Affective Gaming: Using Games as a Tool for Inducing Emotions

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Affective Gaming: Using Games as a Tool for Inducing Emotions

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Preface. After obtaining our bachelor degree in Informatics at Fontys University of Applied Science in Eindhoven, a master program in the field of human and information technology was started. Therefore the master program Human Aspects of Information Technology at Tilburg University was selected. During the pre-master program, we attended very interesting courses about Cognition by Emiel Krahmer and Marc Swerts, and User Interface Design by Suleman Shahid. We, Dave Kierkels and Lars van Bommel, both agreed that these two fields together would fulfill our interests and that it would be perfect to write our master thesis about a subject which combines those fields.

When looking for an interesting subject among all the possible and available subjects provided by Tilburg University, the thesis proposal of Suleman Shahid was the perfect combination of what we learned during the courses Cognition and User Interface Design. Immediately, in October 2009, we contacted Suleman to ask to work on this thesis proposal together. After a few meetings we were selected to work on this subject together with Suleman.

After a detailed plan of action, designs for the games, necessary to conduct this study, were made and translated into fully functional games. During the development, several elementary schools were contacted to conduct our experiments at these schools. In June 2010, after several tests and a final pilot test at the university, the experiments were conducted using our games. The results of the study are presented in this thesis.

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Abstract. This paper describes the investigation how to design affective games for the purpose of changing emotions and the influence of affective games on the mood of children. Two games were developed during this particular research where one game had a simple but effective design and the second had an advanced design. Results shows that both games can be used as a tool for inducing emotions by Dutch children in the age of seven to nine years in a natural and ethical way. Furthermore, it was found that gender had no influence on emotions.

Keywords:
Chapter 1 | Introduction

This chapter is an introduction. First background information is given, followed by the objectives of this study, the approach and finally the structure of this thesis will be described.

1.1 Background

Games are fun to play and therefore many people love to play games. There are different types of game and a wide variety of genres is available. Although each genre has its own specific characteristics, games generally are interactive, result-oriented, competitive, dynamic, exciting in nature and most of all, fun to play (Salen & Zimmerman, 2003 in Shahid, Krahmer, & Swerts, 2008). Because games have these properties, they can have an influence on the emotional state of the player and therefore can be used for training purposes and as a method for eliciting emotions in a natural and ethical way.

When it comes to computer games, this is called affective computing. Picard (2009) defined this as “computing that relates to, arises from, or deliberately influences emotion”. Generally speaking this means, affective computing is computing that relates to recognizing, interpreting, processing and stimulating human emotions. This can be used to reduce user frustration, enable comfortable communication of user emotion, develop applications to handle affective information and to build tools that help develop social-emotional skills. Therefore, computer games are an excellent tool to induce emotions thanks to the large scope of possibilities when designing games. One example of these possibilities is that games can be designed in such a way that they can be automatically adjusted to the player at run-time.

While playing games, people show a various number of different facial expressions, which might correspond to the emotional state of the player. Ekman (1972, 1999) found that there are six basic emotional states; two positive emotions (happiness and surprise) and four negative emotions (fear, sadness, disgust and anger). There are different emotion elicitation techniques, for example including images and
sounds (Bradley & Lang; Wiens & Öhman), expressive behavior (Ekman; Laird & Strout), scripted and unscripted social interactions (Harmon-Jones, Amodio, & Zinner; Roberts, Tsai, & Coan), and music (Eich, Ng, Macaulay, Percy & Grebneva). Although there are different ways of recognizing these emotions, for example by body movements and sounds, facial expressions are mostly used for recognizing emotions.

Currently, a large amount of research has been performed in the field of gaming and emotions. However, most research has been done with adult participants. Therefore, it would be interesting to conduct our study with young children, to see how children interact and show their emotions while playing affective games. Computer games can be used for creating a fun environment and for eliciting emotions. It is interesting to combine these elements and to use games in a fun and ethical way. Knowing this, we want to investigate the influence of affective games on the mood of Dutch children and to see whether this is different between gender.

1.2 Objectives

In our study we investigate how the six basic emotions are being expressed by Dutch children and observe if emotions are being expressed in a spontaneous or in a mimicked way. The objectives of this study are twofold. The first objective is to use affective games to explore to what extend emotions can be elicited and to discover differences and/or similarities in the way children express these emotions by looking at their facial expressions. The second objective is to design two games which can be used as a tool for inducing emotions.

We are interested to see if games have an influence on the emotional state of children, and therefore we want to investigate to what extent their mood has changed after having played a game. Moreover, we investigate if there is a difference between genders.

To determine how computer games could be best designed for the purpose of inducing emotions, it is interesting to look for differenc-
es in the way children express the six basic emotions. Using a game which represents an emotion (either as text or as an image), we will look for differences in the facial expression of the children between both types of representations and we are interested to see if the facial expressions differ when children get a second chance for showing a particular emotion.

Moreover, we look for differences in the way Dutch children express their emotions while playing games and use these results to compare two game types, which are a simple but effective game and an advanced game that uses storytelling techniques.

Previous research has shown that the facial recognition software FaceReader™ was not able to recognize facial expressions properly and therefore the software was not able to generate useful research data. In order to improve FaceReader™, another objective of this study is to investigate what factors are of influence on this software. We are interested to see if gender, facial coverage or hyper articulation is of influence on the performance of FaceReader™.

1.3 Approach

This chapter describes how the different tasks and phases during this study were handled. On the whole, these tasks can be divided into designing games, contacting elementary schools, conducting experiments, analyzing data and finally, documenting the results.

To design affective games for changing emotions, there are several important phases which have to be completed in order to get the best results for this study. The figure below illustrates the different
phases of the user centered design process we followed (Norman, 2002).

![User centered design life cycle](image)

In this study, the end-users are Dutch children aged seven to nine. Primarily, existing games for this target group, to identify the types of games which can be used for our purposes, were consulted. Moreover, we looked at similar research what has been done with the same target group, and what type of games were used in these studies.

Knowing the user, the next step was to understand the users’ needs and goals, and to understand which use of colors, characters, music and sounds in the games would meet the users’ expectations. Keeping these expectations in mind, a broad range of game scenarios was described and was finally narrowed down to two game scenarios (Appendix IX).

Before creating functional designs for the games, a brainstorm session was held to determine the structure and visualization of the games. Hereafter, storyboards were written to describe the game play, use of colors, characters and sounds in more detail (Appendix X). During this phase, elementary schools were contacted to ensure the number of sufficient participants for this study in an early stage.

Knowing the users’ expectations and the structure and visualization of the games, the detailed game descriptions and storyboards were translated into low fidelity game designs (Appendix VII). These designs were sketched on paper and finally translated into high fidelity game designs in order to have a decent representation of the final games. This phase was completed by an expert review by our supervisor Suleman Shahid.

Using standard programming the high fidelity designs were translated into fully functional games, which were tested several times.
and finally used for conducting the experiments in order to gather data for further analysis.

Figure 4. Two games which we developed for this study.

After the experiments were conducted and all necessary data was collected, this data was analyzed and the results were documented in this thesis.

This study was conducted by two persons which led to a division of work; the design part was mainly done by Dave Kierkels and the programming part was mainly done by Lars van Bommel. Even though there was a division of work, which was created for the reason that Dave has better design skills where Lars has better programming skills, we both contributed to the design and programming parts.

1.4 Structure thesis
In the following chapter a summary of related literature will be given. Furthermore, we will give our reflection on these previous studies, followed by our motives for this study. In this chapter, the research questions and the hypotheses are also included. In chapter three descriptions of the games used for this study will be given, where chapter four describes the procedure, the measurements and the used experimental design and analyses. After the method section, the research questions will be answered in chapter 5, the results section. In chapter six we will discuss our results and draw a conclusion based on this study. Finally, there will be a detailed description of possible future work in chapter seven.
Chapter 2 | Literature review

In this chapter we will discuss previous research, which has been done in the fields of game design for children and affective computing. After having described the previous research, a summary of this literature review will be given. Finally, we will give our reflection on this literature in relation to our study.

2.1 Previous research

Research has been performed during the last few decades to investigate how to recognize facial expressions, the use of affective computing and how to design computer games for children.

*Emotions*

To measure the effect of affective games on the users, there are six basic emotions to distinguish. The six basic emotions are surprise, fear, anger, disgust, sadness and happiness (Ekman, 1972). Each emotion has its own characteristics in facial expression. In his work, Ekman describes the characteristics of each emotion and how these can be recognized (Appendix XII).

*Affective computing*

Picard (1999) defined affective computing as “computing that relates to, arises from, or deliberately influences emotion”. It can be used in four areas related to Human Computer Interaction, namely; “(1) Reducing user frustration; (2) Enabling comfortable communication of user emotion; (3) Developing infrastructure and applications to handle affective information; and, (4) Building tools that help develop social-emotional skills.” (Picard, 1999, p. 1). User frustration at run-time can be addressed by affective computing in two ways; the first way is to identify situations which can be experienced as frustrating by users in run- and design-time, and the second way is to lessen the frustration a user experiences during a task or interaction. During interactions with computers, people often show different emotions, but computers are
generally unable to recognize these emotions. By building systems that are able to recognize emotions, these systems can also be used to communicate affective feedback and therefore provide a more comfortable way of communication between user and computer. It is suggested by current intervention techniques that, when given lots of examples, autistic children are able to recognize and understand emotions shown by people better. In order to help develop social-emotional skills, several tools which repeat these emotions and situations, can be build (Picard, 1999).

Game design principles

Verenikina & Herrington (2009) reported that in computer game design for children it is important to design games in such a way that the user has the freedom to explore, and the game should therefore be controlled using spontaneous, self-initiated and self-regulated acts. Furthermore, games should provide an imaginative situation familiar to children, there should be no obligation to achieve a goal so the game can be played relatively ‘risk’ free and the player should experience fun both during game play and when the game is finished. A way to ensure this is to end with a fun animation (Marco, Baldrarasi, & Cerezo, 2010).

A good way of implementing the above features in games, is to use interactive storytelling which is a technique that can be used to explain and help young children to understand the world, and help them with communication, recognition and recall skills. Moreover, storytelling is used to improve linguistic and literacy skills and can be used to stimulate children’s creativity and promote fun, enjoyment and engagement while learning (Garzotto, Paolini, & Sabiescu, 2010). Chris Crawford (2004) defined interactive storytelling as “a form of interactive entertainment in which the player plays the role of the protagonist in a dramatically rich environment.”

Another important aspect of interactivity in game design, according to Sturm, Bekker, Groenendaal, Wesselink, and Eggen (2008), is providing the user with feedback. This can be done in
various ways, for example by using sounds, light and or physical change of objects. By providing feedback, the user will be informed about the system receiving his or her input, about the game progress and whether an assignment or task is completed successfully or not. The response given by the system can be linked to the given task or assignment and it can be used as a motivator for completing the game.

Figure 5. Final feedback after finishing the basic game Show It!

Previous research (Wade, Shriberg, & Price, 1992; Oviatt, Levow, MacEarchern, & Kuhn, 1996; Levow, 1998; Bell and Gustafson, 1999) has shown that people tend to hyper articulate when a speech recognition system does not understand them and the people have to correct themselves. People do this in different ways; some people speak louder and others speak higher or longer. In this case, hyper articulation can also be recognized by looking at the facial expression of the speaker (Wang, Demirdjian, & Darrell, 2007).

2.2 Reflection

In previous studies several aspects, which we found very interesting to investigate, were missing and we therefore added these to our study. In many previous studies, the participants were often adults or students, while we wanted to conduct our study with young children. We were interested to see how young children interact and show their emotions while playing games. During our literature review we missed studies using Nintendo Wii for interaction. Therefore we added the Nintendo Wii to our games as an extra game element. For interaction with games using facial expressions we wanted to create a unique combination in experimental research by using a Nintendo Wii togeth-
er with facial recognition software. This way the children had to use their facial expressions in combination with the Nintendo Wii to control the games.

![Image of Nintendo Wii and facial expression combination](image)

*Figure 6. Combination of Nintendo Wii and facial expression to control the games.*

We stated earlier that a fun animation at the end of a game should be implemented to encourage children to repeat playing. We tried to put the children in a happier state even before the game started by adding a fun animation as an intro to the first game “Show It!”.

In previous studies it was found that feedback can be provided in several ways. One thing we missed was how immediate feedback could be used as a tool for inducing emotions and therefore we added a moving score bar like the one in the Indian TV show called “Dus Ka Dum”.

Where previous research mainly focused on reducing frustration, we wanted to induce frustration to see if children will try harder to get a good score, which might lead to hyper articulation. It is previously shown that when hyper articulation occurs in speech, there is also a change in facial expressions and we found it interesting to look at these facial expressions and for differences in expressiveness.

### 2.3 Motives for our study

The motives of our study can be divided into three fields of research, which are in the field of human and psychology, in the field of game design and in the field of technology.

Within the field of human and psychology, we look for changes in children’s emotions over games. Moreover, we are interested to see...
if children recall the correct facial expression from their memory, or if they mimic the represented emotion. We investigate this by observing children and to see if they show different facial expressions as a response to emotions represented by the game as text or as images. For the same reasons, we look for differences between the six basic emotions and for gender differences.

Results retrieved from the field of human and psychology, can be used to design games in an optimal way for future research in the field of affective computing. To determine the optimal game design, we want to investigate how children respond to different game features by designing two different types of affective games. Game features we compare are for example: a storytelling versus a non-storytelling game; positive versus negative feedback given by the game; and emotions represented as images versus text. If computer games should contain the features reported by Verenikina & Herrington, we can expect that children will like the “Emotion Park” game more than the “Show It!” game because in “Emotion Park” these features are implemented.

Furthermore, we want to investigate if gender, facial coverage and hyper articulation have an influence on the performance of the facial recognition software FaceReader™. These results can possibly be used to improve this software, for example, for future research. If each emotion has its own facial characteristics, as stated by Ekman, and FaceReader™ uses these facial characteristics for analysis, we can hypothesize that FaceReader™ will perform better when hyper articulation occurs.
From a human and psychology perspective, the main research question is:

*Can emotions be changed in children over games by emotion elicitation?*

If the above question can be answered positively, we would find it interesting to see if there are gender differences.

From a game design perspective, the main research question is:

*How can games be designed in an optimal way for emotion elicitation?*

To find how to best design a game for the use of emotion elicitation, a few corresponding sub questions have to be answered first:

- What influence does an emotion represented in the game as text and as an image, have on the emotion in children?
- What differences can be found in the way children respond to the six basic emotions?
- What are the differences in the induced emotions using an interactive storytelling game (Emotion Park) compared to a non-storytelling game (Show It!)?
- What influence do positive (*Correct* mode) and negative feedback (*50-50* mode) have on the emotion in children?
- Can hyper articulation be induced by giving children a chance for correction after negative feedback?
From a technological perspective, the main research question is:

*What is the best way of using the facial recognition software FaceReader™ in research in order to get the best data?*

To be able to answer this main research question, several factors that have a possible influence on the performance of FaceReader™ have to be taken into account. The factors are: the influence of a person’s gender; the influence of wearing glasses or other facial coverage and if hyper articulation is of influence.

**Division of work**

Because of the large scope of the study, this study was conducted by two researchers and to be able to cover all research fields, a division of work was made. Although Lars mainly focused on game design and Dave mainly focused on the questions “Can emotions be induced in children?” and “How to gain optimal performance for the facial recognition software FaceReader™?”, both researchers helped each other in answering the questions in order to get the best analyses.
Chapter 3 | Game Descriptions

In this chapter a detailed description will be given about the games we designed and developed for this study.

3.1 Game Paradigm

For our study we developed two affective games for inducing the six basic emotions in either a natural or mimicked way in Dutch children. This was done by using the GamE (Game as a method for eliciting Emotions) paradigm. The GamE paradigm stands for games that can be used to elicit and/or induce emotions in an ethical and natural way (Shahid, Krahmer, & Swerts, 2008).

Before developing these affective games, low fidelity game designs were sketched on paper. In order to have a decent representation of the final games, Adobe Photoshop CS3™ was used to translate these sketches into high fidelity game designs. Finally, the games were developed using Adobe Flash CS3™, were tested several times and then used for conducting the experiments.

Figure 7. Low fidelity design, functional design and the final design used in the advanced game Emotion Park.
3.2 Game 1 - Show It!

The first game, Show It!, is a game which shows an image or a word representing an emotion, depending on the game condition set up front by the researcher. The participant has to show the same emotion as represented in the image or word. The game was designed to measure differences in shown emotions by children. Therefore, the game can be played in three game modes; one Correct mode, one 50-50 mode and one mode where scores and feedback are read by FaceReader™ 1.0 using live audiovisual data.

Concept of game

The concept of Show It! is to elicit emotions corresponding to the emotions shown in the game.

The game contains three game modes (Correct, 50-50 and FaceReader), and each game mode can be played in two conditions (Text and Images). The overall game design is the same for all game modes, but a difference is that in the 50-50 mode, 18 emotions are being shown and in the FaceReader- and Correct modes, only 12 emotions are being shown. The reason for this is that six rounds with negative feedback were added to the already existing 12 rounds with positive feedback. Furthermore, in the Correct mode the system always returned positive feedback above 75%, regardless of how the player performed on a particular emotion. In the 50-50 mode both positive and negative feedback are returned; positive feedback is always above 75% and negative feedback is always below 25%. After a negative score is given, the same emotion is being repeated with the purpose of inducing hyper articulation in the player. The feedback for this round, designed for hyper articulation, will always be positive.
This design was chosen because we were interested to see if children showed the emotions more expressive when they received only positive feedback, than children who received both positive and negative feedback.

Moreover, we were interested to see how children reacted on real-time feedback returned by the system according to FaceReader™ and therefore the third game mode (*FaceReader*) was created. In this game mode, FaceReader™ will try to read the scores from the live audiovisual data stream, if the scores cannot be read (bad image quality could be a cause for this) the software will try again. After three attempts, a random feedback score is being generated.

Concerning the game conditions (*Text and Images*), we were interested to see if children recall the correct facial expression from their memory, or if they mimic the represented emotion. We investigate this by observing children and see if they show different facial expressions as a response to emotions represented as text and as images by the game.

Finally, we were interested to see which combination of game mode and condition can be used for designing best new affective games for the purpose of changing emotions in children.

**Game Design**

The game was designed in such a way that different images can be used as representations for each emotion. Which images to use, and the corresponding feedback, can be configured using an XML-scheme (Appendix VIII). This was done so that other researchers are able to
edit the game very easily, just by replacing images or texts. This way, the game could be played using other images instead of SpongeBob, and the game could also be played in different languages, which makes it possible to conduct the same research in different countries to investigate, for example, cross-cultural differences.

For this study, the game was designed using two different conditions, text and SpongeBob faces. The reason for choosing SpongeBob was that children in the age of seven to nine are really fond of this character. Another reason for choosing SpongeBob in our game design was that this character is well known for showing all types of facial expressions, which fitted perfectly with our study. The player will see either SpongeBob faces or text, which one of these the player will see is set up front by the researcher.

When the game starts, SpongeBob SquarePants (further called SpongeBob) and two buttons, ‘Play’ and ‘Options’, are shown. The options were added for the researchers to have an easy way for choosing the game modes. As mentioned earlier, these game modes are; Correct, 50-50 and FaceReader.

When the ‘Play’ button is hit, the game starts and SpongeBob walks into the screen and waves to the player. This was added as an introduction to the game and to let the children ‘meet’ SpongeBob. When SpongeBob enters the screen, background music is played to make the game more cheerful and more fun playing. This was added because Marco et al. (2010) stated that it is important to make games fun to play.
After the intro, the first round is being played and an image is displayed for which emotion should be shown. Five seconds later, the image of the emotion disappears and a score bar is being displayed. The score bar moves up until the correct score is reached, and when this happens a sound is being played corresponding to the score and the feedback text is shown. When the player is finished reading the feedback, the player presses the ‘Continue’-button using the Wii Remote to continue the game. This is implemented for more interaction with the Nintendo Wii and for the reason that children love to play games on the Nintendo Wii and therefore it made the game more fun to play. After all rounds have been played, a final feedback text, score and image are given and the game is finished.

**Features**

Show It! contains several features, which were added for game play, to induce emotions and to provide feedback to the player. One of these features is a cheerful and happy background music for more engagement.

Six different feedback mechanisms for interaction with the user were implemented. Immediately after an emotion was shown, the user received five types of feedback. (1) A visual score bar slider going from the bottom to the top, indicated (2) the score in percentages. (3) When the score was above 50%, the score bar slider went into the green area. Below 50% the score bar slider stayed in the red area. Furthermore, there was (4) a textual feedback which represented a comment on the score and (5) a little sound was being played which represented the score as a sound (‘aaahh’ for negative, ‘ooohh’ for medium and ‘hooray’ for positive scores).
(6) The sixth feedback mechanism is a positive background image or a negative background image at the end of the game, depending on the final score.

**3.3 Game 2 – Emotion Park**

The second game, Emotion Park, is a theme park based game, which contains six different attractions to induce the six basic emotions.

**Concept of game**

A theme park was chosen as the concept for this game for two main reasons. The first reason was that children love theme parks and the second reason was that the different attractions could be used perfectly to elicit the six basic emotions in a natural and familiar situation. By providing this natural and familiar situation, the need for information
from a player’s memory to perform a task is reduced, which Norman (2002) defined as natural mapping.

This game is based on interactive storytelling, which is often used in affective games to enhance the interaction with the game. The storyline guides the player through the game and challenges the players to interact with it by using their emotions.

For Emotion Park we designed five different attractions and one surprise act for inducing the six basic emotions (happiness, surprise, sadness, anger, fear, disgust) (Ekman, 1999). (1) The rollercoaster was chosen for inducing anger, (2) the can knockdown stand was chosen for inducing happiness, (3) the haunted house for inducing fear, (4) the Ferris wheel for sadness and (5) the food stand was chosen for inducing the emotion disgust. A bonus attraction, the balloon stand, was added as an extra game element to make the game more fun to play and was not designed for inducing emotions. Moreover, a clown was added as a surprise act for inducing the emotion surprise.

![Figure 12. The attractions of Emotion Park.](image)

**Game Design**

Emotion Park is also a dynamically driven game, which makes the game easily editable. The difference with Show It! is that in Emotion Park only the textual aspects are dynamically driven and the images are hard coded in the game. The main reason for hard coding the images was that this game should be played using these attractions for inducing the six basic emotions. A technical reason for this choice was that the file size would be too large when not hard coding these images, which would lead to a longer initial loading time of the game. For
more interaction with the game, Emotion Park was designed in such a way that it has to be controlled using the Wii Remote in combination with the players’ facial expression.

When the game starts, a story text which tells the story of Ozi will be shown. Ozi comes from outer space and wants to learn how to live on planet Earth. Ozi knows most things, but he does not understand emotions. The player is being asked if he is interested to learn Ozi how to show a particular emotion in a particular situation by visiting Emotion Park. If the player has read the story, a button ‘enter the park’ needs to be clicked after which the doors of Emotion Park will open and a nice theme park sound will be played. When entering the park, a map of the park is shown and every attraction can be visited in a self-chosen order. There are six attractions which are meant for inducing the six basic emotions. The seventh attraction was added for more game play.

For inducing the emotion happiness, a can knockdown stand can be visited where six cans have to be thrown off a wooden shelf. When the cans are hit, they will fall off the shelf and when a ball has missed the cans, it is placed back on the table to try again. After three balls have hit the cans (all cans always fall the same way after they are hit), a storyline is being shown which asks the player to show a happy emotion in order to learn Ozi how to react when winning a game.

![Figure 13. Game play and storyline of the can knockdown stand in Emotion Park.](image)
Next, a Ferris wheel can be visited. When the player arrives at the Ferris wheel, a long waiting queue is shown with a waiting time up to 120 minutes. The player shows a sad emotion because there is not enough time to wait that long. An employee shows up and tells the player to show real sadness, after which the player receives a free ticket for the balloon shooting stand.

*Figure 14. Game play and storyline of the Ferris wheel in Emotion Park.*

When arriving at the balloon shooting stand, the mouse pointer is replaced by a crosshair and the employee tells the player to hit three balloons to win the game. If the Ferris wheel is not visited yet, and thus the player has no ticket, the employee tells the player that the game can only be played when having a ticket. This attraction is added for more game play and therefore it is not necessary to show an emotion in order to continue the game.

*Figure 15. Game play and storyline of the balloon shooting stand in Emotion Park.*
When visiting the food stand, the player is being asked to choose between a cup of soup and a hamburger. After making a choice, the product is shown and the player is asked to show Ozi how to look disgusted because there is a worm in the hamburger or soup.

![Figure 16. Game play and storyline of the food stand in Emotion Park.](image)

After four attractions are visited and the player suspects to return to the map, a clown suddenly appears and walks towards Ozi and the player. The clown is in the park to give away presents to children and therefore he gives Ozi a present. The player has to show Ozi to be very happily surprised after which he receives the present and returns to the map.

![Figure 17. Game play and storyline of the clown in Emotion Park.](image)

If the player visits the haunted house, a close up of the house is shown with a ghost located in the top window saying “Enter if you dare”. When the player enters the haunted house, the screen turns black and the mouse pointer is being replaced by a big circle of light as if the player is holding a flashlight. This flashlight can be used to scout the haunted house where spiders, bats, pumpkins and a ghost are hidden. After ten seconds having scouted the haunted house, the flashlight will
be pointed automatically at Ozi and the player, and a story text tells that the player should teach Ozi how to look scared in order to leave this scary house.

![Figure 18. Game play and storyline of the haunted house in Emotion Park.](image)

The final attraction which can be visited, is a roller coaster. When the player enters the attraction, an employee shows up and says that all visitors have to be taller than 1.40 meters to enter the ride. A screen is showed on which the player and Ozi are standing in front of a horizontal bar, which indicates the minimum length for accessing the attraction. The employee says that Ozi is not allowed to enter the ride because he is too small, but the player is clearly equal in length, which is a bit taller than 1.40 meters, and is allowed to enter. A story text is shown which tells the player to look angry and teach Ozi this emotion because it is not fair to discriminate. This is implemented to make the game more educational and to learn children about discrimination.

![Figure 19. Game play and storyline of the roller coaster in Emotion Park.](image)
When all attractions are visited, the player has to go to the exit where a guard thanks the player for visiting Emotion Park and a final story text is shown. The final storyline informs the player that Ozi understands all emotions, and therefore he is able to live on planet Earth for which he is thankful to the player. Moreover, the story text attends the children to the fact that they received a present from the clown in the park after which a small present is given to the children in real life to thank them for participating in this study.

![Image](image.png)

*Figure 20. Game play and storyline of the exit in Emotion Park when the game is finished.*

**Features**

Several features were added in Emotion Park to increase the gameplay, to induce emotions and to provide support and feedback to the player. Emotion Park contains two different sounds; the first sound is a general background music, which sounds like a random theme park music. The second sound, a "scary" sound, is being played when the player enters the haunted house to induce fear.

To support the story, Ozi and a character representing the player, are present at almost every screen in the game.

To provide support to the player about how to show an emotion, feedback is provided in two different ways; represented as text and images. When the player is asked to show an emotion, the character in the game shows that corresponding emotion which helps the player and textual feedback will be given when the emotion is shown.
3.4 Technical aspects & issues

Adobe® Flash® CS3
The games were developed using Adobe® Flash® CS3 because it offers a broad range of possibilities and graphic animations. Another reason for choosing Flash is that the Nintendo Wii contains an installed internet browser which supports Flash games.

PHP
The participant’s score collected by FaceReader™ had to be written to a simple .txt file, but because Adobe® Flash® does not support this, an extra PHP-script was necessary. From the Adobe® Flash® code, the PHP-script was executed to write the scores along with the condition to the .txt file.

WampServer 2.0
The Nintendo Wii was not able to render the game fast enough via its browser and no PHP-script could be executed on the Wii. Therefore, it was necessary to host and run the games locally from a laptop using WampServer 2.0. Because the games were running on a local network and not via the internet, the initial loading speed increased dramatically and the PHP-script could be executed.

Nintendo Wii & Bluetooth
To control the games running on a laptop, the Nintendo Wii Remote was connected to this laptop via Bluetooth. With the help of the program WiinRemote, it was possible to use the Wii Remote instead of the mouse to move the mouse pointer.
A Wii sensor bar was necessary for the Wii Remote to know its position and a Nintendo Wii was necessary to supply this sensor bar with power. Because the children were holding a Wii Remote and saw a Nintendo Wii, they thought they were playing the games directly on the Nintendo Wii. As explained earlier, the games were actually played from a laptop.

![Figure 21. Connection of the used devices.](image)

**FaceReader™**

FaceReader™ 1.0 was used on the same laptop to analyze the live audiovisual data and to write the measured scores for each emotion (a score between 0 and 1) to a text file. It was not possible to use FaceReader™ 2.0 because this version locks the text file it uses to write the results to. This was a problem because the text file had to be read by the games in order to provide live feedback.

![Figure 22. File and feedback handling by the system.](image)
EyeCatcher

The Eyecatcher was used to gather audiovisual data, which was split into two video- and audio-streams. One stream was connected to the laptop mentioned above to supply FaceReader™ 1.0 with the data necessary for measurements. The other stream was connected to the second laptop where the tool VirtualDub was used to capture the video streams. The reason to split the data and to use two laptops was, that one laptop did not have enough memory resources to run all tools.

Figure 23. Two laptops connected to EyeCatcher and speakers.
Chapter 4 | Method

In this chapter we will describe our participants in this study; how this study was conducted; and how the analyses were made.

4.1 Experimental Setup

To investigate the influence of affective games as a tool for inducing emotions, several instruments were used in our experiments. An Eye-Catcher was used to display the games and for capturing the children’s facial expressions. The EyeCatcher was placed on a table together with the Nintendo Wii console, a Wii remote and two speakers. Surrounding the participant there was a black curtain in order to get the best FaceReader™ results. The experimental room was arranged in such a way that the children were not able to see the control room. In the control room, there were two laptops which were connected to the EyeCatcher. One laptop was used for capturing audiovisual data using VirtualDub and the other laptop was used to capture FaceReader™ data, to display the games on the EyeCatcher and for playing sounds through the speakers.

*Figure 24. Side view of the experiment room and the control room*
4.2 Participants

There were 56 Dutch children that participated in our study, of which 31 male and 25 female. The children, from four randomly chosen elementary schools, were aged seven to nine with an average age of 8.41 years ($SD = .80$). All children played Show It!, of which 34 took part in the Emotion Park game. The children who played Show It! were divided in three game modes and two conditions. In the game modes Correct and 50-50, there were 16 children in both conditions and in the FaceReader game mode, there were seven children in both conditions.

Table I: Division of participants in different game modes and conditions for Show It!

<table>
<thead>
<tr>
<th>Game mode</th>
<th>Condition</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>Images</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Words</td>
<td>16</td>
</tr>
<tr>
<td>50-50</td>
<td>Images</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Words</td>
<td>16</td>
</tr>
<tr>
<td>FaceReader</td>
<td>Images</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Words</td>
<td>7</td>
</tr>
</tbody>
</table>
All participants had prior written consent by their parents to participate in this study of which 48 had written consent to use the results and audiovisual data for research purposes.

### 4.3 Procedure

Six elementary schools were contacted via e-mail and telephone, out of which four schools responded positively for participation in this study. These four schools are situated in Boxmeer, Leveroy, Echt and Tienray in the Netherlands. After receiving positive feedback from the schools, a letter with an explanation of this study together with a consent form, was delivered to the parents of the children. After receiving enough consent forms the experiments were started.

In a room, specially prepared for these experiments, the children played two games. The children were called one by one from their class room and walked together with one of the researchers to the experiment room. Here, one of the researchers asked some general questions to make the child feel comfortable. After this, the researcher explained the games and explained how the questions of the questionnaire should be answered, which was by picking one of the mood cards.

![Figure 26. The way the pre- and post questionnaire were conducted using mood cards.](image)

After this explanation, the questions of the pre-questionnaire (Appendix V) were asked by the researcher, after which the child was asked to sit down in front of the EyeCatcher to play the first game.
When the first game was finished, one of the researchers asked the child if everything went well and to come and sit at the interview table again, where the questions of the post-questionnaire of the first game were asked. Meanwhile, the second game was being prepared by the other researcher and when the post-questionnaire was completed, the child was asked to sit down in front of the EyeCatcher again to play the second game.

After the second game was finished, the questions of the post-questionnaire of the second game were asked. After having finished the final questionnaire, the researchers thanked the child for participating and rewarded the child with a bracelet of the football world cup 2010, which was a huge hype among children during the time of the experiments.

The total experiment took approximately 20 minutes, after which the child returned to the class room where the next child was asked to participate.

### 4.4 Measurements

With the help of pre- and post questionnaires, we measured the fun the children experienced over the games by including various mood indications in every questionnaire. To measure the game experiences, we adapted the Game Experience Questionnaire as described by Ijsselsteijn, de Kort, and Poels (n.d.). The post questionnaires of both games contained one open-ended question about what the children's overall impression of the games were. Finally, we included 5- and 7-point Likert scales to ask the children what their expectations of the game were.
The children were asked for example; whether they have learned when
to show a particular emotion in a particular situation, what their expe-
riences with the game were, whether they paid enough attention to the
games while playing, and whether they played the game with the in-
tention of having fun or with the intention to win. Furthermore, qualitative data was gathered about the shown emotions and about interac-
tions of the children with the game while playing.

**Questionnaires**

To measure the emotional state of the participants, we used one pre-
questionnaire before starting the games and one post-questionnaire
after each game. The questionnaires were designed in such a way that
we were able to measure differences in the emotional state of the par-
ticipants before and after playing the games, which we used for further
analysis.

These questionnaires were also designed in such a way that children in
the age of seven until nine were able to give answers corresponding to
the scale which belonged to the questions. This was done by asking the
participants the questions after which they had to pick a card, lying in
front of them on the table, corresponding to the scale of the question-
naire.

*Figure 29. Mood cards.*

This design was chosen to make it more easily for the children to un-
derstand how the questions should be answered. This way the children
did not need to read and fill out the questionnaire themselves (some
children had problems reading), but one of the researchers read the
question out loud and the children only needed to pick a card corre-
sponding to their answer. Another advantage of this design was that it
pointed out to be time saving.
4.5 Design and Analyses

First, the means of the mood values in the pre- and post-questionnaires were calculated. These means were used in an Independent Sample T-Test for measuring differences between gender using mood as the dependent variable and gender (levels: male, female) as the between variable.

These calculated means were also used in Repeated measures analyses of variance (REMANOVA's) for measuring differences between the independent variables using mood as a dependent variable. These independent variables were game types (levels: storytelling, non-storytelling), game modes (levels: correct, 50-50), and the game conditions (levels: text, images).

Means of the answers to both post-questionnaires were used to calculate which game children liked most and to calculate which game was most educative.

To investigate which game was liked most, a Paired Sample T-Test was used with game as within variable (levels: Show It!, Emotion Park) and fun as dependent variable. Another Paired Sample T-Test was used to investigate which game was most educative, using game as within variable (levels: Show It!, Emotion Park) and educative as dependent variable.
Chapter 5 | Results

In this chapter, the quantitative data and qualitative data which we gathered in this study, are discussed in two separate sections. In both sections, the data retrieved using the basic game Show It! is used to compare game modes and conditions. Moreover, the data retrieved from both games is used to compare Show It! with Emotion Park.

5.1 Quantitative data

5.1.1 Show It!

What influence does an emotion represented in the game as text and as an image, have on the emotion in children?
All children had a positive change in mood after having played the game, regardless of the condition. \( M = 4.46, \ SD = .455, \ F (1, 71) = 8.45, \ p < .025 \). However, no significant differences in the emotional state of children were found when an emotion was represented as an image or represented as text, \( F (1, 71) = .09, \ p = .76 \).

What influence do positive (correct mode) and negative feedback (50-50 mode) have on the emotion in children?
All children in both game modes Correct and 50-50, were happier after having played the games, \( M = 4.46, \ SD = .463, \ F (1, 57) = 12.3, \ p < .025 \). Whether the participant retrieved positive or negative feedback was not of significant influence on the emotions, \( F (1, 57) = 2.36, \ p = .13 \).

5.1.2 Show It! & Emotion Park

What are the differences in the induced emotions using an interactive storytelling game (Emotion Park) compared to a non-storytelling game (Show It!)?
All children who played either a storytelling- or a non-storytelling game, had a positive change in emotions over the game, \( M = 4.48, \ SD = .440, \ F (1, 102) = 19.8, \ p < .001 \). Although all children had a positive change in emotion, no significant differences were found between the two different types of games, \( F (1, 102) = 1.48, \ p = .226 \).
Can emotions be changed in children over games by emotion elicitation?

All children had a positive change in mood after having played the games, regardless of the game mode, game condition or gender, (Pre: M = 4.22, SD = .542, Post: M = 4.59, SD = .387, t(51) = 6.99, p < .001, effect-consistency = 85.6%).

Can gender differences be found in the induced emotions?

All children were happier after having played the games. The mood of male children (Pre: M = 4.11, SD = .610, Post: M = 4.57, SD = .426, t(29) = 5.77, p < .001, effect-consistency = 86.7%) was changed more than the mood of female children (Pre: M = 4.36, SD = .403, Post: M = 4.61, SD = .335, t(21) = 4.67, p < .001, effect-consistency = 84.1%). However, a two-tailed test showed that there were no significant differences in the change of mood between genders, (t(50)=.33, p=.75).

Which game was being liked most?

Children liked the advanced game better (Emotion Park: N = 31, M = 6.77, SD = .425) than the basic game (Show It!: N = 31, M = 6.52, SD = .677). However, no significant difference can be found between the two games, (t(30) = 1.97, p = .058).

Which game was found as being most educative?

Children found the interactive storytelling game (Emotion Park: N = 31, M = 3.84, SD = .969) more educative than the basic game (Show It!: N = 31, M = 3.67, SD = 1.11). However, no significant difference can be found between the two games, (t(30) = .90, p = .38).
5.2 Qualitative data

Our impressions of the children’s verbal and nonverbal expressiveness during the experiments, were used to derive results for this section.

In order to ensure qualitative data, at least five representatives were observed in each condition. These representatives were randomly divided over gender, and equally divided in numbers for different measurements. For example, when observing children playing Show It! to see if differences occur between the text and the image condition, we made sure there was an equal division over game modes and conditions. This resulted in two representatives in each game mode, which adds up to six representatives per condition.

To analyze the performance of the facial recognition software FaceReader™, we observed the overall quality of the readings of this software during the experiments. After having recorded the videos of the children, the videos were imported into the software for an analysis by FaceReader™ itself.

5.2.1 Overall impression

Overall, it seemed that the children liked playing both games very much and they seemed to understand how the games should be played. The children liked the fact that the games had to be played using the Nintendo Wii Remote and it seemed that almost all children knew how to use this controller. In the beginning, children seemed to be a bit shy but while playing the games, they felt more confident and showed their emotions more ‘freely’. There was a difference in expressiveness; some children were very expressive and made sounds and gestures together with their facial expressions, while others hardly showed any facial expressions.
**Show It!**

When SpongeBob entered the screen and waved at the children, many children smiled and waved back to SpongeBob. Overall, the children were able to show the correct emotion but it seemed to be more difficult for them to show the correct emotion when the game represented an emotion as text compared to an emotion represented as an image. This could indicate that children find it easier to mimic an image than to recall an emotion from their memory.

It also seemed that children showed a corresponding response to game feedback. They gave a positive response to positive feedback, for example by yelling “Yes”, and a negative response to negative feedback. After receiving negative feedback and children got a chance for correction, they hyper articulated to get a better score.

**Emotion Park**

Some of the children had difficulties reading, which was a slight problem for this game because the game told a story. This problem was solved by reading the text out loud for these children. It also seemed that the story texts were a bit long at some points, because the children showed bored faces at these moments.

**FaceReader™**

Unfortunately, the facial recognition software FaceReader™ failed to recognize children’s faces most of the times and therefore it failed to recognize the corresponding emotions. It was also noticeable that FaceReader™ was able to read faces of adults better. Due to this, most of the data captured by the software was useless.
5.2.2 Informal video analyses

5.2.2.1 Show It!

What influence does an emotion represented in the game as text and as an image, have on the emotion in children?

Overall, no difference in expressiveness between the conditions could be found when observing the children. However, there was a difference in the way the children expressed themselves; in the images condition, some children mimicked the shown emotion. In the text condition, children seemed to recall the facial expression from their memory and some children accompanied their facial expressions with their hands and by making sounds.

Table II. Comparison of children playing Show It! in different conditions.

<table>
<thead>
<tr>
<th></th>
<th>Disgust</th>
<th>Angry</th>
<th>Scared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text condition</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td>Images Condition</td>
<td><img src="image4.png" alt="Image" /></td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
<tr>
<td>Game Image</td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
<td><img src="image9.png" alt="Image" /></td>
</tr>
</tbody>
</table>
Can hyper articulation be induced by giving children a chance for correction after negative feedback?

Hyper articulation did occur when giving children a chance to correct themselves, but generally this was not shown very expressively. Furthermore, we have seen that hyper articulation differed a lot between children. Children who showed their emotions very expressively, hyper articulated more than children who were not very expressive in showing their emotions.

Table III. Differences in showing emotions between the first try and second try; hyper articulation occurred.

<table>
<thead>
<tr>
<th></th>
<th>Happy</th>
<th>Scared</th>
<th>Sad</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Try</strong></td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
<td><img src="image3" alt="Image" /></td>
</tr>
<tr>
<td><strong>Second Try</strong> (hyper-articulation)</td>
<td><img src="image4" alt="Image" /></td>
<td><img src="image5" alt="Image" /></td>
<td><img src="image6" alt="Image" /></td>
</tr>
</tbody>
</table>

What influence do positive (correct mode) and negative feedback (50-50 mode) have on the emotion in children?

Overall, children responded positively to positive feedback and showed a disappointed face when receiving negative feedback. Some children seemed to show slightly happier faces at the end of the game when they had received only positive feedback than children who received both positive and negative feedback during the game. Although there was a difference, this was only a minor deviation and this differed between children, which makes it difficult to generalize these results.
Table IV. Differences after receiving positive- and negative feedback during game.

<table>
<thead>
<tr>
<th>Child 1</th>
<th>Child 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positive Feedback</strong></td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>Negative feedback</strong></td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
</tbody>
</table>

Table V. Differences after receiving positive- and negative feedback when the game is finished.

<table>
<thead>
<tr>
<th>Positive feedback at end of the game</th>
<th>Negative feedback at end of the game</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
<tr>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
</tr>
</tbody>
</table>

5.2.2.2 Show It! & Emotion Park

What differences can be found in the way children respond to the six basic emotions?

There seemed to be a difference in the expressiveness between children; some children were very expressive, where others were not expressive at all. However, each child individually did not show differences in expressiveness between the six basic emotions.
Table VI. Differences in expressiveness for the emotions disgust, angry and scared.

<table>
<thead>
<tr>
<th></th>
<th>Disgust</th>
<th>Angry</th>
<th>Scared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very expressive</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td>Not expressive</td>
<td><img src="image4.png" alt="Image" /></td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
</tr>
</tbody>
</table>

What are the differences in the induced emotions using an interactive storytelling game (Emotion Park) compared to a non-storytelling game (Show It!)?

Observing the children, it seemed that their emotions were induced by both games. However, the children seemed to be more expressive in the non-storytelling game (Show It!) than in the storytelling game (Emotion Park) which could mean that Show It! induced more emotions.

Table VII. Differences in showing emotions between the storytelling game and the non-storytelling game.

<table>
<thead>
<tr>
<th></th>
<th>Happy</th>
<th>Sad</th>
<th>Surprised</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storytelling game</td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
<td><img src="image9.png" alt="Image" /></td>
</tr>
<tr>
<td>Non-storytelling game</td>
<td><img src="image10.png" alt="Image" /></td>
<td><img src="image11.png" alt="Image" /></td>
<td><img src="image12.png" alt="Image" /></td>
</tr>
</tbody>
</table>
5.2.3 FaceReader™ analyses on video

What influence does a person’s gender have on the performance of FaceReader™?

Both the results of our own observations of the performance of FaceReader™ and the analyses performed by FaceReader™, showed that there was no difference on the performance between boys and girls.

What influence does a person’s age have on the performance of FaceReader™?

We have seen that there was a difference in the performance of FaceReader™ between children and adults. The software performed significantly better for adults than for children, even though we used the children’s training set in our experiments. This training set is adjusted to young children and should improve the performance of FaceReader™ when analyzing children. Unfortunately, this could not be confirmed by our observations.

Is there a difference in the performance of FaceReader™ for children wearing glasses, or having other facial coverage?

Overall, FaceReader™ scored at least a ‘Medium’ result in our rankings for one in every three cases. For children wearing glasses, the analyses of the software scored ‘Medium’ or better in our rankings in only one of every five cases. This indicates that the software performs better for children not wearing glasses. No differences could be found for other facial coverage such as hair or caps.

Will FaceReader™ perform better on facial expressions shown ‘normally’, or hyper articulated?

When hyper articulation occurred, children were very expressive in their facial expression and body language. As a result of this, children made a lot of movements in front of the camera which had a negative influence on the performance of FaceReader™.
Chapter 6 | Conclusion and Discussion

In this study we investigated how children responded emotionally when playing affective games. We developed two affective games to collect the emotional data of the children, using FaceReader™. The first game was a simple but effective game without using storytelling. The second game was an advanced game which included storytelling. In the simple game, we implemented three game modes (Correct, 50-50 and FaceReader) and two conditions (Text and Images). The collected emotional data was used for statistical analyses (quantitative data), for human reflection (qualitative data) and for automatic analyses by the facial recognition software FaceReader™.

Our results show that all children had an induced emotional state and that they were happier after playing the games. This is in line with our hypothesis, stating that emotions can be induced by letting children play affective games. Almost all children reported that the games were full of fun and rated them as being educative. Marco, Baldarassi and Cerezo (2010) stated that fun animations at the end of the games will encourage children to repeat playing, and we found that children were also encouraged to play a game after having seen a fun animation as an introduction to the game.

Although the games were fun to play, the statistical analyses were inconclusive on how to best design a game for inducing emotions in children. The reason for this was that the results showed no significant differences between different game elements. No significant differences in mood were found between children who played the storytelling game and children who played the non-storytelling game. No significant difference between the text condition and the image condition; and whether the participant received positive or negative feedback had any significant influence. This last finding confirms a previous study conducted by Verenikina & Herrington (2009), who stated that children do not care about winning, they just want to have fun while playing games.
Where the statistical analyses were inconclusive, inspection of the recordings revealed a different perspective, which resulted in an insight in how to best design games for inducing emotions. Children showed their emotions more expressive in a non-storytelling game than in a storytelling game and they responded more expressive to emotions represented as images than represented as text. Another finding is that there was a difference in how children reacted on given feedback. This in comparison to the results derived from the statistical analyses. Children showed either a disappointed or a neutral face when they received negative feedback and showed a happy face when they received positive feedback. The conclusion derived from the qualitative data is therefore that an affective game that should induce emotions can best be designed as a simple game without storytelling showing emotions represented as images, which gives the user positive feedback and which induces hyper articulation.

The facial recognition software FaceReader™ returned the best results on children who were not wearing glasses. Gender was not of any influence on the performance, and hyper articulation decreased the performance. The reason for this decrease was that children made a lot of movements while hyper articulating, making it more difficult for the software to obtain good readings. These findings were not in line with our hypothesis, which stated that hyper articulation would make it easier to distinguish the facial properties as described by Ekman (1999), and therefore lead to better performance of the software.
6.1 Critical remarks & recommendations

There are a few critical remarks on the choices made during this study that are interesting to note. It seemed that children agreed very easily to the questions in the questionnaire without thoroughly thinking about the question. If this was the case, this might have caused the differences between the quantitative and the qualitative results. Therefore, it might have been better to design the questionnaire slightly different.

Show It! was always played before Emotion Park which might have caused an already increased mood before playing the storytelling game and because of this experimental design, the results might have been affected. Another point of discussion is that the storytelling game contained a lot of text compared to active game elements, where the non-storytelling was a concatenation of active game elements. This could also have been of influence on the results.

Furthermore, our experiments were designed in such a way that the children played both conditions in only one game mode, either Correct or 50-50. To compare the differences between the positive (Correct mode) and negative feedback (50-50 mode), it might have been better to let the children play both game modes. There reason for this is that there might be a difference in expressiveness between children.

This study has provided reasons on how to best design computer games for the purpose of helping children with their cognitive development in a fun and ethical way. Especially for autistic children or children who have difficulties in expressing themselves, these games could be of additional value.
Chapter 7 | Future Work

In connection with this study several recommendations for future research can be made. First of all, the previously mentioned limitations of this study should be taken into account. Secondly, it would be interesting to try to induce hyper articulation using different methods, to see if other differences can be found in the way children hyper articulate, and to find the best method on how to use hyper articulation for eliciting emotions. Another interesting point is to take ethnicity as a factor and to look for cross-cultural differences using the games developed for this study. Finally, it would also be interesting to see if the emotional expressions and emotional state could be affected when children play these games in pairs of two.

Acknowledgments. We thank Suleman Shahid for being our supervisor and for helping us with this study. We also thank Emiel Krahmer, Marc Swerts, Rein Cozein and Anne Vermeer for participating, assisting and thinking with us during this study. Furthermore, we thank all children who participated in this study, their parents who gave their consent and all principals and teachers of the schools that allowed us to conduct our research. Many thanks to the people who gave their comments on a previous version of this thesis. And last but not least, we thank our family and friends for their support during this study and during the time we studied at Tilburg University.
References


Appendix I: Game Play Show It!

Screenshots menu:
Screenshot intro:
Screenshots emotions as images:
Screenshots emotions as words:

- Blij
- Vies
- Verdrietig
SHOW IT!

Boos

SHOW IT!

Bang

SHOW IT!

Verrast
Screenshots positive feedback:

![Aardig gedaan!](image1)

![Heel goed gedaan!](image2)

![Perfect gedaan!](image3)
Screenshots negative feedback:
SHOW IT!

Kom op, dat kan beter!

Verder
Appendix II: Game Play Emotion Park
Laat Ozi zien dat je het heel vies vindt dat er een worm in je eten zit.

Ozi begrijpt je niet, probeer heel vies te kijken.

Goed gedaan! Je hebt Ozi goed geleerd hoe je vies moet kijken.
Laat de meneer zien dat je heel verdrietig bent dat jullie niet in het reuzenrad kunnen en verdiend een gratis kaartje voor ballon schieten.

Ook begrijpt je niet, probeer heel verdrietig te kijken.

Goedzo Pak het kaartje maar.
Kun binnen als je durft!

Brrrrr ... het is erg hier. Latst Ozi zien dat je heel bang bent sodat hij mee uit het spookhuis gaat, weg van de spookjes.

Ozi begrijpt je niet, probeer nog banger te kijken.

Goed gedaan! Ozi begrijpt nu hoe je bang moet kijken.
Hallo kinderen, ik heb een kado voor jullie, pak het maar!

Wat een verrassing dat jullie een kadoje krijgen van de clown! Laat Ozi zien hoe je verrast kijkt.

Ozi begrijpt je niet, probeer heel verrast te kijken.

Heel goed gedaan! Ozi begrijpt nu hoe je verrast moet kijken.

Emotion Park
Heel goed gegooid! Laat Ozi zien dat je heel blij bent.

Ozi begrijpt je niet, probeer heel blij te kijken.
XVII
Goed gedaan! Je hebt Ozi geleerd hoe je boos kijkt.

Bedankt voor jullie bezoek!

Je hebt het heel goed gedaan! Je hebt Ozi heel goed geleerd hoe hij moet lachen, verdrietig moet kijken en hoe hij boos moet kijken.

Ozi begrijpt nu alles heel goed en nu kan hij bij ons op de aarde komen wonen. Hij wil graag je vriendje blijven, omdat jij hem alles zo goed geleerd hebt!

Had je van de clown in het park ook nog een vermaassing gekregen? Of niet?
Appendix III: Pictures of the Experimental Setting
Appendix IV: Children Interacting with the Games
Appendix V: Questionnaires

Game study

Pre Questionnaires

Date: ________ Consent: ___ Participant no: _____

Name: __________________________ Age: ______ Gender: ______

IK VOEL ME OP DIT MOMENT:

VERDRIETIG

| 🙁 | 😞 | 😊 | 😊 | 😊 | 😊 |

VROLIJK

NIET ZO FIJN

| 🙁 | 😞 | 😊 | 😊 | 😊 | 😊 |

FIJN

ONTEVREDEN

| 🙁 | 😞 | 😊 | 😊 | 😊 | 😊 |

TEVREDEN

ONGELUKKIG

| 🙁 | 😞 | 😊 | 😊 | 😊 | 😊 |

GELUKKIG
Nu wat vragen over de spellen

Ik denk dat het leuk is om de spellen te spelen

- Ik denk dat de spellen saai zijn
Game study
Post Questionnaires Game 1

Date: _________  Consent: ___  Participant no: ______

Name: ___________________  Age: ______  Gender: ______

IK VOEL ME OP DIT MOMENT:

VERDRIETIG

VROLIJK

NIET ZO FIJN

FIJN

ONTEVREDEN

TEVREDEN

ONGELUKKIG

GELUKKIG
**Nu wat vragen over het eerste spel**

Ik vond het leuk om dit spel te spelen

\[ \text{zet een lijn om een rij gezichtjes om te laten zien hoe leuk je het vindt om het spel te spelen} \]

1. **Het spel was leuker dan ik dacht**

\[ \begin{array}{cccccc}
\text{Helemaal} & \text{niet waar!} & \text{maakt niet uit} & \text{waar} & \text{helemaal waar!} \\
\end{array} \]

2. **Ik vond het spel spannend**

\[ \begin{array}{cccccc}
\text{Helemaal} & \text{niet waar!} & \text{maakt niet uit} & \text{waar} & \text{helemaal waar!} \\
\end{array} \]
3. Het spel was saaier dan ik dacht

4. Het maakte niks uit of ik won of niet, ik wilde gewoon lol maken

5. Ik vind het jammer dat het spel klaar is

6. Ik lette goed op tijdens het spel

7. Ik kon makkelijk de emoties tonen die van me verwacht werden
8. Ik wil dit spel vaker spelen

![Emojis](attachment://emojis.png)

Helemaal | niet waar | maakt | waar | helemaal | waar!
---|---|---|---|---|---
Niet waar! | | | | | 

9. Ik snapte hoe ik het spel moest spelen

![Emojis](attachment://emojis.png)

Helemaal | niet waar | maakt | waar | helemaal | waar!
---|---|---|---|---|---
Niet waar! | | | | | 

10. Ik vond het een leerzaam spel

![Emojis](attachment://emojis.png)

Helemaal | niet waar | maakt | waar | helemaal | waar!
---|---|---|---|---|---
Niet waar! | | | | | 

11. Ik vond het makkelijk om dit spel te spelen

![Emojis](attachment://emojis.png)

Helemaal | niet waar | maakt | waar | helemaal | waar!
---|---|---|---|---|---
Niet waar! | | | | | 

Wat vond je van het spel?
Game study
Post Questionnaires Game 2

Date: ________  Consent: ___  Participant no: ________

Name: ______________________ Age: ______ Gender: ______

IK VOEL ME OP DIT MOMENT:

VERDRIETIG

VROLIJK

NIET ZO FIJN

FIJN

ONTEVREDEN

TEVREDEN

ONGELUKKIG

GELUKKIG

NIET ZO BLIJ

BLIJ
Nu wat vragen over het tweede spel

Ik vond het leuk om dit spel te spelen

12. Het spel was leuker dan ik dacht

13. Ik vond het spel spannend

14. Het spel was saaier dan ik dacht

(zet een lijn om een rij gezichtjes om te laten zien hoe leuk je het vindt om het spel te spelen)
15. Ik vind het jammer dat het spel klaar is

Helemaal niet waar maakt niets uit waar helemaal waar!

Niet waar!

16. Ik lette goed op tijdens het spel

Helemaal niet waar maakt niets uit waar helemaal waar!

Niet waar!

17. Ik kon makkelijker de emoties tonen die van me verwacht werden dan bij het vorige spel

Helemaal niet waar maakt niets uit waar helemaal waar!

Niet waar!

18. Ik wil dit spel vaker spelen

Helemaal niet waar maakt niets uit waar helemaal waar!

Niet waar!

19. Ik snapte hoe ik het spel moest spelen

Helemaal niet waar maakt niets uit waar helemaal waar!

Niet waar!
20. Ik vond het een leerzaam spel

21. Ik vond het makkelijker om dit spel te spelen dan het vorige

22. Ik vond het leuker om dit spel te spelen dan het vorige

23. Ik snap nu beter dan eerst welke emoties ik wanneer moet tonen

Wat vond je van het spel?
Appendix VI: Mood Cards
Appendix VII: Sketches of Games

Show It!

![Sketch of a character saying "Show It!"
and various actions: Play Game, Options, Color, Inventor rude, Facepalm.]
Well Done!

End of the Game

Your turns! Keep Going.
This is how you win.

Back To Party
Emotion Park
Dear your friend,
you are covered of ghosts and your
friend will
help you not to be scared in the
"house of ghosts".

[Diagram of a house]

[Diagram of stick figures]

[Diagram of a Ferris wheel]

...and bring you to the amusement park.
There is a very long queue.

They are not open for all very, unfortunately.

"Since your friend has really good
you cannot ride the Ferris wheel."

Because you are really bad.
You are "short enough" for that.

[Diagram of a beach umbrella]
Child has a
small balloon
with four of
the balloons.

BALLOON SHOOTER

Child and friend
would like to go
to ride the
eroller coaster.

Your ride speed
is high, but only
the correct friend
is allowed. The ride
is too fast.

If you are bad,
you will go down
and have fun.

Roller Coaster
"Because you are not allowed to eat
the mushroom, your friend doesn't go
in the undermountain as well.
You decide to 'dine and head for another ride'"
'Throw Balls'

'Throw Balls'

Child may throw 3 times and earn.

Both child and virtual friend are happy.

Show your friend how cool you are.
claim grew up
and surprises child
with surprise, which
is all the word.

“ isolated the claim that
your Ouiji board
just as
your usual trend
then the claim
will give you the
present.”

Sorry, what a surprise!
we get a present
from you?
Thank you!
Appendix VIII: XML-Schemes for Show It! Game Modes

Correct mode:

```xml
<?xml version="1.0" encoding="utf-8"?>
<correct-version>
  <assignment name="image1">
    <image-file>images/emotions/spongebob/happy.png</image-file>
    <score>688</score>
  </assignment>
  <assignment name="image2">
    <image-file>images/emotions/spongebob/disgust.png</image-file>
    <score>908</score>
  </assignment>
  <assignment name="image3">
    <image-file>images/emotions/spongebob/angry.png</image-file>
    <score>988</score>
  </assignment>
  <assignment name="image4">
    <image-file>images/emotions/spongebob/sad.png</image-file>
    <score>718</score>
  </assignment>
  <assignment name="image5">
    <image-file>images/emotions/spongebob/surprised.png</image-file>
    <score>748</score>
  </assignment>
  <assignment name="image6">
    <image-file>images/emotions/spongebob/scared.png</image-file>
    <score>958</score>
  </assignment>
  <assignment name="image7">
    <image-file>images/emotions/spongebob/angry.png</image-file>
    <score>698</score>
  </assignment>
  <assignment name="image8">
    <image-file>images/emotions/spongebob/disgust.png</image-file>
    <score>658</score>
  </assignment>
  <assignment name="image9">
    <image-file>images/emotions/spongebob/happy.png</image-file>
    <score>948</score>
  </assignment>
  <assignment name="image10">
    <image-file>images/emotions/spongebob/sad.png</image-file>
    <score>968</score>
  </assignment>
</correct-version>
```
50-50 mode:

```xml
<correct-version>
  <assignment name="image1">
    <image-file>images/emotions/words/happy.png</image-file>
    <score>768</score>
  </assignment>
  <assignment name="image2">
    <image-file>images/emotions/words/disgust.png</image-file>
    <score>228</score>
  </assignment>
  <assignment name="image3">
    <image-file>images/emotions/words/disgust.png</image-file>
    <score>848</score>
  </assignment>
  <assignment name="image4">
    <image-file>images/emotions/words/sad.png</image-file>
    <score>918</score>
  </assignment>
  <assignment name="image5">
    <image-file>images/emotions/words/angry.png</image-file>
    <score>768</score>
  </assignment>
  <assignment name="image6">
    <image-file>images/emotions/words/scared.png</image-file>
    <score>148</score>
  </assignment>
  <assignment name="image7">
    <image-file>images/emotions/words/scared.png</image-file>
    <score>938</score>
  </assignment>
  <assignment name="image8">
    <image-file>images/emotions/words/surprised.png</image-file>
    <score>218</score>
  </assignment>
</correct-version>
```
Goed gedaan! 62 punten!
Appendix IX: possibly usable ideas for games

Tilburg University

Game Descriptions 29-01-2010

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1. **Basic Games:**

The basic games we would like to use for this research will contain the facereader in passive mode, it will only be used to measure emotions.

1.1 **Advanced Games:**

The advanced games we would like to use for this research will be quite advanced. The facereader should be used not only for measuring the emotions, but also to influence the game. For example when a child blinks with his/her left-eye, it’s a left-mouse-click and with his/her right-eye a right-mouse-click would be activated. We should also try to use the Wii in this interactive game.

1.2 **Pros and Cons:**

For each game some pros and cons will be given. The pro ‘Children love playing on a Wii’, is not being mentioned everywhere since this applies to all of the games listed below.

1.3 **Overview of games:**

Basic games:

- Shell game
- Bingo
- Memory
- Higher-Lower including ‘Dus-ka-dum’ bar

Advanced games:

- Candy bag collector
- Show It!
- Treasure Hunt
- Operation
- Hangman
1.4 Basic Game 1: Shell game

Game details
The game is being played with three cups and one small ball on a table. The ball lies under one cup and then the cups are being shuffled. After shuffling, the children have to say under which cup the ball lies. The game is being played for 10 ‘shuffles’ and at each good answer the children earn a candy (or maybe something else). When they give a wrong answer 2 candies are lost. After the 10th shuffle the children can take the earned candies which are left.

Induced emotions
In this game the emotions happiness, sadness and surprised are being induced. Children become happy when they think to know under which cup the ball lies and by earning a candy. They are also happy when the game is over and they may take the earned candies. Children become sad when they give a wrong answer and they lose a candy. When the game is over and there is no candy left, their emotion is probably sadness as well. The emotion surprised is being induced when doing a trick with the ball and put it under another cup even though children are 100% sure the ball lies, for example under the left cup. When then the ball is under the right cup, children will probably show a surprised emotion and ask themselves how it is possible that the ball is not under the cup they have chosen.

Use of face reader
In this game the face reader is in passive mode and collects data about the emotions of the children. Face reader will not influence this game.

Use of Nintendo Wii
This game can be played using a Wii but it can also be played in real life using real cups and a small ball. If the game is being played on a Wii, children have to click on the cup they think the ball contains, using the controller of the Wii.

Pros
- Simple game.
- Easy to understand for the children.
- Easy to conduct.
- Easy to manipulate the game.
- It really has the focus on the three emotions; happiness, sadness and surprised.
- Relatively easy to build this game for the Wii.

Cons
- ?
1.5 Basic Game 2: Bingo

Game details
The game starts with a card with numbers on it. Every few seconds a new number will be drawn by the game host. If you have the number on your card, you should cover that number. If you have all the numbers covered, you win. If someone else beats you to it, you lose.

Induced emotions
In this game the emotions happiness, sadness and surprised are being induced. Children become happy when they are almost winning, and they are sad when they know it takes too long for them to get the numbers they need. They can be very surprised if a joker arrives to the scene and lets them cover a number.

Use of face reader
In this game the face reader is in passive mode and collects data about the emotions of the children. Face reader will not influence this game.

Use of Nintendo Wii
This game can be played using a Wii and the wii controller can be used to cover the numbers on the card. The controller can be used as a mouse pointer.

Pros
- Simple game.
- Easy to understand for the children.
- Easy to conduct.
- Very easy to manipulate the game.
- Relatively easy to build this game for the Wii.

Cons
- This game maybe can take a while but we can solve this by not having to many numbers on each play card.
- It has the main focus on the emotions; happiness and sadness (winning or losing). A bit less on 'surprised'.
1.6 Basic Game 3: Memory

Game details
The game is being played with 12 cards upside down. You have to turn around 2 of them. When they are matching, you can remove them from the game field. The goal is to match all cards as some as possible.

Induced emotions
In this game the emotions happiness, sadness and surprised are being induced. If a child can’t seem to create pairs, the child will become sad, but if it does create pairs, the child will be happy. We are able to surprise the child by putting images on the card that the child does not expect.

Use of face reader
In this game the face reader is in passive mode and collects data about the emotions of the children. Face reader will not influence this game.

Use of Nintendo Wii
This game can be played using a Wii. If the game is being played on a Wii, children have to click on the cards which they think are matching.

Pros
- Simple game.
- Children are familiar with the game.
- Easy to conduct.
- Very easy to manipulate the game.
- Relatively easy to build this game for the Wii.

Cons
- This game could take a while but we can solve this by not having to many cards.
- It has the main focus on the emotions; happiness and sadness (winning or losing). A bit less on ‘surprised’.
1.7 Basic Game 4: Higher – Lower Card game including ‘Dus-ka-dum’ bar

Game details
In this game there are 10 cards shown on the screen but they are flipped over and the children will not see the cards. Only the first card is turned over and the number on the card is visible. The number on the cards are in the range from 1 to 10 and children have to guess if the number on the next card is higher or lower than the previous card. Each time the children click ‘higher’ or ‘lower’ give an answer. There is a bar on the screen which goes up and down like the bar in the ‘Dus-ka-Dum’ game and stops at the right answer; higher or lower. When the answer is correct, the card is being shown and children have to guess the number on the next card. The game is over when children choose the wrong answer or when every card in the game is being turned over.

Induced emotions
In this game especially the emotions happiness and sadness are being induced. Children can win (happiness) or lose (sadness) the game. But also the emotion surprised is being induced. This is being done by the Dus-ka-dum bar on the screen in combination with a number on the card which is very close to the 1 or very close to the 10 and children are almost sure they give the right answer to win the game. The Dus-ka-dum bar will move up and down and tends to point to the most expected answer but finally points to the unexpected answer. We think the face expression of the children will show a surprised expression that the answer is not the answer they expected. This emotion is being strengthened because the Dus-ka-dum bar also tends to point to the answer the children gave.

Use of face reader
In this game the face reader is in passive mode and collects data about the emotions of the children. Face reader will not influence this game.

Use of Nintendo Wii
Children will use the Wii for clicking on ‘higher’ or ‘lower’. The controller of the Wii functions as a mouse pointer.

Pros
- Simple game to play.
- Children are familiar with the game.
- Easy to understand.
- Easy to conduct.
- A very quick game which induces emotions very well.
- Very easy to manipulate the game.
- Relatively easy to build this game for the Wii. (‘Dus-ka-dum’ bar excluded.)
- The ‘Dus-ka-dum’ bar might induce the emotions even stronger.

Cons
- It might be a bit difficult to create the ‘Dus-ka-dum’ bar. We have to find a way to build it.
- Already used for previous research (however, not on a Wii and using a ‘Dus-ka-dum’ bar).
- It has the main focus on the emotions; happiness and sadness (winning or losing). A bit less on ‘surprised’. Children will be surprised when a 10 comes after a 9 but we think this raises more sadness than being surprised.
1.8 Advanced Game 1: Candy bag collector

Game details
This advanced game is a game where children have to collect candy bags which are falling and flying across the screen. There are good candy bags, bad candy bags, a thief and present boxes crossing by. The children have to collect 20 good candy bags to earn a real candy bag which we will give to the children after playing the game. If the children collect a bad candy bag, there are 5 good candy bags lost. If they do not catch the thief, the thief will steal all the candy bags. The children are not being told of the present boxes. The present boxes contain either good candy bags or bad candy bags, the children will not know this. This is a guess for them whether to collect these or not. The games is being played for a particular time which can influenced by us in order to let the children win or lose.

Induced emotions
During this games the emotions happiness, sadness and surprised are being induced. Children become happy when collecting good candy bags and by catching the thief and finally, by earning the real candy bag. They become sad when they collect accidentally a bad candy bag because 5 good candy bags are being lost, when not catching the thief who steals their candy bags and finally when they did not collect enough good candy bags to earn a real candy bag (of course afterwards they do get a candy bag from us). The emotion ‘surprised’ is being induced when a present box appears on the screen. Children will not know what to do with it, “should we collect it or should we not?”.

Use of face reader
In this game the face reader is in passive mode and collects data about the emotions of the children. Face reader can be used in active mode by showing a hand on the screen which can be pointed with the Wii remote. The bags can then be collected by blinking with eyes or look really happy (which makes it harder to play because you must only look happy when you want to grab a bag). A difficulty could be to create a fart sound, which makes the children laugh, which closes the hand.

Use of Nintendo Wii
Children will use the Wii for collecting the candy bags, the present boxes and for catching the thief. The controller of the Wii functions like a mouse pointer. Collecting and grabbing (read: clicking) will be done by emotions and the active face reader.
Pros
- Children are familiar with this type of game.
- Easy to understand how the game should be played.
- Easy to conduct.
- It really has the focus on the three emotions; happiness, sadness and surprised.
- We think children love playing a game by using their emotions.
- Children can earn real candy by collecting the candy in the game.

Cons
- Might be difficult to create such a game for the Wii.
- Difficult to manipulate the game during the play.
- Game is a bit more difficult to play for the children, while they have to use their emotions for it in combination with the Wii controller.
- Testing this game with children in advance is necessary.
1.9 Advanced Game 2: Show it! (Based on Bop It)

**Game details**
In this game the children will hear a little music with crazy sounds. During the game a few commands are being given by the game and the children have to react on them. For example if they hear the command smile (they have to smile), sad (they have to look sad), surprised (they have to look surprised), wink (they have to wink) etc. The game speed will increase during the game so it will be harder for the children to show the right emotion at the right time.

**Induced emotions**
In this game we can induce many emotions but we would focus on inducing the emotions happiness, sadness and surprised by giving these commands during the game.

**Use of face reader**
In this game the face reader is in passive mode and collects data about the emotions of the children. The face reader is also in active mode and the children have to play the game by showing their emotions at the right time.

**Use of Nintendo Wii**
Children will use the Wii to start the game.

**Example of the game:**
[http://www.youtube.com/watch?v=sDPwQnmaPqA](http://www.youtube.com/watch?v=sDPwQnmaPqA)

**Pros**
- Easy to understand how the game should be played.
- Easy to conduct.
- It really has the focus on the three emotions; happiness, sadness and surprised.
- Easy to manipulate the game to induce a particular emotion by adding for example more ‘smile’ commands or ‘sadness’ commands.
- We think children love playing a game by using their emotions.
- Children HAVE to use their emotions, otherwise the game is over.
- A very funny game

**Cons**
- Might be difficult to create such a game for the Wii.
1.10 Advanced Game 3: Treasure Hunt

**Game details**
In this game you start with a map which has a cross defining the treasure. At some places you have to chose between going left and right. To find the treasure, children need to maybe scare away a pirate. When they get to the treasure they win the game.

**Induced emotions**
In this game especially the emotions happiness, sadness and surprise are being induced. Children can find the treasure (happiness) or die trying (sadness). By letting a pirate jump in to the screen, the children will be surprised, and they will be even more when they hear that they can scare the pirate away by looking really angry.

**Use of Face reader**
In this game the face reader is in passive mode to collect data about the emotions of the children. The face reader is also used in active mode by checking if the child looks angry enough to scare away the pirates.

**Use of Nintendo Wii**
Children will use the Nintendo Wii controller as a mouse pointer to decide where to go next.

**Pros**
- Easy to understand how the game should be played.
- Easy to conduct.
- We think children love playing a game by using their emotions. Especially to scare away ‘the bad guys’ (the pirates).
- Children HAVE to use their emotions, to be able to pass by the pirates.
- A very funny game.
- A good theme for children.
- A nice combination of using the Wii and playing the game using your emotions.

**Cons**
- Might be difficult to create such a game for the Wii.
- A bit difficult to manipulate the game during play. Depends on how the game is built.
- It has the main focus on the emotions; happiness and sadness (winning or losing). A bit less on ‘surprised’. Also the emotion anger is being induces strongly. (scare away the pirates).
1.11 Advanced Game 4: Operation

Game details
In this game you see someone (SpongeBob?) lying on an operation table and the idea is that you have to put in organs and bones at the right place to keep him alive. The trick is not to touch the sides of the holes (where the pieces should go into). When this happens you lose a point. When you insert the last piece, the heart, you should reanimate him so he can come back to life. This is done by making a smile at the same time as you hear a heartbeat on the screen. If you do this well, you can see a heartbeat meter going up and finally you see SpongeBob back alive and kicking. If you look angry, SpongeBob won’t make it, and a point goes lost at which the child has to try again. The children have 10 points and each time something goes wrong, they lose 1 point.

Induced emotions
In this game the emotions happiness, sadness and surprise are being induced. Children can insert pieces of SpongeBob’s body, each time they succeed in this they will be happy. Each time they lose a point, they will be sad. At the end they will be surprised because their smile will get SpongeBob back to life, if they smile at the same time as the beep coming from the screen.

Use of Face reader
In this game the face reader is in passive mode to collect data about the emotions of the children. The face reader is also used in active mode by letting the child smile to save SpongeBob.

Use of Nintendo Wii
Children will use the Nintendo Wii controller as a mouse pointer to insert the pieces of the body. If possible, it would be nice to ‘shake’ the wii-controller when inserting a body piece.

Pros
- Easy to understand how the game should be played.
- Easy to conduct.
- Children might be familiar with the game (it is based on ‘Dr. Bibber/Operation’).
- Children love SpongeBob.
- We think children love playing a game by using their emotions. Especially if a hero (SpongeBob) can be saved.
- Children HAVE to use their emotions, otherwise SpongeBob will die.
- A very funny game.
- A good theme for children.
- A nice combination of using the Wii and playing the game using your emotions.

Cons
- Might be difficult to create such a game for the Wii.
- A bit difficult to manipulate the game during play. Depends on how the game is built.
- It has the main focus on the emotions; happiness and sadness (saving SpongeBob or not). A bit less on ‘surprised’.
1.12 Advanced Game 5: Hangman

Game details
In this game you see someone standing on a piece of wood. You also see the alphabet and a question with space for the answer. Each letter in the answer is replaced with a dot. The child has to pick a letter from the alphabet, of which the child thinks it will be in the answer. If the letter is in the answer, all the dots which stand for that letter will be replaced by that letter. If the letter is not in the answer, you will see part of a robe going to the person standing. If you have 5 letters wrong before getting to the answer, the wood will crack, and the person will fall through. All you see is a tight rope and an Angel flying up from the hole the person fell in. If you have the answer correct, the person survives and he thanks you.

Induced emotions
In this game the emotions happiness, sadness and surprise are being induced. If the child guesses a letter correct, the child will be happy. If the child guesses a letter wrong the child will be sad. The child can be surprised by what the person does when he dies/survives.

Use of Face reader
In this game the face reader is used in passive mode to collect data about the emotions of the children. The face reader is used in active mode to ask the children if they want to use a letter. If the child smiles and nods, the child agrees to play that letter. If the child shakes his head and looks a bit angry, the child does not want to play the letter.

Use of Nintendo Wii
Children will use the Nintendo Wii controller as a mouse pointer to start the game. For the rest of the game the controller will be used to select a letter (after which the child has to smile if he is certain about the letter).

Pros
- Easy to understand how the game should be played.
- Easy to conduct.
- Easy to create this game on the Wii.
- Children are familiar with the game. (Hangman/Galgje)
- We think children love playing a game by using their emotions.
- Children HAVE to use their emotions, otherwise the letter is not given.
- A nice combination of using the Wii and playing the game using your emotions.

Cons
- It has the main focus on the emotions; happiness and sadness. A bit less on ‘surprised’.
- Maybe children find guessing letters not very interesting and maybe therefore the induced emotions are not very expressive.
Appendix X: Detailed description of the final games

Game Descriptions 09-02-2010

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1. **General description:**

There will be 2 games in this study. One basic game and one advanced game. There will be three versions of each game, one which gives the children the idea they have done very bad, one for very good, and one using the face reader. The first two versions will be created using a ‘set’ game, which always returns feedback that the child has acted incorrect or correct. The children should receive points, so not just correct or incorrect but maybe a percentage of 70% correct and 30% incorrect or marks from 1-10.

The age of the participants has been set at 8 years.

For the games it is very important there is a natural mapping of emotions.

1.1 **Basic Game:**

The basic game we would like to use for this research will be Show it. It will only use the face reader in both active and passive mode. This game is used to induce emotions.

1.2 **Advanced Game:**

The advanced game we would like to use for this research will be a storyline game. The child follows a story and has to show all six emotions to end the game successfully. The face reader will be used in both active and passive mode. The difference with the basic game is that besides emotion inducing also emotion regulation is wanted. This can be done by a friends that comes to help, and you should smile to welcome him. If he does something wrong it is not very nice to be angry at him, you should rather react mild.
1.3 Basic Game: Show it! (Based on Bop It)

Game play
There will be 18 assignments (each emotion 3 times). The child has to show the emotion that is asked and the child will receive immediate feedback after each assignment. At the end of the game the child will get an overall grade.

This game can have a lot of variations, for example how the assignments will look like and how the feedback will look like. Below are for each point some possibilities given, our preferences are crossed.

Assignment possibilities

- Emotion comes up as text.
- Emotion comes up as a ‘real-life’ face.
- Emotion comes up as an animated face.
- Emotion comes up as a full bodied ‘real-life’ person showing the emotion.
- Emotion comes up as a full bodied animated person showing the emotion (SpongeBob?).
- Emotion comes up as a sound.
- Emotion comes up as something the child has to link with (weather: sunny, rainy, storm, etc.).
- Emotion comes up as combinations of above.

Feedback possibilities

- True/false.
- 1-100% scale (given in a bar).
- Mark between 1-10.
- Face showing degree of happiness.
- Person or group of persons showing degree of happiness (Spongebob and friends cheering or being disappointed). (Our preference for the overall grading).
- Dus-ka-dum bar showing 1-100% scale. (Our preference for the immediate feedback).
1.4  Advanced Game 1: Treasure Hunt

Game play
In this game you start with a map which has a cross defining the treasure. When you reach the treasure they win the game.

- A prince arises and wants to help you on your quest (emotion: happy).
- The prince turns around and turns out to be a dragon (emotion: surprised).
- A dragon says he is going to kidnap you (emotion: scared).
- The dragon points out the treasure map is a trick to kidnap children and he ate the real princess (emotion: sad).
- You have to scare the dragon away by looking angry (emotion: angry).
- The dragon becomes really sick suddenly and he throws up (emotion: disgust).
- It turns out he puked out the princess and she is saved (emotion happy).
- Together you do find a treasure and the game ends.

Remarks
Emotion regulation should be implemented in the game, maybe by letting setting up a last assignment which the princess does and the child has to react to this.
1.5 Advanced Game 2: The life of Zoe, the little dog.

Game play
In this game you have to raise a puppy, until it becomes older and gets children itself.

- You are a little child and your mother comes home with a puppy and she asks what you think of it (emotion: happy).
- The puppy is still young and so it poops on the couch, and it is your puppy so you have to clean it up (emotion: disgust).
- Then when you go walking with your dog, he sees a rabbit and runs away following it, onto the speedway (emotion: scared).
- A friend of you comes at your house to play, and Zoe bites your friend in his middle (emotion: anger).
- Then Zoe gets sick and he has to go to the doctor (emotion: sad).
- The doctor says the dog is not going to die but Zoe is getting a baby (emotion: surprised).
- The end.

Remarks
There is no emotion regulation-part in this storyline, maybe this should be implemented in some way.
1.6 Advanced Game 3: Bob the Builder

Game play

In this game the child plays Bob the Builder and you have to help your friend with refurbishing her house. The child has to help painting the house and to refurbish the attic.

Painting tasks:

- Your friend wants to have a orange house and you have to go and buy orange paint.
- Once bought the orange paint, you return home and find out the can of paint is yellow. (emotion: surprised).
- You go back to the store to get the orange paint.
- The orange color is sold out. (emotion: sad).
- Then the person in the store tells you that you can create the orange color by mixing red and yellow. (emotion: happy) (child also learns something here: which colors to mix to get the orange color).
- You also buy the red paint and return home to mix the color in order to get the orange color. This works! (emotion: happy).

Refurbishing the attic:

- After the painting is done, your friend asks you to refurbish the attic.
- At the attic there is a ghost.
- To scare the ghost away you first pretend you are scared of the ghost by looking very scared (emotion: scared).
- Then the ghost comes closer because you look scared and then you look very angry to scare the ghost away. (emotion: angry)
- Now the ghost is gone and you can finish refurbishing the attic.
- After you are finished you are very hungry.

Dinner:

- You have worked very hard helping your friend refurbishing her house. She is very happy and made you a meal. She made you sprouts.
- You really don’t like sprouts.
- Show your friend that you don’t like sprouts so she will bake for you delicious French fries. (disgusted).

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Remarks

- There is no emotion regulation-part in this storyline, maybe this should be implemented in some way.
## Appendix XI: Experimental requirements

### SHOW IT! Experimental design

<table>
<thead>
<tr>
<th>condition</th>
<th>Words</th>
<th>SpongeBob</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Always win</td>
<td>10 kids</td>
<td>10 kids</td>
<td>20 kids</td>
</tr>
<tr>
<td>50%-50%</td>
<td>10 kids</td>
<td>10 kids</td>
<td>20 kids</td>
</tr>
<tr>
<td>FaceReader</td>
<td>10 kids</td>
<td>10 kids</td>
<td>20 kids</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30 kids</strong></td>
<td><strong>30 kids</strong></td>
<td><strong>60 kids</strong></td>
</tr>
</tbody>
</table>

- Every kid will play Show It! in a certain condition.
- For Show It! The kid will get either words or SpongeBob.
- Each kid will be in only one condition.
- Each combination of condition and words/SpongeBob will be played by 10 kids, this adds up to 60 kids.
SHOW IT! Always win condition

- Each kid plays 12 rounds and gets OR just words OR SpongeBob faces.
- Each emotion will be shown two times.
- After every word or SpongeBob face there will be positive feedback to the kid. So this will be between 50 and 100%.
- The feedback scores are set up front.
- The order in which the emotions are shown is set up front.
- The systems never shows the same emotion twice after each other.

Scheme

- Happy1 – 58%
- Disgust1 – 83%
- Angry1 – 98%
- Sad1 – 63%
- Surprised1 – 71%
- Scared1 – 55%
- Angry2 – 69%
- Disgust2 – 88%
- Happy2 – 94%
- Sad2 – 85%
- Scared2 – 73%
- Surprised2 – 56%
SHOW IT! 50-50 condition

- Each kid plays 18 rounds and gets OR just words OR SpongeBob faces.
- Each emotion will be shown three times; two times positive and one time negative.
- After every word or SpongeBob face there will be feedback to the kid. This will be between 0 and 100%.
- The feedback scores are set up front.
- The order in which the emotions are shown is set up front.
- If the system returns a positive feedback score for an emotion, the next emotion will always be a different emotion.
- If the system returns a negative feedback score for an emotion, the next emotion will always be the same emotion with a positive feedback score. This induces hyper articulation.

Scheme

- Happy1 – 67%
- Disgust1 – 32%
- Disgust2 – 73%
- Sad1 – 85%
- Angry1 – 58%
- Scared1 – 36%
- Scared2 – 78%
- Surprised1 – 29%
- Surprised2 – 65%
- Disgust3 – 58%
- Happy2 – 42%
- Happy3 – 75%
- Scared3 – 88%
- Sad2 – 31%
- Sad3 – 92%
- Suprised3 – 62%
- Angry2 – 47%
- Angry3 – 83%
SHOW IT! FaceReader condition

- Each kid plays 12 rounds and gets OR just words OR SpongeBob faces.
- Each emotion will be shown two times.
- After every word or SpongeBob face there will be real-time measured feedback to the kid. So this will be between 0 and 100%.
- The feedback scores are measured real-time.
- The order in which the emotions are shown is set up front.
- The systems never shows the same emotion twice after each other.
- A kid can never be incorrect four times in a row. After three times the system will always return a positive feedback score.

Scheme

- Happy1
- Disgust1
- Angry1
- Sad1
- Surprised1
- Scared1
- Angry2
- Disgust2
- Happy2
- Sad2
- Scared2
- Surprised2
Emotion Park

- Each kid plays Emotion Park after they have played Show It!
- The kid has to read a storyline first.
- The kid has to show each emotion once.
- In every ride in Emotion Park, except for the bonus ride ‘balloon shooter’, the kid has to show the right emotion.
- If an emotion is shown by the kid, there will be either a positive or a negative feedback.
- If the kid doesn’t succeed showing the right emotion according to FaceReader, he or she can try again.
- The feedback scores are measured real-time.
- A kid can never be incorrect four times in a row. After three times the system will always return a positive feedback score.
- At the end of the game, another storyline comes up which finishes the story.
- The kids will get the present they earned in the game from the researchers when the games ends.
Appendix XII: Six basic emotions by Ekman

<table>
<thead>
<tr>
<th>Appearance of the Face for Six Emotions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surprise</strong></td>
</tr>
<tr>
<td>Brow-Forehead</td>
</tr>
<tr>
<td>Raised curved eyebrows; long horizontal forehead wrinkles</td>
</tr>
<tr>
<td><strong>Eyes-Lids</strong></td>
</tr>
<tr>
<td>Wide opened eyes with Schlera showing above and often below the iris; signs of skin stretched above the eyelids and to a lesser extent below</td>
</tr>
<tr>
<td><strong>Lower Face</strong></td>
</tr>
<tr>
<td>Dropped-open mouth; no stretch or tension in the corners of the lips, but lips parted; opening of the mouth may vary</td>
</tr>
</tbody>
</table>

| **Fear**                                |
| Raised and drawn together brow; flattened raised appearance rather than curved; short horizontal and/or short vertical forehead wrinkles |
| **Eyes**                                |
| Eyes opened, tension apparent in lower lids, which are raised more than in surprise; Schlera may show above but not below iris; hard stare quality |
| **Mouth**                               |
| Mouth corners drawn back, but not up or down; lips stretched; mouth may or may not be open |

| **Anger**                               |
| Brow pulled down and inward, appear to thrust forward; strong vertical, sometimes curved forehead wrinkles centered above the eyes |
| **No Schlera shows in eyes; upper lids appear lowered, tense and squared; lower lids also tensed and raised, may produce an arched appearance under eye; lid tightening may be sufficient to appear squinting** |
| **Either the lips tightly pressed together or an open, squared mouth with lips raised and/or forward; teeth may or may not show** |

| **Disgust**                             |
| Brow drawn down but not together; short vertical creases may be shown in forehead and nose; horizontal and/or vertical wrinkles on bridge of nose and sides of upper nose |
| **Lower eyelids pushed up and raised, but not tensed** |
| **Deep nasolabial fold and raising of cheeks; mouth either open with upper lip raised and lower lip forward and/or out, or closed with upper lip pushed up by raised lower lip; tongue may be visible forward in mouth near the lips, or closed with outer corners pulled slightly down** |

| **Sadness**                             |
| Brow drawn together with inner corners raised and outer corners lowered or level, or brow drawn down in the middle and slightly raised at inner corners; forehead shows small horizontal or lateral curved and short vertical wrinkles in center area, or show bulges of muscular contraction above center of brow area |
| **Eyes**                                |
| Eyes either glazed, with dropping upper lids and lax lower lids, or upper lids are tense and pulled up at inner corner, down at outer corner with or without lower lids tensed; eyes may be looking downward or eyes may show tears |
| **Mouth**                               |
| Mouth either open with partially stretched, trembling lips, or closed with outer corners pulled slightly down |

| **Happiness**                           |
| No distinctive brow-forehead appearance |
| **Eyes**                                |
| Eyes may be relaxed or neutral in appearance, or lower lids may be pushed up by lower face action, bagging the lower lids and causing eyes to be narrowed; with the latter, crow feet apparent, reaching from outer corner of eyes toward the hairline |
| **Outer corners of lips raised, usually also drawn back; may or may not have pronounced nasolabial fold; may or may not have opening of lips and appearance of teeth** |