three to four children must not agree on one solution, but instead are able to collect and discuss different alternatives.

Afterwards, the different alternatives regarding the game parts are presented to the other children and discussed with them. It should be explained to the children that the presented ideas are a starting point for discussion and that new ideas can still be created. Agreed ideas for the game concept (that more than half of the children liked) are noted down on a poster to create one big vision (i.e. mix of ideas). At the end another round of discussion should be done to see whether the agreed parts of the game ideas really fit together to identify necessities for further modifications. The presentation order of the topics is highly relevant for the flow of the game conceptualization. The following order should be used: 1) the goal, 2) the course of the game (storyline) and environment, 3) the game character, opponents or obstacles, 4) the game controller and interaction, 5) the game rules and 6) the name of the game.

**Game Concept Description**

After the concept creative thinking, the children are asked to write proper game descriptions, which they learn in the reading and writing classes. Therefore, the poster of the concept creative thinking approach is transcribed and handouts are given to the children in order to work with the so far developed ideas. The goal of the game concept description is to create texts describing for example the goal, interaction, procedure, rules or needed material for the game. These texts are then used to create a merged game description, which should have the length of one to two A4 pages (for a proper proof of concept evaluation with
experts). It should explain and contain everything that has been agreed upon.

**Design Phase**

Once the game concept is finished, the design phase can start with sketches of game characters and level design.

**Game Progress Storyboards**

The menu design can be explored with storyboards in small groups [11]. Storyboards are typically used in the film industry for sketching or mock-up shots before they are actually filmed. They are also used for concept sketches or mock-ups of game levels (see [10], [23]). The game progress storyboards aim at illustrating specific progresses (e.g., in menus) or highlighting certain aspects within games (e.g., game play scenes). One advantage of using these types of storyboards is that they allow children to experiment with changes in the storyline of the game and to discuss, as well as describe, different outcomes.

As an example, the paper-based game progress storyboards can be used to describe menu procedures. The children draw on the left side of a sheet of paper and describe on the right side the interaction with the interface as well as animations of interface elements for the designers and developers. In order to support the children during the creation of the progress storyboard, they can be provided with important aspects of menu design that need to be considered (e.g., selection of difficulty level, game world or amount of players).

**Creative low-fidelity Prototyping**

At the end of the design process, creative low-fidelity game prototypes can be developed in groups of four children. The goal of creative low-fidelity prototyping is to create tangible game prototypes, which are sketchy, incomplete and quickly built working models. As children need a starting point for prototyping [24], the game progress storyboard was used to illustrate a short sequence of interactions within the game. Similar to Knudtzon et al. [11], the children are provided with Playmais, Playdough, Lego and other creative material to create prototypes.

The prototypes are used to illustrate parts of game levels and the children can try out game procedures/mechanics and actively discover problems or challenges in the game play. For very complex game concepts, the low-fidelity prototypes might be problematic, as the implementation might be too difficult or simply impossible. In the end the creative low-fidelity prototypes are filmed, while the children play the respective gaming sequence. Afterwards, the other children can ask questions, make remarks or improvement suggestions. The videos can be used to envision the game ideas of the children for the designers and developers, if they are not able to attend the creation process of the prototypes done by the children.

**Evaluation Phase**

**Playtesting applying the extended Short Feedback Questionnaire (eSFQ)**

In order to evaluate the developed prototypes group playtestings [5] with children can be performed in public settings (e.g., school) or in a lab. In order to investigate the specific game experiences of children we adapted and extended our previously developed feedback questionnaire [18] (that was already adapted for evaluating game input devices), to assess not only fun/enjoyment, but also curiosity and co-experience.

The eSFQ consists of six parts: 1) the question “How much did you enjoy the game?” to be answered with the “Funometer”, 2) pre-defined opposed attributes describing the experienced fun of the game, 3) the question “Would you like to play the game again?” to be answered with yes, maybe or no, 4) three items “I wanted to continue playing because I wanted to see more of the game world.”, “I was curious to the next event in the game.”, and “I sought explanations for what I encountered in the game.” to be answered with a five-point Likert scale, 5) pre-defined opposed attributes describing their co-experiences, which arise while playing against each other and 6) demographic data (age and gender). For more information see [17].

**CONCLUSION**

Overall the CCGD benefits from the combination of multi-disciplinary approaches that support the game development process with children in the context school. They should illustrate how an active involvement of school classes throughout the different UCD phases can look like. Not all of these approaches need to be applied in the presented order. Rather, they should be seen as part of a collection of approaches for the whole game development process. Although some approaches seem to build up on each other, most of them were developed to be applied independently but can easily be combined.

**ACKNOWLEDGMENTS**

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Safety-Critical Systems and Video Games: Contradictions and Commonalities

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ABSTRACT
Goal of this workshop is to gather researchers and practitioners interested in cross fertilization between safety-critical systems and video games theory and practice. This includes: the application of video games interaction techniques to the domain of safety-critical systems, the comparison of development processes and how to get the best of both worlds, evaluation of usability and user experience in video games and how it could be transferred to safety-critical systems, how dependability and fault-tolerant technologies could be transferred to game development … Submissions focusing on the "cross-over" between these two areas are welcome. Application areas span from aeronautics, air-traffic management or satellite ground segments and more generally command and control systems to platform games, MMORPG, games on mobile devices... Experience in games design, programming, development, evaluation … is welcome. We would like to have a special focus around the study of autonomous behavior in both domains/areas.

Author Keywords
safety-critical systems, aeronautic, video games, formal method, human-computer interaction

ACM Classification Keywords
H.5.2. User Interfaces, J.7 Computers in Other Systems (command and control), B.1.3 Control Structure Reliability, Testing, and Fault-Tolerance, K.8 Personal Computing (Games)

INTRODUCTION
In the area of Human-Computer Interaction there is a distinction between interactive systems that are applied in domains like entertainment and leisure or standard office work environments and interactive systems that are perceived as safety-critical as in the domains of Healthcare, Aeronautics, Air Traffic Management or Satellite control. While entertainment and “standard” work interactive systems have a strong focus on usability and user experience, in the area of safety-critical systems factors like safety, reliability, fault-tolerance or dependability are as important as usability and user experience of primary importance while usability problems is usually compensated by training.

These two distinct views about interactive systems, lead to two different communities using different approaches, development processes and methods. Contrary to the current perception that this distinction is important and should remain, we argue that methods, approaches, processes and solutions in one area can be fruitfully deployed in the other area.

One precise example of such possible cross-fertilization is design and development of user interfaces including autonomous behavior in safety-critical systems [1]. Solutions from video games can be used to solve some of the major problems when interacting with this type of autonomous behavior in a user interface of safety critical systems.

The main goal of this workshop is to identify areas of fruitful integration between video games and safety-critical systems, to investigate new solutions and to build a community interested in this area.

DESCRIPTION OF AUTONOMOUS BEHAVIOUR

PROBLEM AREA

In the design of user interfaces for safety-critical systems the current main challenges and goals for autonomous behavior are that the operator should first identify a plan, input the plan into the system, and then trigger the supervisory system to execute the plan which includes some degrees of autonomy (i.e. that the supervisory system has some delegated authority).

Work has been done and is still in progress on authority sharing [7]. Of course, the operator being in charge of, and responsible for, the operations should always have the possibility of interfering with the current plan (possibly under execution).

One solution to that problem is to reduce the operator’s role to the one of automation overseer and thus only acting at a high (and abstract) strategic level as proposed in the various levels of automation defined in [9]. Such solution makes it
very difficult (and nearly impossible) for the operator to come back to a more low (and concrete) tactical level especially in case of degradation of the automation capabilities of the controlled system. Thus, other solutions have to be identified and designed requiring scientific means to assess:

- How the operator will be able to identify (from the currently available information about the system) new plans or modification to current potential plans (or potential configurations)?
- How the operator will be able to build new plans or configurations?
- How the operator will be able to assess the impact of a potential new plan or configuration?
- How the operator will be able to interact (both monitor and possibly interrupt) with the current configuration under “execution”. This interaction aspect can be particularly complex if, in a proactive system, the configurations are executed in an autonomous way by the supervision system?

As for solutions, one of the areas heavily using autonomous behavior is the area of games. Recent work in the area of games has shown that beyond simply performing a task, users want to engage with an interactive system, allowing them to have a playful and joyful experience [7]. User experience in games considers that the users should enjoy their activities while interacting with the computer and that this enjoyment can be one of the main goals they want to achieve.

In games the interaction is no longer only based on direct manipulation and input, but gamers interact with a number of autonomous agents (e.g. non-player characters (NPC)) that can only be indirectly influenced. Other interaction and usages include autonomous behaviors of game entities (e.g. for collecting resources in a game). There is a broad variety of ways to interact with these autonomous entities ranging from simple dialogue-based interaction to more complex interaction patterns, like position and movement of the (played) avatar, to influence the behavior of the NPC.

We believe that such automation-related problem can play the role of a Guiney pig and trigger pertinent reflection and discussions during the workshop. It can also provide a concrete example providing a shared understanding amongst the participants.

WORKSHOP TOPICS

Workshop topics include, but are not limited to:

- the application of video game (design) concepts, methods, processes etc. in the area of safety-critical systems
- the application of solutions, concepts, methods, processes from the area of safety-critical systems to video game
- the design, development and investigation of autonomous behaviors in video games or safety-critical systems
- the application of 3D and innovative interaction technologies from the video games to safety-critical systems
- the comparison of current state of knowledge in terms of interaction techniques both in the area of safety-critical systems and video games
- analysis and comparison of input devices used in both area
- analysis and comparison of processing capabilities (DSP, GPU, CPU, …) of the hardware platforms for video games and safety-critical systems

PARTICIPANTS

We expect participants from:

- Video game design and development, user interface design and engineering in various application fields including safety-critical systems interested in the overall topic.
- Academics and practitioners carrying out research around the notion of autonomous behaviors. Their area of expertise can be related to interaction, human factors or interactive systems development. Their topic of interest should involve usability, reliability, safety, usability and/or user experience.
- Students interested in video games and/or safety-critical systems interested to learn about the intersection of these two domains.

The upper limit in number of participants is 30, to allow for active participation and a fruitful discussion of topics.

PARTICIPANT SOLICITATION AND SELECTION

We will advertise the call for position papers in the CHI community, air-traffic management community, aeronautics as well as other safety-critical system domains using the usual mechanisms including announcements in mailing lists on HCI, software engineering, safety critical systems, conferences and personal contacts, especially at several upcoming meetings. The workshop organizers will use their involvement in industry to reach out to people with a main interest in designing user interfaces for safety-critical systems. We will also solicit participation from people with experience in the application of video games in other domains as well as the video games community.

Workshop participation will be based on an (up to) six page position paper (ACM Format) describing interests and previous work in the topics of the workshop. Selection will be based on the quality of the abstract, answers to the list of issues, the extent (and diversity) of participants backgrounds. We welcome participants both industry and academia and particularly welcome participants with a
familiarity with user interfaces dealing with autonomous objects and systems.

We envision two main types of contributions: problems contributions bringing case studies or theoretical problems and solutions contributions bringing solutions already proven efficient in one of the domains considered.

PRE-WORKSHOP ACTIVITIES
Position papers will be made available on the webpage and circulated in advance of the workshop.

STRUCTURE AND SCHEDULE
The one day workshop is structured as follows:

Morning, first half: Preliminary introductions; logistics; agenda; presentations by participants (about 7 minutes each, depending upon number). Goal of the presentations of the participants is to understand their background and how they would deal with this kind of particular applications.

Morning, second half: Break down in small groups according to backgrounds (human-factors, user experience, interaction techniques design, visualization, interactive systems specification …). Goal is to identify possible crossover between the two domains and start working on a classification of the intersection between safety-critical systems and video games.

We will then re-convene for a read-out of the groups’ proposed solutions. End of morning will prepare afternoon breakout groups.

Afternoon, first half: Then new groups will be built in order to mix the different experiences and thus to produce different proposals. Groups will be now built on process stages and/or methods uses.

Afternoon, second half: Read-outs of the specific advantages of the different approaches used. Large group discussion and revision. Group synthesis into poster. Plans for future works.

DISSEMINATION
Results of the workshop will be made available as interactive poster during the conference. Results will be summarized to be submitted to the Interactions Magazine of SIGCHI. According to the quality of the submissions and the results of the workshop we foresee the publication of an edited book on the topic of the workshop. This is similar to what we did for the CHI’96 workshop on Formal Methods for Computer Human Interaction which are now published by Springer Verlag [2].

ORGANIZERS BACKGROUND
Eduardo José García González is a principal researcher at CRIDA (ATM R&D + innovation Reference Centre) as well as assistant professor in the Air Navigation department and professor of safety methodologies and tools in the Master in Airport Systems of the UPM. He is coordinator of the HALA! SESAR Research Network and has a long experience on Air Traffic Management [11].

Philippe Palanque is Professor in Computer Science at the University Toulouse 3. He is working on formal methods for interactive systems, especially dealing with the notations and tools for the specification of real-time interactive applications including interactive civil aircraft cockpits [10], military cockpits [3] and satellite ground segments [5]. He is member of the EC and CMC of ACM SIGCHI and full paper co-chair of the ACM Engineering Interactive Computing Systems conference (EICS 2012).

Regina Bernhaupt is working on usability and user experience evaluation methods for non-traditional environments, especially areas as contrary as games interactive TV [4] and safety-critical system. She is leading the user experience research at ruwido and is invited professor at IRIT [http://www.irit.fr/~Regina.Bernhaupt/]

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Conceptualising, Operationalising and Measuring the Player Experience in Videogames

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ABSTRACT
The player experience is at the core of videogame play. Understanding the facets of player experience presents many research challenges, as the phenomenon sits at the intersection of psychology, design, human-computer interaction, sociology, and physiology. This workshop brings together an interdisciplinary group of researchers to systematically and rigorously analyse all aspects of the player experience. Methods and tools for conceptualising, operationalising and measuring the player experience form the core of this research. Our aim is to take a holistic approach to identifying, adapting and extending theories and models of the player experience, to understand how these theories and models interact, overlap and differ, and to construct a unified vision for future research.

Author Keywords
Videogames; player experience.

ACM Classification Keywords
H.5.2. User Interfaces: Evaluation/methodology; K.8.0. General: Games.

General Terms
Measurement; Experimentation; Human Factors; Theory.

INTRODUCTION
The increasing number and diverse range of people playing videogames are evidence for the unique motivational pull this medium offers. The question of how, and in what contexts, interactions with games promote lasting engagement and immersion is an ongoing one. The experience of being entertained, as regarded from a psychological point of view, is not fully understood [30]. While it is commonly accepted that videogames are gratifying and enjoyable, the multifaceted nature of research in this area has led to a broad range of approaches for understanding the phenomenon.

Media-related enjoyment is a complex construct that includes references to physiological, affective, cognitive, and social dimensions [30][24]. The player experience can be considered in a variety of ways including the subjective feelings experienced by players [3], the motivations for playing videogames [30][25], and the influence of the medium, in terms of design and content, on the experience [30].

There is promising research focused on the rigorous and systematic analysis of the gameplay experience and there are varying perspectives emerging in relation to how, and in what circumstances, games engage people at a cognitive, social, and emotional level. This workshop aims to examine the complex issues surrounding the conceptualisation and measurement of the player experience, taking into consideration:

- motivations for video gameplay;
- the state of a player during gameplay with a focus on the experience itself; and
- how structural elements of videogames impact on player experience.

During the workshop we intend to deconstruct the concept of the player experience and undertake a deep analysis of the characteristics, attributes and qualities that contribute to enjoyable gameplay. An expected outcome from the workshop is an emerging model of the player experience.

PLAYER EXPERIENCE
The growth of research into the player experience in the past five years is evident with research covering player motivations, engagement and immersion, and the influence that game design has on player enjoyment. The workshop examines the contributions that existing research makes as we look to better conceptualise, operationalise, and measure player experience.

Player Motivation
Recent research has identified motivation, in terms of cognitive processes, as playing a central role in the gameplay experience. Videogames are largely autonomous pursuits that create their own internal motivations for playing [13]. Intrinsic motivation can be characterised by free choice, interest, optimal challenge, and psychological needs, such as effectance, personal causation, competence, autonomy, and social needs [8]. Motivation theories focus
on people as problem solvers; notions such as curiosity, incongruity, and complexity; and concepts of perceived control and self-determination [18].

In the early 1980’s, Malone [20] identified three categories of individual motivations during gameplay: challenge, fantasy, and curiosity. This original theory was later expanded to add control as an individual motivation, as well as cooperation, competition, and recognition as interpersonal motivations [21]. Increasingly, the social components of gameplay are being explored as motivations for gameplay (e.g., [6][34]). While intrinsic motivation is central to videogame play, research has also examined the influence of extrinsic motivation on the gameplay experience. The Work Preference Inventory has been used to measure both intrinsic and extrinsic motivation orientations of game players [1].

Ryan, Rigby and Przybylski [25][26] have applied an established psychological theory – Self-Determination Theory (SDT) – to videogame player motivations. SDT is primarily concerned with the potential of social contexts to provide experiences that satisfy universal needs in people. In addition, research has identified the influence that personal characteristics of the user, such as a willingness to suspend disbelief [19], or internal tendencies to become involved [32], have on a player’s gaming experience.

**Enjoyment and the Player Experience**

Research persistently identifies that people primarily use media for enjoyment [27]. Media enjoyment has been categorized as having affective, cognitive, and behavioural dimensions [22], and these dimensions have been used to examine videogame enjoyment [10]. More widely, enjoyment in videogames has been examined with respect to flow (e.g. [27][5]). Flow is a theory of optimal experience that may be described as the holistic sensation that people feel when they act with total involvement [7]. The most typical kind of flow experience is play, and games are the most common forms of play activity [7].

Given that engagement and absorption are pillars of enjoyment within a gameplay context [16], videogames have been examined with respect to immersion [16], presence [29], and cognitive absorption [2]. Many of these concepts are linked. Immersion, like flow, is defined as a state whereby people become highly absorbed in their activities [16]. Similarly, cognitive absorption is a state of deep involvement that results in temporal dissociation and a lessening of awareness of surroundings [2]. Presence may be defined as the subjective sensation of being within a scene depicted through a virtual medium [29].

It’s important to acknowledge the interrelationship between the sensory experience provided by the videogame environment and states of flow, immersion, presence, and cognitive absorption. While the medium is the trigger or context for these states, by definition these states occur within, and are properties of, the person. For example, presence and immersion are achieved when a person’s perception fails to acknowledge the role of the medium or technology [29]. Immersed and absorbed players ‘lose’ themselves within a game world [16]. To achieve such a state, a player needs to be able to seamlessly interact with the external representations produced by the game.

**Game Design and Player Experience**

Enjoyable game experiences result from players being able to work through the game interface to become immersed in playful activity. The game environment is the medium that allows the player to achieve such an experience. The characteristics of the game form and content, in combination with characteristics of players, influence a player’s feeling of presence [19]. It is the interaction between sensory stimulation, environmental factors, and a player’s internal tendencies that encourage involvement and enable immersion [32]. Achieving a state of flow is dependent on flow activities, activities that have clearly achievable goals and where the person understands the rules of interaction and feels in control [7]. Flow relies on a dynamic interaction between the skill and challenge levels offered by an activity [7]. Immersive flow experiences emerge when an ideal balance between level of ability and challenge is achieved.

Malone and Lepper [21] identified heuristics for creating engaging experiences. These heuristics are based on features that make games fun and have been designed to motivate and engage. Habgood [13] has used these heuristics as the foundation for designing engaging educational games. Similarly GameFlow [28] is designed to identify elements of game environments that influence the player experience. Based on flow, GameFlow is a model consisting of eight elements with associated criteria for achieving enjoyment in games. Research has also explored how different people are motivated by different psycho-structural elements of games [31]. This research builds on the structural features of games that might influence the play experience [33] and a taxonomy created by King et al. [17] that offers a psychological understanding of these structural features.

**MEASURING PLAYER EXPERIENCE**

Alongside the issue of conceptualisation of the player experience is the question of how player experience is validly measured. A number of survey measures have been developed and validated to varying extents. Many of the relevant measures focus specifically on the experience of videogame play, including the Player Experience of Need Satisfaction [26], the Game Experience Questionnaire [15] and the Game Engagement Questionnaire [4]. Other relevant measures include those that are focused on immersive or engaging experiences, but not necessarily specific to videogames, examples include the Tendency...
Towards Presence Scale [29] and the ITC-Sense of Presence Inventory [19].

Additionally, emerging research has begun exploring the value of biometric data as a more objective means of assessing the experience of videogame play. Research in this area has explored questions of dynamic difficulty adjustment, engagement, immersion, flow, emotional response, motivation, arousal and the impact of violent content. The measures employed include electroencephalography (EEG), electromyography (EMG), eye tracking, heart rate, respiration, skin conductance, blood pressure and functional magnetic resonance imaging [16][9][11][12][14][23]. In terms of measurement of the play experience, important questions remain around; the overlap between different measures, the reliability and validity of both subjective and objective techniques, and also how the two types of techniques can be used effectively together.

**WORKSHOP GOALS AND THEMES**

Within this workshop we look to understand the complex relationship between players, the play experience, and the game environment. In order to understand this complexity we must analyze the active role that player characteristics and the game have on motivations to play. Antecedents that influence play experience, such as individual player differences, and the design, structure, and content of game elements also need to be considered. Player experience in terms of flow, presence, immersion, and cognitive absorption are central to research in this field.

We are particularly interested in research that rigorously and systematically analyses the gameplay experience. In taking a psychological perspective, we intend to examine theories of motivation (e.g. SDT) and explore how these might be used to better understand and measure people’s enjoyment of videogames. Existing theories of engagement and absorption and their relationship to the gameplay experience are cornerstones of research in this field. How these theories may be considered with respect to antecedents to, and predictors of, enjoyable, engaging, and immersive play experience is also of particular interest.

The overarching goals of the workshop are not only to explore conceptualisations of player motivation, the play experience and the game environment, but also to begin to understand how these aspects interact, overlap and differ. Example questions in this space include; how are the elements of game environments that promote flow, immersion engagement etc. best distinguished from the internal experience of the player in these states? How do players’ individual motivations interact with features of the game environment? How do the various conceptualisations of play experience (need satisfaction, flow, immersion, enjoyment, engagement etc.) differ and overlap?

**TOPICS OF INTEREST**

We invite contributions from various disciplines on topics including, but not limited to:

- Examining the physiological, affective, cognitive, and social dimensions of player experience;
- Analysis of the relationship between structural game elements (e.g., goals, feedback) and player experience;
- Novel methods designed to support the investigation of the gameplay experience; and
- Adaption of existing methods and discussion of strengths and weaknesses in the context of the play experience.

In sum, we aim to bring together experts with an interest in the topics listed with a view to better understanding each other’s work but more importantly, to identify and explore where different conceptualisations and methodologies overlap, complement and potentially inform one another.

**WORKSHOP FORMAT**

This 1-day workshop will begin with brief introductions by all participants and short presentations of all workshop submissions. On completion of the presentations we will conduct a brief exercise to identify themes, ideas and issues that have emerged. Small group activities will follow. These activities revolve around scenarios designed to explore the strengths of existing subjective and objective measures of the play experience. Discussions and results for each group will be recorded and presented. The final session is a wrap-up that focuses on general observations from the workshop, future work and plans for follow-up activities.

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ABSTRACT
This paper describes a novel approach to Experience-Driven Content Generation, intent on facilitating authoring of adaptive game design experiences. After reviewing major methods and technologies for analysis and improvement of player experience, the authors propose a framework that harnesses available technology to empower game designers to more effectively craft experiences. The idea of this approach is to let authors materialize their expectations on how players should end up playing the game into a platform, which can then automatically optimize game parameters to fit that vision.

Author Keywords
User Experience; Computer Games; Game Design; Content Generation

ACM Classification Keywords
K.8.0 Personal Computing: General—Games

General Terms
Design; Measurement

INTRODUCTION
The field of game design has, for the most part, been governed by intuition and empirical knowledge, with very little usable theory existing which can frame the process of videogame creation. In regards to how videogames convey experience—the actual perception of the artifact in use—major lines of thought lack concrete evidence. Founding pillars of game theory come from different fields and are mostly general in nature, and while certainly useful for guidance in game design, they lack a strong quantitative basis [18]. Recent years have seen the rise of new methods that can better inform creators in the videogame design process, by providing increasingly meaningful and objective data on how videogames are effectively played and perceived. This changes the design landscape considerably, opening up new avenues for exploration. On the forefront of research in the area has been the idea of Experience-Driven Content Generation. The concept is to use gameplay data to generate some sort of player profile, one which can then be used to dynamically tailor the experience to each player’s personal needs. The rationale behind this approach takes into consideration the fact that videogame markets have become heterogeneous, catering to increasingly fragmented segments of the population, relying on different structural aspects to produce similar affective experiences [27]. The problem in this approach, as we see it, is that it unbalances the role between author and audience in a medium that we consider is already too player-centric. By consciously enforcing a game-design methodology that views players as the center of the creative process, designers are giving up any potential creative output. While this path is welcome and can appropriately serve many production companies, we believe it is not agnostic in terms of what type of philosophy it imposes on creators. It incurs the risk of crippling creativity, for players can only want and appropriate known videogame templates, and by subjugating game design in function of players needs, a vicious cycle may emerge where we keep feeding the same old formulas to players.

LITERATURE REVIEW

User Experience
It is in part because of this awareness that artefacts design is shifting from the product design to experience design, i.e. from the material properties of the artefact to how it ends up being used in context, or experienced [7]. Understanding users’ experience and how artefacts imply and mediate specific experiences thus becomes the focus of the designers’ work. To begin with, user experience is a hard concept to define, and despite growing interest in the question, the answers are diffuse and ambiguous [17]. McCarthy and Wright form a comprehensive picture of the concept starting from a pragmatist point of view, “experience can be seen as the irreducible totality of people acting, sensing, thinking, feeling, and making meaning in a setting, including their perception and sensation of their own actions”[7]. In this sense, all interactions between users and a given artefact, are part of the experience, whether they be subjective (thoughts, emotions, memories, interpretations) or objective and therefore, observable and measurable (movement, action, space, passing of time, behavior). What then becomes relevant is to consider which methods can be used to extract meaningful information regarding user experience, and how they can be framed in order to assist the design process.

Self-Reporting

Subjective reports or questionnaires were still the most widespread means for assessing a subject’s emotional response in 1999 [5], and remain so even today for evaluating affective experience in user-product design [11]. Reporting can be achieved by oral interview or through written questionnaire, typically after the experience has ended [10]. Subjective reports present a wealth of problems regarding their use as a persons’ experience assessment method. Results are highly subjective and dependent on subjects’ “perception of the experience and its context and [...] ability to interpret and express their feelings” [11]. The questionings, be they verbal, written or otherwise, influence on subjects replies, as they are inevitably conditioned by social constraints on how to answer. In consumer research, direct questioning has been noted for its relevant number of arising issues concerning users incapacity to properly express their needs [23]. Worse, subjects rely on their memory of the events (experiential memory) when filling out forms, therefore assessing their own biased recollection of felt emotions as opposed to their actual feeling [5]. Further limiting the usefulness of the method, the “act of repeated measurement can potentially alter the emotional response itself” [19], impeding possibilities of continuous inquiries to subjects for greater time-definition.

**Physiological Data**

Computer science can now offer alternatives to subjective reports for assessing a person’s cognitive and affective state. Emotion, for instance, is not only comprised of a subjective experience but also a number of physiological correlates [6], and these physiological changes can potentially be measured and analyzed so as to recognize emotion, as well as other psychological variables. Measurements of several types of biological signals, from electroencephalography to heart rate activity, skin conductance, temperature, etc. have been used to assess cognitive and emotional states [14, 11, 12, 16, 9, 1]. Some of these systems show very promising results, with correct classification accuracy getting closer and closer to 100%; however, research into automatic detection is still in its infancy, with results lacking off-laboratory validation. Our own research highlights many of the pitfalls of trying to employ and EGG system for classification of emotions during a gameplay session [3]. Pattern recognition systems need vast amounts of data in order to produce general classification models, and right now, there is no accepted database of cognitive and emotional patterns, even worse, there is no complete and consensual model of cognitive and emotional states; in fact, there is not even a consensus on what comprises an emotion. The relationship between these bodily processes and cognitive aspects of experience is, simply put, not fully understood by currently existing theories and methods. Furthermore, there is a case to consider in the difficulty in using these methods on location; while EEG devices are getting smaller and smaller, they still tend to be unwieldy, lacking portability, ease of use and wide-spread availability, limiting their use in large scale deployment of videogames.

**Gameplay Metrics**

Gameplay metrics are a recent method used in gameplay analysis. It tracks UIEs (user interaction events), producing detailed logs of all actions which users take part in [13]. It automatically records user behavior and tracks specific metrics of interest (e.g. time taken to carry out a specific task), without the need for time consuming ethnographic studies, audio-visual recording analyses or other hand-coded methods [13, 4]. Data can consist of “low-level” metrics (e.g. keystrokes) or “high-level” (e.g. player position in the virtual world) [22], providing several tangible benefits [4], namely: high detail, quantitative data on player behavior; an objective method for visualizing and analyzing game-session data; detailed feedback on game design and mechanics; help track location of game problems and helps evaluating fixes; customizable details of analysis; easily supplemented by other existing methods for user experience testing and bug-tracking (since data for these purposes can be collected simultaneously).

For now, the focus is on dealing with issues that emerge from game production processes, giving stake holders access to objective data on how the game ends up being played [13, 4, 22, 8, 2]. In turn, this information allows for accurate fine-tuning of different aspects of the experience, guaranteeing that designers’ original vision is preserved and increasing the probability of commercial success [13, 4]. There is the issue of how data can be processed and presented to designers in order to become useful. Given the large quantities of data generated whilst in play, a great effort has to be put in making the right data available in the right format, with considerable research being made on visualization tools for that end [2, 8]. And this is only in terms of how data can be made meaningful; the following problem being how knowledge on game design issues can be translated into improved designs that solve these same issues. Right now, designers must explore the data and use their know-how and intuition to solve these issues, await new feedback and then verify if the problem has indeed been solved.

**Experience Driven Content Generation**

Right now, a growing body of research is tackling head on how game experience variables can be improved through procedurally generated content (Experience-Driven Procedural Content Generation, or EDPCG for short [27]). The general concept is to use a data source to create a player experience model (product of the interaction of players with the game system), and then generate/evolve game content that improves player experience. Data sources that can be used for the assessment of player experience include all the above sources: gameplay metrics, physiological data, subjective reporting etc., with several alternatives falling in these families. Experience quality is then assessed based on player experience data, whether it be the result of gameplay, questionnaires, or even simulated game-play sessions (using AI techniques). Once quality has been assessed, content is represented in computational form, and new game content is generated. Procedurally generated content can encompass level design, art assets, etc. As of now, several pioneering efforts have been made with this approach.

In [25], Yannakakis et al. studied how to measure game interest in predator/prey games (such as Pac-Man), based on the assumption that interest is mostly determined by qualities of
computer characters’ behavior as opposed to other features (such as the game’s graphical properties). To this effect, they proposed and then implemented a neuro-evolution learning algorithm that maximized interest criteria based on gameplay metrics, validating the technique with pair-wise player questionnaires [25, 24, 26].

In [18], this methodology was expanded to classify and predict a greater number of experience variables, covering up to 6 emotional categories: fun, challenge, boredom, frustration, predictability, and anxiety. Metrics data from several gameplay sessions was used to track correlations with player experience reports and different Super Mario Bros. levels. Their model’s accuracy for the six emotion types was high. Finally, Super Mario Bros’ levels were adapted in real time in order to optimize fun, both for human players and AI simulated agents [20].

These studies show that subjective experience perception criteria can be evaluated from automatically extracted metrics data. Furthermore, these studies show that game variables that affect experience can be altered so as to improve quantitative and qualitative aspects of player experience, by using well-known optimization algorithms.

**APPROACH**

Several benefits have been studied and verified in relation to user-centered design philosophies, namely in terms of increased system quality thanks to more accurate requirements, heightened production efficiency, improved user acceptance, amongst others [15]. But we share with other researchers [21] reasonable concerns over how this user-focused mentality can impair innovation and creativity. Even proponents are careful in how they frame a user-centered approach to design, maintaining a focus on designer’s intervening in the process [15]. Indeed, user-centered design presupposes designers to enter into meaningful dialogical debate with users, in such a way that knowledge is shared from both ends so that design decisions are rightfully informed in collaborative manner [21], never dictated exclusively by user needs.

The problem with the aforementioned EDPCG approaches, as we see them, is that they unbalance the role between author and audience in a medium that we consider is already too player-centric. Game designers, like other members of the design field, run the risk of “reducing experience to the mere "pleasure due to the feel of the action"” [7], i.e., thinking of user satisfaction as opposed to user experience. Experiences can be a way to fulfill greater psychological needs [7], and do not come to us ready-made, the effort we undertake is a requirement for the quality and meaningfulness which the experience comes to possess [17].

**DESIGN**

Here, we lay out the major coordinates of this new EDPCG approach, by describing its functioning in terms of the major units of the methodology. Firstly, it will be a Metrics Based Experience Model that would power the architecture. With this choice we are making the assumption that gameplay Metrics are a good player experience predictor, or at least, the available best. This choice is justified by the impracticalities of using physiological data in large scale experiments and the lack of confidence in self-reporting; so, gameplay metrics seem the best fit for characterizing player experience. They are quantitative, objective, allow for automatic data collection, and scale well.

Even thus, for the lofty goal of experience design to be materialized, we know that gameplay metrics are not enough to sufficiently describe a game experience. However, it is conceivable that metrics do have sufficiently expressive data for major lines of experience to be derived from and, indeed, it is empirically sound that whatever player experience vision game designers have can be translatable into some envisioned form of in-game behavior. Designers are to be able do this today; the key difference being that a platform as the one we propose can give hard data on how players actually do play, in the end serving as a validation mechanism not for the experience itself, but for the envisioned gameplay behavior. But, in cases where the inherently subjective side of the experience is required by designers, there is nothing impeding the architecture from also providing game experience questionnaires that can supply that information. However, the major focus of our platform is providing the former.

**Content Quality**

Content Quality Assessment would be solely on a designer basis; this means that measurement of the quality of each instantiation of our game is to be done by designers themselves. The idea is to have an open interface which allows designers to determine the criteria that should be fulfilled in terms of player experience. Through this interface, designers can establish which key metrics must be monitored by the system, which range should be achieved, and which parameters should be varied in order to optimize player experience. Unlike examples referred to in the literature review, we do not want players to determine which experience they prefer (directly or indirectly), nor do we wish to allow their subjective feelings to impose as metrics of success of the experience; rather, the point in this approach is to let designers determine how player behavior will occur, under the expectation that it presupposes a specific experience defined by authors. Whether players engage in the game or not is a whole other matter which this approach does not intend to solve.

**Content Representation**

In terms of representation, our proposal in terms of architecture strives for a minimalist, constrained approach. Since the main objective of the architecture is only to provide iterative improvement of player experience until it fulfills specified ‘experience goals’, and not generate totally new videogames, there is no need to represent the entirety of a videogame, only given aspects of the game that affect metrics of interest. Here, we let authors define which game design variables they are willing to forfeit control of, so that the platform can provide new configurations. In this, we also assume that authors chose these parameters in a sensible manner, meaning parameters that are expected to affect target metrics.

**Content Generation**
Optimization of parameters is, at this stage, the most challenging of the architecture’s methods, for the choice of a search algorithm naturally requires understanding of the search space’s properties. Since we could not find any systematic study of the relationship between variation in design parameters and player behavior, we must acquire some sensitivity to this issue through our own research. Data that helps answer how this process works is being obtained by means of several tests that have to occur before such a critical decision as choosing a search algorithm for optimization. For only with such data can an optimization algorithm be chosen with confidence and empirical backing.

Architecture

Now we can describe, in a more formal manner, the system architecture; the following figure shows a schematic for a given iteration $i$.

![Diagram of the Proposed Architecture](image)

Figure 1. Diagram of the Proposed Architecture – see text for details.

As can be seen, there are a number of key variables and functions that our system must offer to designers. Let us describe these.

Variables:

- **$s$** - input/output signals. These are the raw input/output data which are generated during gameplay sessions to then be processed so as to inform the system on how the game is actually being played.

- **$m$** - gameplay metrics. These are constituted by meaningful gameplay data, product of transformations and abstractions in regards to $s$.

- **$m_i$** - experience goals translated into a set of target metrics which materialize designer intentions. The idea is that designers can, in some way, write a meta-script on how he game will end up being played. This script must express itself in a language defined according to their experience model. As such, intentions have to be determined as specific properties of experience which can be translated into behavioral terms.

- **$p$** - game design parameters. These pertain to actual game parameters that designers must open up in their base game (or archetype) for the platform to vary. These should be adequate and sufficient in their range to allow for the optimization of the experience, in order to find a $p_{\text{ideal}}$ that satisfies designer intentions; designers should also afford a working set of these variables $p_{\text{initial}}$ and a limited range for exploration $P$, which establishes their domain.

- **$q$** - quality of a given game solution. This should be a positive value pertaining to how proximate metrics are, at a given moment to the goal. The objective of the platform is to minimize this value.

Functions:

- **$M$** - signal to gameplay metrics function. This represents transformations of input/output signals into workable game design variables $m$ that meaningfully represent player behavior and game-state.

\[ M(s) = m \]  

(1)

- **$G$** - function which represents the videogame’s active, non-linear, transformation of parameters into an experience, and from its interaction with players, deriving a number of signals $s$.

\[ G(p) = s \]  

(2)

As a form of simplifying the notation, we can also define $G_M$ which represents the convolution of $M$ with $G$:

\[ G_M(p) = m \]  

(3)

- **$Q$** - quality method. The purpose of this is to verify if the current working game design parameters $p_i$ provide an experience whose metrics $m_i$ are in line with designers intentions $m_I$.

\[ Q(m, m_i) = q, q \in [0, +\infty[ \]  

(4)

- **$C$** - parameter generation function. Its role is to provide, by use of a search algorithm, an approximation of an optimal value of $p$ that validates condition $Q$.

\[ \lim_{t \to T} C(p_i, q) = p_{\text{ideal}} \land Q(G_M(p_{\text{ideal}}), i) = 0 \]  

(5)

**FUTURE WORK**

At the current moment we are developing the first prototype of our system, which we hope will give us information on which methods can be used for each of the frameworks’ units of processing, as well as give further insight on issues of feasibility, portability and usefulness for designers.

**REFERENCES**


Defining Gameplay Metrics from a Participation-centered Perspective

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ABSTRACT
In this paper we exemplify the definition of gameplay metrics centered on participation, the way players take part in gameplay activity, from which gameplay experience emerges. We demonstrate the use of a game design and evaluation model built upon the participation concept. This model aims to guide the identification and interpretation of gameplay metrics that best fit the character of the videogame under analysis, helping to plan the evaluation of gameplay experience in the perspective of game design goals. By rationalizing the participation in the game context through six perspectives (Playfulness, Challenge, Embodiment, Sociability, Sensemaking and Sensoriality), our work aims to contribute to inform the game design and evaluation activities. Along with the conceptualization of player participation in the videogame context, we propose the use of the Goal-Question-Metrics (GQM) approach to operationalize the production of participation indicators and metrics. To illustrate the definition of gameplay metrics through the GQM approach, we present examples of application of this approach in different games.

Author Keywords
Participation, Game Design, Gameplay Experience Evaluation, Gameplay Metrics

ACM Classification Keywords
K.8.0 [Personal Computing]: General—Games  
H5.2. Information interfaces and presentation (e.g., HCI): User Interfaces, Evaluation/methodology.

General Terms
Design, Human Factors, Measurement.

INTRODUCTION
The gameplay experience evaluation is a crucial step in a videogame development process in order to assess the extent to which the videogame enables the gameplay experience intended. Designing a videogame consists of enabling and inhibiting types of player participation according to an idealized experience [16]. When designing a game a user experience is always invoked, regardless of whether it is considered explicitly or implicitly in the designer’s decision-making process. It is our basic conjecture that the explicit consideration of the participatory qualities of the play experience could help orient the game design activity towards defining the design elements most capable of enabling the intended forms of participation.

However, experience is hard to define and characterize in a formal manner because of its holistic and multi-dimensional nature [14][10]. In the game studies field, gameplay experience has often been characterized through concepts like fun [12][9], flow [6][4][22] or immersion [8][23]. In addition to the often ambiguous definition of these concepts, their usefulness for design purposes is questionable, at least in the sense that they do not allow us to think of the experience enabled by the videogame medium in a way which is both clear, comprehensive, and generative of new experiences.

Ever since Crawford [5], game design authors have dedicated effort at defining the nature of games (e.g.
This need arises from the persistent ambiguity of what we mean by game, which makes it hard to analyze the experience with such artifacts in a systematic and comprehensive way.

The use of gameplay metrics to track players' behavior has been receiving increased interest in the context of gameplay experience evaluation [7][13][24]. The advantages associated with this approach are related to the ability to analyze the behavior of players objectively with a great detail for as long as the entire gameplay session. The fact that this information can be processed automatically allows tracking of a large number of players.

However, given the complexity and volume of data that can be generated in a gameplay session, challenges can be encountered in the interpretation of data. Moreover, the objective data does not answer why the players took their decisions or the emotional effect generated, so it is generally recommended to use additional evaluation approaches.

In this paper we use a game design and evaluation model centered on participation concept as an instrument to guide the definition of gameplay metrics. Additionally we illustrate how we can apply the Goal-Question-Metric (GQM) approach to support the definition of gameplay metrics to measure the players' participation in different videogames.

PARTICIPATION

Thus, if on the one hand the aim of a videogame object is to support an experience, on the other hand, the design of this experience is not directly within the designer's reach in view of the non-deterministic nature of our relation with technology and of the subjectivity associated with the experience [16]; this challenge is compounded with the difficulty in addressing (characterizing, thinking, streamlining) the videogame, mainly because of its multiple character. From this perspective arises the motivation to refocus the issue of game design and evaluation on the perspective of player participation in the game.

In [17] we proposed an initial model aimed at supporting the design and analysis of videogames in order to achieve a rationalization between what the designer intended the playing experience to be and the experience potentially achieved, as interpreted by players. This model will be further developed through the characterization of forms of player participation in the gameplay activity.

In this work we depart from the following notion: "Play is experienced through participation. When a player interacts with a game, the formal system is manifest through experiential effects.” [18] Participation is seen as a key feature of the videogame medium [1][15].

PARTICIPATION-CENTRIC DESIGN MODEL

"Design is the process by which a designer creates a context to be encountered by a participant, from which meaning emerges.” [18] We consider the design of a videogame as the creation of a special kind of context [16]. This context consists of elements that promote and inhibit certain forms of participation, from which experience and meaning emerges. In order to design a videogame it is then necessary to consider how the elements composing the game medium will be translated by the player, so as to support the intended forms of participation and, consequently, a game playing experience. Thus, we find that the concept of participation to be closely related to the gameplay experience and consequently to the design of games as participatory media.

The game design and evaluation model centered on the concept of participation we are presenting is intended to support the designer in considering how the player takes part in the game. To achieve that we consider six perspectives on participation (Fig. 1):

- **Playfulness** - The videogame as a context of free, informal, and unstructured participation.
- **Challenge** - The videogame as a context of structured participation, of a formal challenge, or according to a proposed target.
- **Embodiment** - The videogame as a context of physical participation, both virtual and actual.
- **Sensemaking** - The videogame as a context of significant participation, of creation of meaning.
- **Sensoriality** - The videogame as a context of multisensory involvement.
- **Sociability** - The videogame as a context of social participation, of establishing relationships between players.

With this aim we've considered three operational focii: a) Intent: What is the participation ideal that the videogame is suggesting? b) Artifact: How does the artifact supports the idealized forms of participation? c) Participation: What characteristics of the actual player participation are consistent with or revealing of the participation idealized?

At the intent level of operation we organize the proposed forms of participation and, implicitly, the kind of experiences enabled. At artifact level we envision an object as medium that enables a context calling for the intended forms of participation. The third level of operation is meant to focus observation, analysis and evaluation of actual player participation, in particular, to examine if the gameplay activity meets the design intent, and to point
towards the indicators and metrics we can define that would be revealing of progress towards that intent. Table 1 shows examples of the rationalization of players’ participation in three foci of analysis.

<table>
<thead>
<tr>
<th>Intention</th>
<th>Artifact</th>
<th>Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Playfulness</td>
<td>exploring, discovering, recreating, customizing</td>
<td>the nature of a player’s agency, the variety of interactive elements of the game (objects, characters, actions, etc.)</td>
</tr>
<tr>
<td>Challenge</td>
<td>overcoming a challenge, creating a strategy, defeating an opponent, mastering a skill</td>
<td>nature of challenges proposed, type of penalties and rewards, intensity and organization of challenges</td>
</tr>
<tr>
<td>Embodiment</td>
<td>physical involvement, physical performance</td>
<td>representation of the physical game world, player’s representation on the game world, interpretation of player’s movement</td>
</tr>
<tr>
<td>Sensemaking</td>
<td>interpretation of a role, fantasy, self-expression</td>
<td>theme and underlying narratives, models and representations of phenomena, roles and motives, significant actions</td>
</tr>
<tr>
<td>Sensoriality</td>
<td>contemplation, wonder</td>
<td>style, nature of the stimuli, visual and sonic compositions, synesthetic explorations</td>
</tr>
<tr>
<td>Sociability</td>
<td>competition, cooperation, friendship, identification, recognition</td>
<td>diversity and nature of social interactions and relationships, models of social structures (team, hierarchy, etc)</td>
</tr>
</tbody>
</table>

Table 1 – A Model Proposal for Participation-centered Game Experience Design [14]

THE GOAL QUESTION METRIC APPROACH
We propose to use the Goal-Question-Metric (GQM) approach [20][2] to support the definition of gameplay metrics for the analysis of players’ participation. The GQM approach is a goal-oriented measurement framework to define/select metrics for specific contexts in a top-down manner. Although this approach was initially proposed in the context of Software Engineering, the underlying concepts are suitable to others measurement contexts [E]. Goal, Questions and Metrics are the basic concepts of this approach and are organized in a hierarchical structure with three levels. The first level corresponds to the concept level where intents are synthesized as goals to be achieved in a context and from the perspective of stakeholders, and those goals motivate the measurement exercise. The second level corresponds to the operational level, which establishes the questions to be answered in order to enable decision-making oriented towards the proposed goals. Finally, the third level correspond to the synthesis of metrics that, when collected would enable the processing of quantitative indicators, possibly to be combined, and from which we will draw responses to each question. According to [20] the GQM approach contains four phases:

- The Planning phase – the project for the measurement application is selected, defined, characterized, and planned, resulting in a project plan.
- The Definition phase – the measurement program is defined (goal, questions, metrics and hypotheses are defined) and documented, along with a data definition that specifies what data is needed, how it is obtained and classified, and how each metric should be calculated.
- The Data collection phase – the actual data collection takes place, resulting in collected data from which actual and concrete metrics and indicators can be processed.
- The Interpretation phase – the collected data is processed with respect to the defined metrics into measurement results that provide answers, to the defined questions, after which goal attainment can be evaluated.

The conceptualization of the videogame medium as a context of participation allows us to rationalize the gameplay activity along specific forms of participation and thus guide the assessment of the behavior of players in a quantifiable manner. To achieve that we can argue that it is plausible to consider the use of the GQM approach in drafting a measurement plan for assessing the participation of players. Since the key idea of our work is to understand
the game design activity as a configuration of a specific context that encourages specific forms of participation, we are interested in using the GQM approach to characterize player activity along these perspectives of participation. We think that the conceptualization of gameplay activity around the concept of participation, together with the GQM approach can support the creation of evaluation instruments specific to each project and that can provide useful information to guide the game design activity.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Questions</th>
<th>Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Playfulness</td>
<td>To characterize the participation in the videogame <em>Noby Noby Boy</em> along the perspective of <em>Playfulness</em>.</td>
<td>- Which elements are exploited more often?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- What is the variety of elements explored?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- What is the rate of exploration of each gameplay element?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- What is the maximum/cumulative duration of interaction with each element?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- What is the % of area explored?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- What is the rhythm of exploration?</td>
</tr>
<tr>
<td>Challenge</td>
<td>To characterize the participation in the videogame <em>Pong</em> along the perspective of <em>Challenge</em>.</td>
<td>- What is the duration of the game sessions?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- How many games were lost/won by player?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- How is the distribution of results per player?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- What is the sequence of results?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- What is the rate of progress in the game?</td>
</tr>
<tr>
<td>Embodiment</td>
<td>To characterize the participation in the videogame <em>Wii Sports</em> along the perspective of <em>Embodiment</em>.</td>
<td>- number of interactions per element type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- number of different elements explored per time period</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- maximum number of elements simultaneously operated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- location of elements explored</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- length of movement of the avatar per time period</td>
</tr>
<tr>
<td>Sensemaking</td>
<td>To characterize the participation in the videogame <em>September 12th</em> along the perspective of <em>Sensemaking</em>.</td>
<td>- duration of game sessions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- number of games won/player</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- number of games lost/player</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- sequence of results per player</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- rate of won/lost games</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- number of sub goals per period</td>
</tr>
<tr>
<td>Sensoriality</td>
<td>To characterize the participation along the videogame <em>Flower</em> in the perspective of <em>Sensoriality</em>.</td>
<td>- number of accelerations/period</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- average speed of motion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- duration of each motion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- distance of each motion</td>
</tr>
<tr>
<td>Sociability</td>
<td>To characterize the participation in the videogame <em>The Endless Forest</em> along the perspective of <em>Sociability</em>.</td>
<td>- number of rounds per minute</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- number of shots to terrorists</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- number of shots on civilians</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- number of terrorist deaths</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- number of deaths from civilians</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- number of conversions</td>
</tr>
</tbody>
</table>

Table 2 – Examples of Goal-Questions-Metrics built on different perspectives of participation
Table 2 shows examples of a goal, questions and metrics setting to evaluate the participation of players targeting different videogames, where each perspective of the six forms of participation proposed can be more easily understood. The videogames selection criterion has to do with their character, which we considered primarily enablers of the kind of participation to better illustrate each perspective. Equally plausible would be the definition of the entire spectrum of participation forms along a single project for a more complex game design, that would result in a more complete metrics plan offering a set of complementary perspectives over the play experience.

CURRENT AND FUTURE WORK
In [17] paper we present a preliminary version of a model to guide game design and experience evaluation activities. The model is a step to build methodological instruments for game design and gameplay experience evaluation. Having outlined the basic structure, the model is being tested with support instruments, evaluated based on actual design cases, and improved through iterations. For the evaluation of the model we are analyzing if the six perspectives are adequate to comprehensively characterize participation. To that end our current major concern is how to observe/measure player's participation in gameplay contexts. To that end we are developing gameplay indicators and metrics based on the participation lenses.

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Flow in Games: Proposing a Flow Experience Model

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ABSTRACT
When discussing fun in games, one will ultimately have to discuss the matching of skills and challenges as proposed in Csikszentmihalyi’s flow theory, an influential concept in game design. In this position paper, I want to give a brief overview of flow theory and its application in game research, as well as propose a model for further discussion that synthesizes common streams in game flow research. I hope this synthesis will be challenged and can serve as a discussion point for flow theory and player experience in games.

Author Keywords
Player Experience, Flow, Gameflow, Model Proposition.

ACM Classification Keywords
K.8.0 [General]: Games – Personal Computing; J.4 [Computer Applications]: Sociology, Psychology – Social and Behavioral Sciences; H.5.2 [Information Interfaces and Presentation]: User Interfaces – Theory and Methods

INTRODUCTION
Much what can be read in the modern game design literature about creating games that are “fun to play” can be attributed to an idea of mastering the skills necessary to play a game well [3]. Fundamentally, games are considered most fun if we feel that we are making meaningful decisions and that we are facing increasing challenges that will allow us to learn and train skills [10]. This concept is called flow. It was first introduced by Csikszentmihalyi [5] based on studies of intrinsically motivated behaviour of artists, chess players, musicians and sports players. This group was found to be rewarded by executing actions per se, experiencing high enjoyment and fulfilment in the activity itself. Csikszentmihalyi describes flow as a peak experience, the “holistic sensation that people feel when they act with total involvement” [5]. Thus, complete mental absorption in an activity is fundamental to this concept, which ultimately makes flow an experience mainly elicited in situations with high cognitive loading accompanied by a feeling of pleasure. According to Nakamura & Csikszentmihalyi [12], we can find common conditions that need to be met when entering flow. For example, in a game the following requirements should be met for flow to exist:

- A player performs a challenging activity that requires them to train a skill.
- This activity provides clear and close goals with immediate feedback about progress.
- The outcome of the activity is uncertain, but is directly influenced by player actions.

It seems that some of the core requirements of flow are also requirements of good game design. For example, to sustain interest in a game, it provides immediate clear goals, such as levels or missions, and high scores, health bars or life indicators. This allows players to evaluate individual progress. In addition, player actions directly and visibly impact the game world (e.g. pressing a button triggers shooting a weapon), a concept that has been labeled “effectance” [9, 15]. The following section will present concepts of flow theory in game research. These concepts will be framed in light of emotional and cognitive factors of gameplay experience.

Csikszentmihalyi’s Flow
Given that an individual is in a situation where all prerequisites for flow are present, it is possible to enter flow [12] as having the following components:

1. Concentration focuses on present moment.
2. Action and consciousness merge.
3. Self-awareness is lost.
4. One is in full control over one’s actions.
5. Temporal perception is distorted.
6. Doing the activity is rewarding in itself.

Since the original description of flow was held very general to be applied to a number of activities, game researchers have revisited the original components and redefined them for the analysis of digital games.

Jones’s Flow for Game-Based Learning
Jones [8] adjusted flow theory for use in game research and, for example, uses it for understanding engaging computer-based learning environments.

1. Facing a task that can be completed. Game levels provide small sections of missions and tasks, which make up the entire task of the game.
2. Player is able to concentrate on a single task from multiple tasks in a game. In digital games, convincing worlds are created that draw users in.

3. Tasks in the game have clear goals. Clear goals can be survival, collecting or gathering objects, or solving a puzzle.

4. Game tasks provide immediate feedback on progress. This relates to subjectively felt immediate effectance in games, e.g. clicking mouse triggers a shot, which hits enemy/monster to cause damage or exterminate.

5. Players feel deeply and effortlessly involved in the game. Game environments are far removed from individual realities. It is interesting to note here that this description only accommodates the notion of deep involvement, but gives no indication how this should be effortless.

6. Exercising a sense of control over the game world. Mastering game input and controls of the game.

7. Concern for self disappears during flow experience in a game session. Representation (e.g. death in game is different from death in real life), game problem (e.g. the level of challenge), and control over game systems (e.g. mastering input schemas) collaboratively cause this.

8. Sense of time duration is altered during play. People stay up all night to play games.

Elements (2) and (5), as well as elements (7) and (8) significantly overlap in their manifestations in games [4]. Element (1) should only be restricted the amount of aspiration a player has to play a certain game (i.e., by a player’s internal motivation to complete a game task, not by external factors like game level structure). Cowley et al. [4] also criticize that immediate feedback in games must be suitably patterned for a player to comprehend the information presented by the game world. Thus, although effectance is certainly a driver for game enjoyment [9], as a factor of flow in games, feedback must be presented in a manner that accounts for cognitive, attentional capacities of players.

COWLEY’S RESTRUCTURED FLOW IN GAMES
Cowley et al. [4] also present an updated mapping of flow elements to gameplay elements:

1. Game should feature challenging, but controllable tasks to complete. This is meant to account for the complete gameplay experience including elements of social interaction.

2. Players experience full immersion in the task. High motivation for playing is to feel immersed in a game, but immersion itself is a concept that is roughly defined [7].

3. Players feel in full control. The positive emotion for feeling control follows from cognitive processes enabling control by developing gameplay competence, understanding interaction semantics, and developing a cognitive script.

4. Players have complete freedom to concentrate on a task. Concentration on a task is nothing more than a persistent shift of attention to this task. Thus, the task must be perceptually incentive.

5. Task has clear unambiguous goals. Missions, plot, levels, quests, and explicit structures allow evaluating success of a gaming session. This relates to the ability of the human brain to only process a limited amount of information at a given time.

6. Game gives immediate feedback on player actions. A game may time the delivery of suitable rewards appropriately.

7. Players are less conscious about time passing. Games should focus on a vicarious, temporally-independent environments, enabling subjective perception of time to be altered.

8. Sense of identity lessens during gameplay, but is reinforced afterwards. Identification with player characters might facilitate cognitive shifts from individual identities to in-game identities [14], allowing for a transfer of empathy and emotion between the virtual identities and the player [1].

When we look at our systematic restructuring of these elements into cognitive and emotional components, we find that cognitive elements are central to describing flow-inducing gameplay. Being able to control a challenging task is largely a cognitive effort, but may contain subtasks that can be matched to schemas known from other game or media interactions or developed by playing the game. The full immersion in the task is largely achieved by mental and sensory loading of a player’s cognitive resources. The presence-inducing freedom to concentrate on a task at hand may be guided by a player’s motivational state, their gaming environment as well as any emotional disposition that they might have developed during prior exposure to playing games.

In contrast to this, the focus on clear goals is largely a game design effort to support cognitive processing of in-game information, by dividing gameplay elements into groups and clusters that can be mentally processed by players. The temporal distortion of flow in games depends on cognitive load and the amount of attentional resources an individual allocates to passage of time [16]. Our brain is diverting all focus and attention to gameplay features, which results in a subjective disconnect from real-world time. Finally, the changed efficacy of players when entering and influencing a game world leads to a lessened sense of individual identity, since this is projected on the representative identity within the game world. The exerted cognitive effort to sustain a vicarious identity could be mediated by the
positive emotion accompanying this identification, partly due to the possibility to engage in actions deviant from and likely impossible in reality. Emotion could be a driver of projective identification in a game.

SWEETSER’S AND WYETH’S GAMEFLOW
Sweetser and Wyeth [13] have developed their own mapping of GameFlow criteria for player enjoyment in games. The most significant difference from the other models presented here is that it adds a dimension of social interaction, which is heavily critiqued by Cowley et al. [4], who question whether social interaction needs to be a necessary or desirable part of every game. The GameFlow components [13] are:

1. **Concentration** is largely a cognitive effort that refers to the allocation of a player’s resources of attention and an increase in cognitive, perceptual and memory workload [11]. This description is similar to the engagement phase of immersion [2].

2. **Challenge** is connected to both, cognitive processing to recognize challenging game problems and to an emotional reaction that accompanies challenge as it may be related to prior play experiences that are connected to certain feelings or memories of failure or success. Challenge in gameplay is central in studies of playability, where it is very important to distinguish challenges arising from bad interface and controls from challenges that are part of the game design.

3. **Player skills** relate to learning, development and mastery of a game-related skill set. This is a chiefly a cognitive effort, since it is likely related to the formation of gameplay schemas that are stored in memory and administered to gameplay situations governed by cognitive processes. Thus, the development of basic effective playing skills in the interaction between designed game features and player’s a priori knowledge can be seen as an important precursor for flow.

4. **Control** again relates to the felt effectance of player action. Thus, while mastering control is a cognitive process, control mentioned in this context rather refers to the felt experience of control and is therefore connected to emotional evaluation of the cognitive ability to exert game control. This kind of control could then relate to both internal game-challenge oriented control and user-interaction related control.

5. **Clear goals** is connected to a player’s ability to have enough mental resources for cognitively processing and clustering missions, levels, quests or game sections, so that their progress in the game is always apparent.

6. **Feedback** should be handled by the game to appropriately inform players at all time about their progress. This makes this element overlap with the prior “clear goals” and if we relate this to cognitive capacities of the player, a statement like “avoid cognitive overloading of players” would suffice for both concepts.

7. **Immersion** refers to a game’s capability to cognitively absorb players by pressing their mental processing in a way that is still enjoyable. Thus, immersion in this context is cognitive immersion, governed by an emotional evaluation that decides how much processing of game information is still pleasant.

8. **Social interaction** is not labelled as an element of flow, but as a strong element of game enjoyment. However, social components are crucial for experience.

In overview, the GameFlow model most notably adds the concept of immersion as a component of flow. It is questionable whether human opponents have any influence at all on a player’s flow experience and as Cowley et al. [4] note, Csikszentmihalyi’s original flow studies already included chess players, so that social interaction may have already been a part of their flow experience.

### A SYNTHESIZED FLOW MODEL FOR GAME RESEARCH

<table>
<thead>
<tr>
<th>Flow</th>
<th>Effectance</th>
<th>Identity</th>
<th>Transportation</th>
<th>Mental Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>[8]</td>
<td>Clear goals (3), feedback (4), control (6)</td>
<td>Self-concern lost (7)</td>
<td>Task completion (1), focused attention (2), temporal distortion (8)</td>
<td></td>
</tr>
<tr>
<td>[4]</td>
<td>Challenge/skills for task (1), control (3), clear goals (5), feedback (6)</td>
<td>Immersion (2)</td>
<td>Challenge/skills for task (1), focused attention (4), less temporal perception (7)</td>
<td></td>
</tr>
<tr>
<td>[13]</td>
<td>Challenge (2), skills (3), control (4), clear goals (5), feedback (6)</td>
<td>Immersion (7)</td>
<td>Concentration/ focus (1), challenge (2), skills (3)</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Synthesis of flow models according to their main components into four categories.

The categories of game experiences related or inherent in synthesized flow are the following:

1. **Effectance**: Possibly a very important driver of enjoyment in digital games [9], effectance describes the feeling of empowerment rising in players’ when they can witness the impact of their actions. This can be experienced when challenge of the game match the player’s skills, feedback provides immediate...
information about progress in terms of goals, the interaction semantics of the game system can be mastered. A possibly more complicated mapping is that of action-awareness merging to effectance, but acquisition of gameplay competence can lead to this merging. This is motivated by effectance.

2. Identification: The changed perception of identity was noted as important for flow experience, but it might also be related to concepts of escapism and identifying with a character in a game world [1, 6]. The ability to test out other identities in a game might lead to the reinforced return to the own identity after a play session, described as the reinforced sense of identity [4].

3. Transportation: This is described mainly as the feeling of immersion in games [4, 13]. However, since immersion itself is ill defined and has been described as a progression [7] rather than a state (potentially leading to the state of presence), a more general description of transportation will be used here. Transportation can account for immersion as the process of transporting the player’s mind and for presence as the state of the player’s mind as being inside the virtual world.

4. Mental workload: Many elements of flow contribute to or result from mental workload of players. The distortion of temporal perception that is witness in flow is likely a result from the loading of players’ cognitive resources in a continuous manner during gameplay. The concentration of attention initiates the loading of players’ cognitive information processing. Resulting from this intense concentration is the creation of cognitive scripts for developing skills necessary to overcome present challenges.

![Flow Model Diagram](image.png)

**Figure 1. A synthesized Flow model for game research.**

**CONCLUSION**

These four gameplay components (see Figure 1) omit the discussed items social interaction [13] and self-motivation [12]. The latter can be a result from experiencing either of the states described above, while social interaction might have an impact on identification and transportation, since mental workload and effectance are concepts primarily resulting from the direct interaction of a player with a game system. While this categorization presents a first step toward understanding game experience in more detail, the categories in their current refinement are certainly still very open to interpretation and I hope this approach to synthesizing the flow models in the game research literature will lead to interesting discussions.

**REFERENCES**

Improving the Social Gaming Experience by Comparing Physical and Digital Tabletop Board Games

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ABSTRACT
Board game conversion to digital table tops has the potential to create an exciting and immersive gaming experience. Digitization can reduce the amount of manual work by automating game mechanics, such as scorekeeping and housekeeping activities; thus, allowing players to focus on strategizing and socializing. However, automation can increase the potential for confusion, such as why counters were updated. To understand the impact of automation on the social gaming experience, we conducted a mixed-methods study comparing physical and digital tabletop versions of the board game Pandemic. We collected and analyzed both quantitative and qualitative data using statistical and video analyses. These analyses revealed many important and subtle differences between the physical and digital game versions that impacted the players’ social experience. We proposed that our methodology may be useful for studying other types of physical and digital social games.

Author Keywords
Social gaming experience; digital tabletops; collaborative board games; automation; mixed-methods approach

ACM Classification Keywords
H.5.2 [User Interfaces]: Evaluation/methodology.

General Terms
Human Factors; Design; Experimentation; Measurement

INTRODUCTION
The digitization of board games has the potential to provide a more immersive environment, using game sound and animation, and to reduce the need to perform mundane or routine activities, such as shuffling or dealing cards and moving game pieces. Collaborative board games, such as Pandemic and Space Alert, will be used as a case study as they provide players a great chance to socialize while strategizing together.

Digital tabletops are interactive large horizontal surfaces that display content and support direct input on the surface. For example, the Microsoft Surface (Pixel Sense) and the SMART Table are commercially available tabletop products. Digital tabletops provide a promising platform for digital board gaming. Players are able to see each other’s facial expression and gestures; the digital nature of the system provides added benefits, such as setting up and cleaning up the game, keeping track of the scores, and maintaining housekeeping activities to leave players free to form strategies and engage in conversation. Thus, digital tabletop board games have the potential to enable a social gaming experience by combining the advantages of traditional board games with digital capabilities.

Given the potential benefits, some opportunities for further research also arise. While digitization enables automations in gameplay, they can introduce confusion by making the game’s behaviour difficult to follow. To further understand the impact of such automation, we conducted a study to compare players’ gameplay and gaming experience on physical board games to digital versions of the same game.

Our goal of the study was to reveal how different games and platforms can change the social gaming experience. We followed a mixed-methods research methodology [3] that involved collecting and analyzing both qualitative and quantitative data. An open coding analysis process [5] was applied to the qualitative data. Timestamps of player actions related to the social aspect of the gameplay were recorded. Moreover, we compared the physical board game with the digital versions to investigate how to create a more engaging and social gaming experience.

Previous gaming research studies have employed different methodologies for evaluation. For example, heuristic evaluation [4] can provide a quick and relatively cheap way to evaluate games and A/B testing [1] can test a single variable using a large sample of participants. However, these techniques provide little insight into the social aspect of gameplay. To investigate this aspect, observations of people playing games and interviews or focus groups with gamers can be used [2,6]. Though field notes and transcription of game sessions can provide rich qualitative data, in-depth analysis is needed to find subtle changes in players’ interactions and communication patterns, and to gain deep insights through immersion in the data.
The mixed-methods approach involving both analysis of game performance data and video coding of player behaviour allows researchers to describe the rich social gaming experience and interaction and use statistics to confirm the observations. The in-depth observations provided by the video data makes clear the trade-offs in game design and subtle differences across conditions. It also enables insights into players’ social interactions. This paper describes the methodology of our study as an example that uses this mixed-methods approach. Then, we present our video coding scheme and study results to demonstrate how it has provided a richer and deeper understanding of the player experience in both physical and digital board games. Finally, we discuss open questions and future research direction. We suggest that this methodology can be applied to other contexts to get a similarly deep understanding of the social experience of gaming. The methodology also produces both qualitative and quantitative data that can be used together to understand and measure the social gaming experience.

RESEARCH METHODOLOGY

To explore the social gaming experience, we conducted a mixed-methods study using the collaborative board game, Pandemic, as a test case. Three conditions were tested, varying the setup and amount of automation: one physical version with the traditional board game and two digital versions with low and high-automation on an interactive tablet. Twelve groups of three participants played all three versions of the game in a laboratory setting. Preliminary results from this work have been published [7]. This section highlights relevant information to explain our methodology.

Conditions

In the physical condition, we used a commercial board game, Pandemic (Figure 1). In the Pandemic game, three to four players work together to find cures to four diseases to save the world from epidemic outbreaks. One of the challenges in the game is to manage resources to find the ultimate cure while keeping the infections under control. Players lose the game if they run out of time (the set number of cards in a pile they draw from) or if the infections get out of control (i.e., exceed the number of allowed outbreaks).

The digital versions provide different levels of automation in the game and both are played on digital tables. The low-automation version is a direct translation from the physical game. All the game pieces can be positioned anywhere on the display, despite whether the move is legal. Some actions that are cumbersome to perform on a 2D interface were automated, such as shuffling the deck of cards.

The high-automation version (Figure 2) automates many of the game events, such as distributing diseases and resolving special game events, and players are only able to move the game pieces according to the rules of the game. It also handles scorekeeping, drawing cards, and housekeeping activities, such as updating counters. The changes caused by the game automation are shown through animations.

Data Collection

During the study, we collected the following qualitative and quantitative data: video and audio recording of the game play, screen capture of game sessions, and computer logs of the user interaction. Participants also completed a background questionnaire and a post-condition questionnaire after each game session.

Data Analysis

To fully understand the subtle differences in behaviour and social gaming experiences between the physical version and the two digital versions, we performed an in-depth video analysis. We used an open-coding process [5] to identify interesting player actions. Open coding is an iterative process in which the researcher starts with an initial set of codes (i.e., interesting actions), then codes the video data (i.e., records when interesting actions happen), and then revises and re-codes the video as more data are processed. This process produces a list of timestamps for all the interesting actions. They were summed up to produce counts of certain player actions and analyzed using repeated measures ANOVA statistical tests. The timestamps were also used to extract quotations and find examples for interesting actions. In summary, from the in-depth video coding analysis, we were able to extract both qualitative and quantitative data.
We deemed actions and incidents to be “interesting” when they indicated changes in communication patterns that may impact players’ social gaming experience. Specifically, we examined moments of confusion, undo actions, narration, and laughs. The coding scheme and the results will be discussed in-depth below.

The rest of the data collected were analyzed quantitatively. The computer log data were used to analyze each player’s contribution to the collaboration. The questionnaires asked players to rate their gameplay experience, such as level of contribution, understanding of the game actions, and enjoyment, on a 7-point Likert scale. A Friedman’s statistical test was used to analyze questionnaire data.

CODING SCHEME AND RESULTS
In this section, we will highlight the coding scheme and results related to the social aspect of the study.

Confusion
Even though the high-automation game required less effort to play, the chances of confusion increased. In the video analysis, we coded instances of confusion and long pauses during gameplay. We were able to record the number of times players were confused and when the confusion and long pauses happened in the gameplay. The data revealed that, after the animation displayed changes caused by a special event, players often had to look around to search for these changes on the game board. They also made exclamations to show their confusion or paused at length to process the changes. The long pauses are a notable exception in player behavior, as players usually talked non-stop throughout play. After pausing to process changes, players had to engage in further discussion with one another to update and validate their shared understanding of the game state; this discussion sometimes turned into heated debate. Thus, such confusion can negatively impact the social gaming experience and create frustration during gameplay.

Rule Consultation and Undo
One potential benefit of introducing automation is to have a set rule and relieve players from memorizing all of the rules. To examine the potential benefits and drawbacks of rule enforcement, we coded instances of consulting the rulebook, discussing rules, confusion about rule enforcement, and attempts to undo actions. The results showed that undo actions are performed not only for correcting wrong moves, but players often used physical game pieces to test strategies and communicate their ideas to one another. However, no undo functionality was provided in the high-automation version of the game, as this was considered a breach of the rules. Thus, when players attempted to test their strategies in the high-automation version, they sometimes ended up executing the strategy before they intended. Thus, a trade-off exists between providing constraints in the game to enforce rules, and providing the flexibility necessary to support communication strategies between players.

Use of Speech
We were also interested in whether the communication patterns changed across different conditions. To do so, we coded instances of narration, counting, and jokes players made. The data analysis revealed subtle differences in the purpose of narration. In the physical version, players narrated game events to announce what was about to happen as they carried out actions. On the other hand, in the high-automation version, players just reacted to changes and reported them. This result demonstrates a different level of engagement in the game. Finally, the analysis showed that most of the jokes players made were game-related. This leads us to believe that improving players’ interaction with the game and better facilitating the decision-making progress can enhance players’ social gaming experience.

Benefits of the Methodology
The results of the study show several benefits of the methodology. The observations revealed how well players understood the game animation and what coping mechanisms they used to deal with confusion. Compared to self-reported data from questionnaires and interviews, these observations provided a more direct data source of player’s responses. Based on the coding results, we were able to identify particular system actions that created confusion, to compare occurrences across conditions, and to find out the reason.

The video coding analysis also helped us investigate potential trade-offs in the game design and subtle differences across conditions. Finally, researchers were able to become immersed in the gameplay to better understand the social interactions between players.

CHALLENGES AND OPEN RESEARCH QUESTIONS
Through the comparative study between the physical game and the digital versions with different levels of automation, we found that the low-automation version required too much effort to play, while the high-automation version reduced the effort at the cost of player’s enjoyment of the game. Players need to feel in control and engaged during the gameplay through system feedback, but not be required to maintain the game state manually. The question of what should be automated and what should not still requires further investigation. The data analyses revealed that the current animations are too brief, and the system does not provide a way for players to find the changes easily. Moreover, players cannot control the start time of animation or step through automation feedback at their own pace. These factors all impacted player’s enjoyment of the game. Thus, our analyses reveal some of the pitfalls in the current design and provide a better understanding of the problems. As a next step, we would like to improve the animation used for automation feedback, provide a visualization mechanism for changes in game state, and adjust the level of automation and flexibility in the gameplay.

We found that directly translating the physical game into a digital platform does not recreate the same gaming experience as playing the physical game. On the other hand, when
automation is introduced to the game, we found that the game became less flexible even though it supported many attributes that we designed. For example, the game reduces the amount of mundane activities and rule memorization players have to do. The goal of digitizing is not to recreate the same experience but to improve the gaming experience by utilizing digital capability of the systems. Thus, conversion of physical games should not be limited to just a direct translation, but with the goal of providing a more social, engaging, and enjoyable gaming experience.

Our methodology of comparing physical and digital games with extensive observation through an open coding process provides a way to gain deep understanding of the social interactions among players and their use of the technology. We were able to notice the subtle differences across physical and digital games and found that social gaming experience can be improved through better support on the decision making process. This methodology can be applied to other physical game conversion, such as treasure hunts, card games, and sports games. A possible future direction would be to improve the engagement and immersion of the game by getting players to be more proactive rather than reactive. The game design also needs to facilitate the decision making process by allowing more flexibility.

From the data analysis process, we were able to extract quotations and examples that represent or signal potential behaviour changes. The statistical analysis was used to confirm such observations and point out potentially interesting directions for other data analyses. This approach to investigating the changes in social gaming experience across different conditions allowed us to gain a deeper understanding of the gameplay experience. By using quotations and examples of players’ behaviour, we are able to describe players’ interaction with others and with the game in a richer medium to communicate these findings.

Compared to using performance data, error rate, or response rate, we believe that social interaction and gaming experience are so complex that numbers alone cannot fully describe players’ intentions, subtle behaviour changes, coping strategies, and social interactions. Moreover, through watching and observing the gameplay repeatedly, researchers gain a unique understanding and insight into the interactions, gameplay, and players’ characteristics. In a collaborative game setting, players verbalize their internal thought process and emotions to strategize, engage in conversation, and express confusion. Observations of their conversations, interactions, gestures, pauses, and body language can all be used to evaluate the social gaming experience.

Despite all the benefits of deeper understanding and a richer dataset, this methodology is very time consuming. The open coding process requires several passes on the coding scheme until it captures the essence of interesting behaviour, and the same video may need to be coded repeatedly for each new coding scheme. Moreover, the technical details also matter, such as the quality of the audio and video recording. The researchers also need to be neutral and make unbiased observations. However, this investment of time and effort can produce a rich analysis that provides an in-depth understanding of players’ gaming experience, social interactions, and the subtle differences in how people use the technology. We also believe that qualitative data should be valued and used to describe players’ gaming experience.

FUTURE DIRECTION
Our future research will be furthering this investigation on the social aspect of the gameplay through improvements to the visualization of game automation, to better convey changes. We will attempt to balance automation and user control, and to facilitate players’ decision-making processes. Moreover, we will make use of audio recording software and computer logging software developed by our colleagues to reduce the time needed for the coding process.

WORKSHOP GOALS
We would like to share and discuss with other researchers in the gaming field our approach of using video coding analysis to evaluate the social gaming experience. We also hope to receive feedback on our future studies and learn new methodologies that can be incorporated into this work.

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Is a second person elicitation method suitable to study flow?

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ABSTRACT  
This position paper asks the question of whether the elicitation method for the study of subjective experience developed by the second author is appropriate for the study of flow in computing environments in general and in gaming environments in particular. Taking into account the fact that, among other reasons, a pressing issue in the study of flow in computing is to distinguish between similar, possibly related states that have been identified as flow, we argue that the referred elicitation method is particularly suitable to establish those distinctions. The paper discusses the advantages and disadvantages of adopting that method for the study of flow and identifies particular issues within flow that could be addressed by studies employing it.

Author Keywords  
Player experience, Flow, First person methods

ACM Classification Keywords  
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms  
Human Factors; Measurement.

INTRODUCTION  
The concept of flow has been used to describe psychological states of optimal experience that are characterised by a deep concentration in the task at hand, a merging of action and awareness, a loss of self-consciousness, a sense of control, time distortion and experiencing the activity as intrinsically rewarding [6]. Computing studies of this concept have reported digital environments as conducive to flow and promoting positive attitudes and outcomes for users [10, 11, 19].

However, there is a lack of clarity about what the concept really means. It has been suggested, for example, that flow is not a monolithic concept but a family of similar states differentiated by the characteristics of the associated activity domains [8]. Csikszentmihalyi himself has said that there might be degrees in the flow experience, “a continuum between almost imperceptible microflow events, and the truly memorable occasions of deep flow” [5]. However some studies have questioned if the apparently different states they have identified can be considered as part of a flow continuum or distinctly different psychological states [22].

According to Romero & Calvillo-Gamez [16], in addition to this lack of clarity, studies of flow in computing have missed key elements of its original definition, such as the notion of effortless attention. Based on those elements they propose an Embodied view of Flow, which, although potentially helpful in distinguishing between the different states associated with Flow, requires making very fine distinctions about those states. We argue that in order to make those distinctions, a method for the study of subjective experience such as the Second Person Elicitation Method [15] is necessary.

This paper has four sections. The first is this introduction. The second offers a brief summary of flow, its associated misconceptions and the most relevant aspects of the view of flow proposed by Romero & Calvillo-Gamez [16]. The third section talks about first person methods for the study of experience and specifically about the Second Person Elicitation Method [15]. Additionally this section discusses why we believe this method is highly suitable for the study of flow. The last section presents some conclusions and discusses specific issues within flow that could be addressed by studies employing the Second Person Elicitation Method.

THE CONCEPT OF FLOW  
Flow has been defined in a number of different ways: as engagement and immersion in an activity [11], as absorption in a virtual space and the fading away of the physical world [2], as a playful and exploratory experience [21], and as an experience which is undertaken for its own sake [4], among other definitions. It has also been suggested that there might actually be different types of flow, or "flow dialects" [19]. Voiskounsky et al. [20], for example, claim that the characteristics of the flow experience might be different depending on whether the user is shopping online, browsing the web or playing online games. In the same line, Novak et al. [14] suggested that both people...
using the internet with a specific purpose and those browsing without a preconceived purpose can experience flow but that they might be experiencing different types of flow. They call the first type of experience goal-directed flow and according to them, instances of this state occur when users are engaged on a specific task with a clear aim and which usually has a utilitarian benefit or value. In contrast, the second type of flow, experiential flow, occurs when users are engaged on non-directed activities that have a hedonic value such as recreational web browsing, for example.

This lack of clarity, however, is not exclusive to computing studies of flow. As mentioned above, Wright et al. [22] identified four apparently different states fitting the definition of flow. They question whether these states can be considered as part of a flow continuum or whether they are distinctly different psychological states. The four states identified by them were challenge-skills, enjoyment, positive distraction and mindfulness. Challenge-skills is the state that most closely resembled flow as described by Jackson & Csikszentmihalyi [13] and occurred when their participants were faced with numerous challenges and operated at the limit of their skills. Participants would feel nervous and excited before their flow experience and there were typically emotional challenges associated with the task. Enjoyment and positive distraction occurred in not so challenging contexts where participants felt relaxed. Enjoyment was characterised by absorption in the task; however, in contrast with challenge-skills, there were no apparent emotional challenges (for example when going for a walk or when gardening). In positive distraction, participants were typically engrossed in experiences that would take them away from their worries and that did not demand specific skills. In these experiences participants were physically inactive (like listening to music for example). Mindfulness occurred when participants experienced moment-to-moment awareness that resulted in relaxation and an alertness of the world around them [22].

Although Csikszentmihalyi has warned against reifying flow [5], the ambiguity of the concept has created a situation in which research in the area might be studying altogether different phenomena. Additionally, computing studies of flow do not agree on which of its characteristics to include, and how they can be defined, categorised or related among them [10].

Romero & Calvillo-Gamez [16] have proposed a view of flow based on notions of embodied interaction [9]. This view proposes a framework to help in understanding the source of the misconceptions and discrepancies mentioned above. Their proposed view suggests that concepts such as effortless attention, effortful attention and captive attention can be fundamental in differentiating among the several states that have been classified as flow. They develop their view around these concepts, conceptualising flow as a state of deep concentration that is perceived as effortless. What this means is that people perceive this experience as their attention being effortlessly carried by a current, hence the analogy with flow. Under ordinary circumstances, subjective attentional effort in a task is proportional to the demands of the task, until there comes a point in which no increase in effort is possible (see Figure 1a) [1]. In contrast to this effortful attention scenario, there are occasions in which, at some point in the execution of the task, one is concentrated so thoroughly in the activity that suddenly attention seems effortless. At these moments, increased demands can be met with a sustained level of efficacy but without an increase in the perceived attentional effort (see Figure 1b).

![Figure 1. Effort vs. demands in a) effortful and b) effortless attention. From Bruya (2010).](image)

So effortless attention, and therefore flow, is a paradox because the demands of the task would require a level of attention that should be perceived as effortful and yet the subjective experience is one of effortlessness. This does not mean that the person is paying less attention; the level of attention is high but the perceived effort to achieve it is relatively low. Here it is important to clarify what is understood by effortful attention.

According to Schmeichel [17], attention can be either driven by the person doing the attending or by external stimuli (external stimuli could be internal to the person's body, as in a sensation of hunger for example). Attention can be (and constantly is) captured by external stimuli: smells, noises and images of the external world, for example. People pay attention to these stimuli without trying; in other words, their attention is grabbed without spending any effort. In such situations we can talk about a captive attention, as there is a passive quality to it; the person is not in control of which stimuli are attended to. In contrast, sometimes people might focus and maintain attention on specific stimuli intentionally. In these cases, it is said that some effort is required to keep such focus and therefore there is a more active quality to attention. Effortful attention is said to be a specific instance of self-control because the tendency to attend to constant external distractors must be overridden in order to keep an intentional focus on the chosen stimuli.

Romero & Calvillo-Gamez’s [16] view can be very helpful in distinguishing between states such as experiential flow,
enjoyment, positive distraction and challenge-skills, among others. Specifically, the differentiation between captive, effortful and effortless attention could be used to distinguish between those different types of flow. The crucial feature to consider here is whether it was the participant or the stimuli the one who was driving the attention process. However this assessment might be hard to make for the participant. Given that people in flow are highly absorbed in the task at hand, they might or might not be aware of their experiencing it; and even if they are, their awareness of it might be blurred. According to Petitmengin [15], when performing a task, we make use of processes that are precise but that very frequently are pre-reflective in the sense that they elude our consciousness. This might be the case here; information about the inner experience of flow might not be available at a reflective level. In order to make the assessment of who was driving the attention process and therefore being able to distinguish among the different types of flow, a suitable data gathering method would have to be employed.

From the methods typically employed in flow research (interviews, direct observation and questionnaires [7]), interviews are perhaps the only one that would be able to make pre-reflective aspects of inner experience available for analysis. Although interviews have not been applied very frequently since Csikszentmihalyi’s pioneering work on flow, there is a resurgence of interest in them of late [7]. Specifically, second person methods seem very appropriate, as they are particularly suitable for exploring inner experience.

SECOND PERSON METHODS
Second person methods are typically interview-based methods that allow gathering data about the subjective experience of a first person by an interviewer or "second person" [12, 15, 18]. Although descriptions of subjective experience reported by the person having the experience could contain a great deal of useful data, inner experience has been absent from scientific discourse for the last half-century because to obtain accurate and reliable descriptions of experience proved particularly difficult [12]. However there is a resurgence of interest in providing reliable methods for the study of subjective experience. The Second Person Elicitation Method by Petitmengin [15] is one such method. This method allows a person who may not be trained to provide rich descriptions of her/his subjective experiences. Petitmengin’s method seems particularly suitable for the study of flow because it can take into account the high degree of absorption of the participant in the task and therefore can make the pre-reflective aspects of that experience available for analysis. Additionally, it can modulate the degree of precision of the description.

Petitmengin’s [15] Second Person Elicitation Method, by making participants focus on processes rather than content in their descriptions, enables them to turn from the objects of attention to the act of perceiving itself. This turning of the description from the ‘what’ to the ‘how’, among other techniques used in Petitmengin’s Second Person Elicitation Method, can bring pre-reflective aspects of the experience to the fore and available for analysis.

Even if the participant’s attention is turned towards processes rather than content, being able to identify whether the person has experienced a captive or effortless type of attention needs a high level of precision in the description. Petitmengin’s [15] Second Person Elicitation Method allows modulating the level of precision of the description by focusing on and exploring the structural and temporal dimensions of an experience. As mentioned above, the crucial feature of the experience is whether the participant or the stimuli was driving the attention process. This information should be accessible by exploring the structural properties of experience to the required level of precision.

Perhaps the main issue with the Second Person Elicitation Method is that frequently the interview is not close enough in time to the actual experience. Instead, it has to focus on re-enactments, which might not be faithful replications of the original experiences [12]. Although this criticism could be debated, here we only want to point out that in the case of flow in computing, frequently the gathering of data happens just after the person has finished interacting with the system. Therefore, in this case the memory of the event should be fresh enough to provide a good chance of a faithful re-enactment. Additionally, the interview could make use of materials recorded from the session such as the interaction replay, the video and audio recordings of the participant’s action and even representations of the trace of physiological data (for example a graph of his/her galvanic skin response during the session).

CONCLUSIONS
We believe that Petitmengin’s Second Person Elicitation Method is particularly suitable to differentiate among states that have been classified as types of flow (experiential flow, enjoyment, positive distraction and challenge-skills, etc.). The crucial aspect that makes this method suitable to make this differentiation is that it can bring pre-reflective aspects of the experience to the fore and available for analysis. The method might have to be adapted to work with the materials recorded from the interaction session but the relevance of this has to be established.

Additionally to differentiating between the different types of flow, the method could also enable a richer characterisation of those states. One interesting aspect that could be explored at a high level of detail is whether flow is correlated with addiction. Chou & Ting [3] have suggested that the flow experience has a strong impact on addiction; however the notion of flow adopted in that study does not take into account its characterisation as effortless attention. It could be that only certain types of flow are correlated with addiction. The use of the Second Person Elicitation Method could allow not only to identify which types of
flow are correlated with addiction but could also help to characterise the addictive experience with a rich level of detail.

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Recording and Understanding the Computer Game Experience: A Cognitive Playthrough of The Legend of Zelda: Ocarina of Time

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ABSTRACT
The paper focuses on a form of cognitive walkthrough - a cognitive playthrough - that was undertaken as part of my PhD research into prosocial and psychologically beneficial aspects of the player experience. Using the needs theory of Abraham Maslow as its starting point, my playthrough of The Legend of Zelda: Ocarina of Time, was used to help form interview questions and to understand the interviewee narratives of the game’s fans. This paper describes the design, the process and the findings of the cognitive walkthrough. The findings showed that playing through the game’s most ludic sections - its temples - was an intellectually consuming activity, from which its players derived great satisfaction. The value of the playthrough in this research has shown it to be useful tool for further use in the fields of Computer Game Studies and HCI.

Author Keywords
Cognitive playthrough; virtual playspace; Ocarina of Time; mental busyness; thought junctions; behavioural properties of objects; mental topography.

ACM Classification Keywords
H.5.m: Information interfaces and presentation: Miscellaneous.

INTRODUCTION
My cognitive playthrough of Ocarina of Time aimed to provide an understanding of how the game’s virtual space is negotiated by the player. As we know, part of computer games’ distinctiveness is that they are played. It was therefore important to design a tool that could capture how the experience of playing a game feels to players: how the gameplay, ‘the game dynamics emerging from the interplay between rules and game geography’ [1] is experienced first-hand. Indeed, I felt that this was the only way that an understanding of feel - what game designer Steve Swink calls ‘the tactile, kinesthetic sense of manipulating a virtual object’ [2] - could be gained. Recording the process was not only necessary for its original purpose but also seen as the first step in making it replicable for any future research.

THE RESEARCH
The objective of the playthrough was to aid the design of interview questions to help better capture this aspect of the player experience, and it also played a role in helping to understand player responses. The notion of the cognitive playthrough was clearly inspired by cognitive walkthroughs, which, as we know, originated in the field of Human Computer Interaction, or HCI, a field and term ‘only in widespread use since the early 1980s’ [3], but influenced by the study of ergonomics and ICT from the 1940s onwards. A walkthrough’s aim is to test if a computer program or system works as it is meant to for a typical user and is undertaken by a user who creates various inputs and notes the results. For most computer programs, the user is, of course, testing for smoothness, or ease of use, with a well-designed program not frustrating progress, or making the user feel overwhelmed by the technology. In the words of HCI expert, Ben Shneiderman, ‘Effective systems generate positive feelings of success, competence, mastery and clarity. The users…can predict what will happen in response to each of their actions’ [4]. For a computer game, however, while the basic principles of the approach remain, the aim differs as games must - to a certain extent - frustrate progress, inspiring the search for solutions (or resolution) in its users, or players. A cognitive playthrough of a computer game, then, should test not for ease of use, but for how players respond to obstacles thrown their way.

The Research Design
In designing the cognitive playthrough, several ideas outside of HCI were considered. These included a form of
content analysis originated by computer game scholars Mia Consalvo and Nathan Dutton in which it is suggested that games can be treated as texts and a version of what they term a ‘Gameplay Log’ [5] was utilised for the playthrough. Also influential was computer game theorist Ian Bogost’s concept of Unit Operations discussed in his book of the same name. In it, Bogost suggests that games (their spaces, their content) can be viewed as being comprised of a series of interlocking units or ‘complex, unit driven networks’ [6]. This work in particular helped in thinking of Ocarina’s temples as units in a larger system and also influenced the notions of ‘thought junctions’ and ‘behavioural memory of objects’ outlined below.

At the heart of the playthrough method is an attempt to note the type and number of choices available to the player as they traverse the virtual playspace. These choices range from the more obvious, such as direction (when entering a room with two exits, for example) or options in a dialogue tree, to slightly less obvious instances of choice. Specifically, these more obscure, or less conscious, instances concern weapons to use during enemy encounters and actions in relation to the negotiation or manipulation of environmental objects (such as walls, ladders, ropes and levers in the dungeon) and personal items (catapult, boomerang, potions etc.) held by the player’s character, Link.

The Process
While a loose, informal playthrough (producing diary notes on geography, topography, narrative, characters, puzzles, acquired items etc.) was undertaken for the entire game, a single one of the game’s dungeons, or temples, was focused on for the main, formalised task, with Ocarina’s final regular example (the Spirit Temple) chosen. The reason for choosing a temple was simple: they contain most features of the game as a whole, but in a compact, condensed form, allowing for a focused analysis.

2 The reason for choosing the final temple in particular was because of its richness: on the whole, temples become increasingly advanced in Zelda games - with the games’ producers increasing the complexity of all previous designs and thus placing demands on the player to use all skills and knowledge gained thus far. The Spirit Temple is further interesting because it needs to be accessed by both ‘child Link’ and ‘adult Link’ to be successfully completed, adding a further layer of complexity.

In essence, the method of recording the playthrough is a relatively simple one, and involves the transcription of every thought and game action (henceforward referred to as thought and action string). Despite its seeming simplicity, this does entail forcing an awareness of a process that is usually completed quite intuitively. This includes forcing a consideration of what might be termed general comprehension and observation (what is seen when first entering a room, say) and play activities (choosing movements and weapons, for instance). I decided that if the process was to be manageable and replicable the key terms needed to be simple and so the following three were used: Thought, Action and Consequence. The completed transcription ran to over 17000 words.

In order to illustrate the process, here is a short sample from negotiation of one room of the Spirit Temple, 41F, which involved a slightly higher number of thought and action strings than any other. The version of Ocarina being played is the original one, on Nintendo’s third game console, the N64.

The transcribed playthrough of Room 41F
I enter the room. THOUGHT: What can I see? THOUGHT: It is a large room with four moving objects. THOUGHT: What are they? THOUGHT: These are enemies, Torch Slugs. THOUGHT: How do I know this? THOUGHT: Because of game convention and memory. I remember them from the Fire Temple. THOUGHT: I therefore know that conventional weapons will defeat them. THOUGHT: What next? THOUGHT: There is no immediate danger from the Torch Slugs, as they are not moving towards me. THOUGHT: Look around. ACTION: Press C to access camera. ACTION: Use analogue stick to look around room. THOUGHT: I see several doors on the other side of the room. At the far end, there is a broad column of fire and something pale and translucent, of equal width above it. THOUGHT: What now? THOUGHT: Move forward to get a better view of the room. ACTION: Move analogue stick forward. THOUGHT: A Torch Slug now moves towards me. THOUGHT: Must change plan and deal with these first. THOUGHT: How? THOUGHT: With Z targeting and sword. THOUGHT: How do I know this? THOUGHT:

1 Consalvo and Dutton’s approach is concerned with exploring and analysing such aspects as save points, intertextual referencing and emergent gameplay.

2 Dungeons, or temples, are a mainstay of the Zelda series and each game has around eight or nine of them. These usually contain the games’ most difficult challenges.

3 In the game’s story, Link fails to save the world - Hyrule - and sleeps for seven years. He is woken up by the game’s ‘sages’ who task him with trying to save the world again, now that he is older and stronger: an adult, in fact. While ostensibly a gameplay mechanic - the child Link can access small crawlspaces, for example - I believed that being made to use both a child and an adult avatar may have elicited a consideration of issues and themes related to childhood and adulthood from my interviewees.
because this is how I defeated them before. ACTION: Press Z to target nearest creature. ACTION: Push analogue stick forward while (ACTION) pressing A to ‘jump attack’. CONSEQUENCE: The Torch Slug is defeated

THOUGHT: What now? THOUGHT: Repeat procedure on all four Torch Slugs. ACTION: ‘Z target’ jump attack all creatures. CONSEQUENCE: All four Torch Slugs are now defeated. THOUGHT: What now? THOUGHT: Have a proper look around, now all is tranquil! ACTION: Use analogue stick to move Link into the middle of the room for best vantage point. ACTION: Press C to access camera. ACTION: Use analogue stick to examine room. THOUGHT: I notice that there are six doors in total. Above me, there is a hookshot target and just in front of that, the translucent object I noticed, is now clear as a block of ice. Beneath that, and amidst the column of fire, is a large chest. THOUGHT: I know this because all previous Boss Keys have been in such boxes.

FINDINGS

The cognitive playthrough generated four interconnected main findings.

- Firstly, the player experiences ‘mental busyness’ during play. There is a constant ‘buzz’ of cognitive activity in the negotiation of dungeon playspace. The buzz is louder at some times compared to others - for example in the solving of a discreet puzzle at one end of the scale and choosing a turning direction for Link at the other - but it is always audible. The following findings also form part of this busyness.

- Secondly, the player experiences ‘thought junctions’ - a term for the moments in the negotiation of space where choices are required. The term ‘thought junctions’ is more suitable than simply ‘choice’, as it highlights that the player experiences many instances of not especially obvious choices, but ones regarding negotiation of space where the selections are seemingly intuitive and may not be consciously recognised as such.

- Thirdly, the player retains a memory of objects’ behavioural properties. In order to progress effectively, the player has an awareness of objects’ properties - say, of one type of stone over another (one can be pushed, another cannot), or, as in the example above, how an enemy may be defeated - and these memories may stem from a much earlier point in the game.

- Fourthly, the player sustains a mental topography. There is a constant awareness - without reference to the map - of the overall negotiable space of the dungeon. There is also awareness of dungeon and overall game objectives, and story. While this awareness is often at a secondary level, with immediate matters of negotiation maintaining precedence, it is always there.

On analysing my interview data, it was found that these four concepts often consumed interviewees intellectually during play, with them reaching what early game scholars Geoffrey and Elizabeth Loftus term an ‘optimal level of informational complexity’ [7]. Such intellectual consumption, or absorption is also supported by the concept of working memory, the name given to the theory of the number of elements a person can retain awareness of at any one time. When research started on this subject in the 1950s, the number of elements was thought to be seven. More recent research, however, suggests it is as low as four. [8]

As regards my thesis, the playthrough was the first part of a two-staged methodology, the results of which helped to structure the rest of the research process by operationalising some of the concepts in the study. This, as noted in the introduction, used Abraham Maslow’s theory of needs as its backbone. An example of this process of turning concepts into tools can be seen in the case of Maslow’s cognitive needs (‘…a desire to understand, to systemize, to organize, to analyze, to look for relations and meanings, to construct a system of values’) [9]. Here it is operationalised as challenge and characterised as a combination of the playthrough’s four findings. This enabled me to gain focus on what those challenges are and what they feel like to players, how in the process of responding to them, for example, Mihaly Csikszentmihalyi’s flow (‘…the state in which people are so involved in an activity that nothing else seems to matter’) [10] is experienced.

EVALUATION

The only disadvantage I found in using this method is that it is time-consuming, with the process of mapping the whole dungeon taking around forty hours. However, I feel that the advantages far outweigh such a shortcoming. The key advantage is, as noted above, that such a close grained method forces an awareness of processes which feel largely instinctual. This allows them to be recognized and considered in a depth that I have not yet found though any other approach. Similarly, such a method ensures that no portion of the play experience is neglected, and allows for a thorough transcription to be created and studied.

Here, mapping out an entire dungeon made sense for the project, but was an extremely labor-intensive task. When using this method in the future, I feel that a more manageable portion of a game may be considered with equally effective results. Such a decision will, of course, always depend on the game under consideration.

CONCLUSION

The cognitive playthrough discovered that the play experience creates an intellectual busyness in the player, with procedural aspects of play – the negotiation of rooms, the dispatching of enemies etc. – combining with awareness
of wider game objectives to create constant mental activity. The playthrough was designed and undertaken for a highly specific purpose (my PhD thesis), but it has provided a working method for characterising the play experience generally. This introduces the possibility of using the same playthrough, or other forms – modifications to the original design as appropriate for pieces under consideration – for further research into procedural, and other, aspects of computer game play.

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Using gamers’ movements to assess their affective experience in movement-based games

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ABSTRACT
In this position paper we outline our ongoing research into the assessment of user experience in movement-based games based on gamers' movements during gameplay. We built a motion capture system using a Kinect sensor and are currently collecting a corpus of affective movement data. With this we plan to train an affect recognition system, which could inform user evaluations of movement-based games, but could also be used in actual movement-based games as a feedback channel to adapt gameplay to the user.

Author Keywords
User Experience, Evaluation, Body Movement, Affect

ACM Classification Keywords
H.5.2 [Information interfaces and presentation]: User Interfaces - Evaluation/methodology

General Terms
Human Factors, Measurement

ASSESSING USER EXPERIENCE
Games are played for entertainment. As such it is crucial for game designers to ensure that their games are fun to play. Assessing how users interact with and experience their use of interactive products is a core topic in HCI. A wide number of methods have been proposed to assess user experience. Yet if we look into how user experience evaluations are conducted, only a few methods are actually used.

Bargas-Avila and Hornbæk [1] reviewed 66 empirical studies of user experience. Even if some studies employ more than one method, their findings show that questionnaires are by far (53%) the most common data collection method, followed by semi-structured interviews (20%), user observations (17%), video recordings (17%), focus groups (15%), and open interviews (11%).

We can conclude that most studies rely on subjective methods based on self-report (questionnaires, interviews, focus groups). Methods based on objective measurements (e.g., eye gaze, physiological data) are surprisingly rare. There is no hard evidence for why objective methods are so unpopular. However it has been put forward they are often difficult to set up [8]. They are also often intrusive to the user (e.g., wearing a heart rate monitor) and restricted to the lab (e.g., most eye gaze). Despite these drawbacks it is widely acknowledged that a combination of subjective and objective methods is desirable to get a richer view of user experience [6].

In the domain of movement-based games a new modality presents itself, which may be useful to assess the user experience: the gamers’ movements during gameplay.

We propose to assess user experience based on users’ bodily expression of affect and envision a tool based on the Microsoft Kinect sensor. We believe that this tool holds several key advantages: First, it only requires a laptop and the sensor itself and is thus reasonably low-cost. Second, it is easy to set up and can be (within certain restrictions) deployed in the wild (in situ), which is important for ecological validity of user experience studies [6]. Third, it is also non-intrusive to the user as no sensors have to be put on users and they can move freely. This tool could provide an easy-to-adopt means for making objective measurements of user experience. Combined with the popular self-report methods, this could result in richer evaluations of user experience.

BODILY EXPRESSION OF AFFECT
Studying bodily expression of affect is by no means a new area of research and dates at least back to James’ 1932 study of expression of body posture [7]. One difficulty that arises from using the body as stimulus to study the expression of emotions is the fact that the human body is complex. The complexity stems from a large number of joints and all possible rotations around these joints that result in a large number of degrees of freedom. It can be argued that the complexity of the body is the reason for the lack of formal models for body postures. The study of facial expression has benefitted greatly from formal models such as the facial action coding system [5], which facilitated the integration and consolidation of research results significantly.

Yet, studies into bodily expression of affect have shown that changes in affective states can be observed in changes
This means mostly swings of the arms and flicks from the wrists. Obviously, these movements do also carry affective information. We can observe from the way a child executes, for example, the throw of a bowling ball whether he/she is joyous because the last throw was a strike, or whether he/she was just embarrassed by classmates prior to the throw.

Affective expressions are movements that have no utilitarian function and only serve the communication of affective states. An example for this is a child throwing his/her hands in the air after scoring a strike in bowling. Another example is a child walking spiritlessly away from the console with hanging shoulders after losing a game. There is obviously a social component present in that the expression of affect has a social function, such as eliciting sympathy when feeling sad. In fact, most affective expressions happen in a social context. When there is no recipient present, we feel less need to communicate our affective states.

Social behavior can be observed in movements that do not fall under the already mentioned categories. An example for this from our observations is a girl throwing her arms around her friend in a gesture of sympathy. Another example is the observation of group behavior. Here the feedback from the teacher was invaluable. He pointed us to elements of group dynamics in the class. We could for example observe how dominant children would stand closer to the console and be more expressive in their behavior than shy children who rather keep to the background and avoid drawing attention to them.

The initial observations gave us an impression of what we can expect when we want to capture motion data from children playing active video games. It also provided us with clues as to what kind of movement features could be important for the automatic recognition of affective user experience.

We then built a motion capture system based on the Microsoft Kinect sensor. The Kinect sensor is a camera-based movement sensor, emitting an infrared grid and aggregating the reflected light into a skeletal representation of the body, similar to the postures shown in figure 1. It is fairly robust in terms of its ability to function in changing (indoor) environments and totally non-intrusive for the user.

At present we are using this system to collect a corpus of movement data in the aforementioned primary school. Here we can record data from children in an environment familiar to them and within their peer group. In our setup, the children play again the Nintendo Wii Sports games. We chose these games as they do require a certain level of movement to play the games, while at the same time requiring very specific movements to steer the game. Also, many children are familiar with them.

Our next step will be an analysis of the captured movement data. Observers will rate recorded postures for emotional expression. Several studies have investigated movement...
analysis in contexts such as dancing [4] or knocking [2]. Feature extraction has been proposed on a low level (i.e., joint angles) and medium level (i.e., expressivity features). Building on existing models is difficult, as they not only differ in elicitation context but also in the underlying emotion model and coding scheme. The task here is to find the model most suited for the context of evaluating human-computer interaction and to validate our approach by comparing it to data retrieved from established user experience methods.

The motion capture system is then to be extended into a complete affect recognition system that analyzes the movements of users and provides user experience evaluators with an assessment of users’ affective states. Apart from technical aspects of implementation, the challenge here will be finding useful ways to represent the data and identifying useful ways of connecting the output of our tool to other means of user experience assessment.

EXPECTED CONTRIBUTIONS

We see three main contributions of this research.

First, showing the feasibility of using gamers’ bodily expression of affect to assess user experience in movement-based games, together with a set of movement features that are proven to contain cues to how people feel during their interaction with a movement-based game.

Second, creating a corpus of annotated affective movement data, which we plan to make available to other researchers. Existing corpora of affective behavior usually consist of acted data, which means they often show exaggerated movements done by people who were instructed to depict a particular affective state in a lab environment. The corpus we are currently collecting contains actually felt affective states, collected in a natural environment.

Finally, providing a tool that can be easily deployed in user experience evaluations of movement-based games. What makes this tool particularly interesting for evaluators is that it can be used in naturalistic settings, thereby providing more ecologically valid data than can be obtained from lab-based approaches. Also, the method is completely non-intrusive to the user and does not distract from the product that is at the focus of the evaluation. Apart from mere evaluation, our system could be part of a feedback channel enabling movement-based games to adapt to the affective states of gamers and provide a more enjoyable gaming experience.

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