Rule customization in Head-Up games

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ABSTRACT
This research examines the feasibility of rule customization for a genre of pervasive games for children called Head-Up Games [11], which are intended to be played outdoors by children and to encourage physical activity and social interaction. An interface to allow customization of game rules was created. An evaluation involving 22 children aged 11-13, showed that children are able to customize the game and this can be an effective means of keeping them engaged with such games for longer periods.

Categories and Subject Descriptors
H.5.2 [**Information Interfaces and Presentation**]: User Interfaces – *interaction styles, user-centered design.*

General Terms
Design, Experimentation, Human Factors

Keywords
Pervasive gaming, Head up games, rules, customization, outdoor, children.

1. INTRODUCTION
Head Up Games (HUGs) are a genre of games that rely on the use of mobile computing and networking to allow children to play interactive games outdoors, encouraging physical activity and social interaction between players [11]. The motivation for these games is that children, at least in developed countries, spend too much time sedative indoors, often in a solitary interaction with a video console or computer. Outdoor games providing some of the attractions of interactive computer games, could help children become more active and to engage socially with each other. In all cases, such games present a novel form of gaming that can be enjoyable and beneficial for children.

A few research prototypes of HUGs have been developed to date, e.g.: Heartbeat: a gaming platform that uses biofeedback [8] and Camelot [12] and Stop the Bomb [5].

The overarching vision for HUGs is that playing them should be much more similar to traditional outdoor games of the past than current video games or even mobile games played on handheld devices. While the prototypes referred to above demonstrated the feasibility and attraction of HUGs for children and their success in encouraging physical activity and social interaction, an important difference still setting these games apart from traditional games, concerns the flexibility of game rules. In traditional games, rules can change fluently to fit the specific context and the preferences of players. They are the subject of negotiation and social dynamics; often local versions of well-known rules become established within a community of children, as for example Hughes has shown in [6]. Contrasting, in current mobile and pervasive games, this flexibility is lost with the game dictating a fixed script along which a player has to act.

An important objective for this research is to ensure that the game rules can be fluently modified by children, enabling local variants of games to be developed within local communities. The research presented approached this issue by designing a game that allowed the adaptation of existing rules. We discuss some background on game rules, the implementation of a game that supports the parameterization of game elements and, finally, the evaluation of this way of designing games thorough testing with children.

2. GAME RULES
As Caillois [2] points out, play must have an uncertain outcome during the entire game, otherwise the reason to play disappears. Game rules not only define the flow of the game, but they also guard this ambiguous element.

Salen and Zimmerman [9] label the space in which a game takes place the *magic circle*. The boundaries of the magic circle are formed by the game rules, and when playing a game, thus within the magic circle, players agree to adhere to the rules. This is an important condition for play, since:

"*The game is ruined by the nihilist who denounces the rules as absurd and conventional, who refuses to play because the game is meaningless. His arguments are irrefutable. The game has no other meaning but an intrinsic meaning. That is why its rules are imperative and absolute, beyond discussion. There is no reason for their being as they are, rather than otherwise.*" [2, page 7].

Furthermore, Goldstein [4] identifies two types of rules: the *ideal* rules and the *real* rules. The ideal rules are the official rules of the game, for example the rules as printed in the manual of a board game. The real rules, however, are a consensus of how players think that the game ought to be played. Real rules are often influenced by the social values held by a community of players. Therefore, as social contexts differ, for a game to be playable for any community, ideally players must be able to adapt the (real) rules to their context.

Around the age of 7, rule-based play starts to emerge in children [10]. Hughes observed a community of children playing the game

Fun and Games 2010, September 15-17, 2010, Leuven, Belgium.

'Foursquare' and noted that they are able to create their own set of 'real' rules [6]. However, 'Foursquare' is a non-technical enhanced game, and it is still an open challenge to find out if children can do so with HUGs. There is a big difference between agreeing on rules verbally versus modifying the system behavior to go along with the agreed rules. First agreeing on a set of rules and then reflecting programming that decision into a device may challenge the abilities of children or may not be fun for them to do at all.

Examples of HUGs known to this point are predefined games and a programmer or a supervisor can only set the parameters. Unfortunately, there is not a way yet with which rules can be changed for Head Up Games. Also, a complicating factor is that HUGs are often designed without screen interface. Although easier to do programming on a screen of a PC, such an approach would compete with the fundamental conception of HUGs. Therefore we opted for a tangible solution that allows customizing game rules directly on the devices supporting the game.

To operationalize the problem of rule customization, we characterize rules in terms of ***parameters***, ***action sets***, ***action conditions*** and a ***social setup*** that together define a game. These are explained below as they help distinguish different levels of control players may have over game rules.

The design of a game starts by setting boundaries such as time and place: A game is played in a field or a room. A game is played for 5 minutes, until a goal is reached or until the break is over. Within these boundaries the game rules are in effect, outside players act normal [7]. Time, place and number of players are examples of **parameters**; they are easy to adjust. Mostly parameters can be expressed in numbers.

When the boundaries are set, it must be decided what happens in the game. A set of possible actions must be defined. Those actions are the main activities during the game, like hiding and seeking, throwing a ball, tagging, running or making an animals' sound. This is the **action set** of the game.

Knowing what to do is one thing, but it must be clear in which order and to which condition these actions can take place. For example, a game of tagging changes when there must be 5 second between two tags. Only allowing throwing the ball standing still could change the flow of a game importantly. These are **action conditions**. They define a game almost as much as the action set, but can be adjusted to improve the game.

Once we know what to do, we need to take care of the **social setup**. How is the game played? One against the rest, individually, in teams, against a common enemy, they are all examples of social situations [3]. These are slightly flexible; it is possible to change teams during a game, or to introduce a helper for the common enemy.

When developing pervasive games, it is very easy to start thinking as a programmer. Actually the categories of rules described above are closely related to the way games are programmed. And it is deceptive to think that the change of 'just' a parameter is not a big change in the game; this may seem to players to become a completely different game. More typical is the other way around: when thinking of 'just' a variation to a game, programmatically it might be a completely new design.

Therefore the design of the game presented later on in this paper was developed not using the framework sketched in this paragraph, but its design was analyzed with the above mentioned categories in hindsight.

3. SUPPORTING CUSTOMIZATION OF A COMMERCIAL HEAD UP GAME

As a carrier platform for exploring customization we adopted Swinxs [1], a commercially available game console that is in line with the principles of Head Up Gaming [11]. Swinxs is a battery operated game console that is instantly usable outdoors, out of the box; it provides spoken instructions and is operated through an audio-menu, a few buttons. It also can read RFID that allows proximity detection for players: this functionality is used in the game to identify players and apply the game rules (e.g., who is back from a sprint fist). The only dynamic visual display is one RGB led. Its visual design is suitable for children. (See Fig. 1) The console comes preloaded with various active and social games. Extra games can be uploaded from the company website to the console using a PC, but currently there are no games that can be customized during playtime.

Fig. 1: The Swinxs console.

The Swinxs console is equipped with a custom IDE (Integrated Development Environment) to write new games using a quasi C style code. Using a state machine the programmer can access the various peripherals such as the RFID wristbands, a sound amplifier suitable for outdoor gaming, 2 buttons, an accelerometer, a microphone and extra optional RFID game cards.

For the Swinxs a successful and popular game was customized: Swinxs Dash. Swinxs Dash is played as follows: Players have to think of an obstacle course and each player has to run this as fast as possible in turns. Time is being measured from a start signal until the player 'bleeps' their wristband. The game already has a creative element, the selection of a running track, but it has no possibility to adjust game rules that the device applies.

The following ways to customize the game were implemented:

- *The possibility of team play.* Players will be randomly assigned to teams of 2 persons. Players of one team must run directly after each other (like a relay race) and the total time is measured. The fastest team wins.

- *Play with ball*. The player has to run the track taking a ball along. Players are not allowed to hold the ball in their hands. It is to be taken along bouncing or with the foot.
- *Bouncing the ball/ playing with foot*. The choice can be made between bouncing the ball and playing soccer wise. This choice can only be made when the ball rule is activated.
- *The amount of laps.* Each player has to run the amount of laps as chosen with the rule cards. After each lap a player has to 'bleep' his wristband.
- *Different music.* By popular request: with the music rule card different music can be chosen. The music plays during the running. There are 6 different music tracks available.

Children were offered the possibility to adapt rules through a voice menu. Rules can be turned on or off. To apply the rules in the game, the players receive 6 rule cards. See figure 2.

Fig. 2: The rule cards

On each card is a picture and keywords that explains the rule to be changed. In the card is an RFID token that can be registered before and after each round. The Swinxs adjusts the rule and confirms with a voice response. The next round the rules apply. No PC is necessary to adjust the rules.

4. EVALUATION

4.1 Participants

Twenty children aged 11-13 from a school in the neighborhood of our University took part in the evaluation study; informed consent was obtained from their parents with the help of the teacher.

4.2 Setup

The goal of the evaluation was to see whether children could customize HUGs during playtime. There was no focus on measuring the success (fun) of the game itself. The children were acquainted with the Swinxs console by playing one round of the original Swinxs Dash game. During the evaluation, children played 3 rounds with Swinxs. They played four at a time, and we had 5 groups in total. Before each round they received a task involving the rule cards printed on a piece of paper. The tasks were:

T1. Make sure everybody runs two laps.

T2. Activate playing in teams; choose your favorite music with the music card; make sure everybody runs one lap.

T3. Choose whether you want to play in teams. Activate playing with ball, Choose whether you want to bounce the ball or play by foot.

The whole experiment was recorded in audio. The observer noted the most remarkable observations, which were verified with the children in a mini interview directly afterwards. During the experiment two researchers were present to manage the children's enthusiasm, to apply the procedure and observe the play. Sessions lasted 15 minutes on average. All sound recordings and notes of the observers were analyzed using interpretative qualitative analysis.

4.3 Results

The evaluation confirmed that children are able to use the rule cards to adjust the rules of a simple HUG. They were able to relay the methods to their peers. Children preferred the customized version of the game over the standard version. When customizing they tried to gradually increase the challenge and variation in the game as much as possible.

In all cases, the children could successfully complete the tasks. In some cases they needed a little hint on how to get the RFID reader of the console to read the rule cards.

Overall, they performed adjustments successfully. Children chose rules cooperatively and supported each other when things were not entirely clear: '*you were the fastest'*. Or, after one child declared he didn't understand, another explained what was happening: e.g., '*Are we playing soccer or do we bounce the ball*?' - '*he is injured so we do by foot*'. Apparently, one child was disadvantaged because of an injury, and for him it was impossible to bounce the ball. The others children acknowledged that, and agreed to take the ball along by foot.

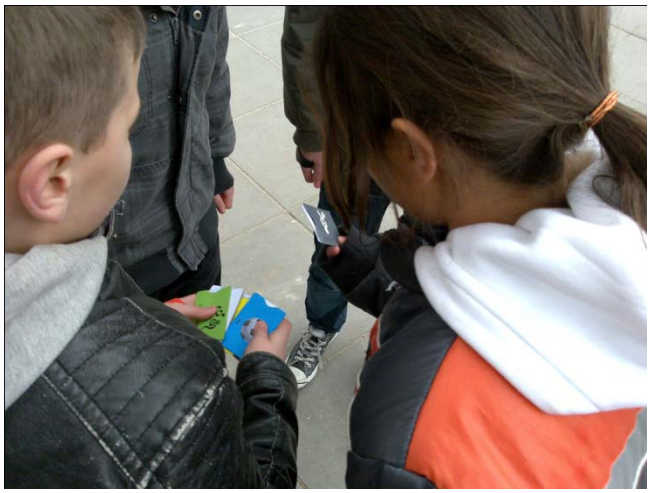

Fig. 3: Children choosing rule cards

The above example illustrates how children were actively busy matching rules to their context. They also looked ahead and tried to come up with rules that would give equal chance to win and make the game exciting. When asked if the game was fun they answered '*this more fun than last because now we had more options*', '*with Music and such things*', '*that we could choose things*'.

Children were really enthusiastic about the customization part. It clearly added to the experience.

Only one of the five groups faced difficulties with adjusting the rules. Difficulties were mainly caused by being distracted and not paying enough attention. However they too managed to complete the tasks.

5. Conclusions

From our evaluation we conclude the following:

- Most children are perfectly capable of changing rules of a Head Up Game without a graphical user interface. After they've figured out the practical working of the rule cards, they have no significant problems selecting the correct cards applying them and communicating the changes to the other players.
- Generally the children foresaw that changing rules would have an implication on the game play. For example, when activating the ball or selecting more laps, they changed the length of the obstacle course, before playing.
- A larger majority of the children in the experiment found it more important that the game was fun for everybody than winning continuously, the winners and the losers! The children thoughtfully made decisions based on the capabilities of the players in the group.

Regarding customization several useful lessons were learnt. First, if using audio instructions like in this case, it helps to repeat adjustable game parameters, as they are easily forgotten.

Linear menu structures should be avoided. Children are not prone to discover possibilities presented to them in a long series; rather they are quickly satisfied with the first provided option, while another may be better. Tangible rule cards help them have an overview of different options and get around this problem. If there are too many options, cards can be distributed over the participants, so they can cooperate.

It is no problem if children are assigned to teams randomly. Generally they experience variation as welcome. If a game is intended to be played multiple times, variation is a good way to keep children's attention. Introducing all options and elements in the outset is overwhelming and can be boring. Uncovering options or features gradually after some play can potentially regain kids' enthusiasm.

Game instructions should be repeated generously as children forget them, but things that will not change should not be repeated or children will become bored.

6. Discussion

In this paper we have discussed the research on a new type of pervasive games: Head Up Games. We have seen that these games are a promising addition to the arsenal of technology that children have access to. They can stimulate outdoor play and social activity. While a few HUG platforms have been developed, none of the examples to date have implemented rule customization during playtime yet.

We discussed the customization of rules that are implemented by technology supporting Head Up Games. An existing game console was used, and a game it supports was extended to allow customization with any of a set of rules. The rules could be activated and deactivated using cards embedding RFID tags; appropriate audio instructions would direct the child for the game.

An evaluation involving 20 children from a local school, aged 11-13, showed that overall children are able to adjust the rules of head up games without a graphical user interface and this increases their enjoyment of the game. They can foresee what the implication is of applying a rule is and they adjust rules so that the outcome of the game stays exciting and fitting their own specific preferences.

For now we applied one customization of each of the game elements parameters, action sets, action conditions and social setup. All the categories seemed to be suitable for customization, but there is little to compare now. In a future research we would want to look at which of the game elements provides more game potential when able to be customized. Also, in the near future we are planning a longitudinal test, to test whether our hypothesis – that children more easily return to a game when they are able to adapt the rules – holds true. Finally, in this evaluation we did not use a HUG platform. We are currently in the process of developing game devices that adhere to the HUG principles and that also allow adaptation of rules.

Our research shows that the potential of Pervasive Gaming could be much bigger for children also addressing collocated play in environments such as playgrounds and parks. With playtime customizations games stay fun longer or could even evolve into something different, which can potentially engage children to play for longer periods. Challenges for game designers are not only to think of new games and game rules but also to develop ways for letting users adapt them to their situation. From this initial exploration it appears that children are not only capable of adjusting game rules; they also enjoy this adaptation very much! End user customization means added value for many products and it need not be just applied to cell phones. We have shown that with a standalone console like the Swinxs flexible playtime rules are absolutely feasible.

7. Acknowledgements

We are grateful for the cooperation and participation of the children and teachers of elementary school 'De Driesprong' in Eindhoven, the Netherlands. Furthermore, we thank Swinxs BV for lending us a Swinxs for the evaluation.

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