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Hospital Hero **A Game for Reducing Stress and Anxiety** **of Children While Waiting in Emergency Room**

MASTER DISSERTATION

Sara Patrícia Fernandes Tranquada
MASTER IN INFORMATICS ENGINEERING



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Resumo

Este relatório conta uma história que teve o seu início numa ideia que nos ocorreu numa tentativa de combater este sentimento conhecido por todos como stress e ansiedade. Mas antes de criarmos a solução para este problema, temos de primeiro apreender os sentimentos subjacentes e os seus efeitos no nosso bem-estar.

Ao longo das nossas vidas, experimentamos momentos de fraqueza e medo. Estes sentimentos podem surgir, por exemplo, enquanto estamos no serviço de urgência de um hospital. Claro que os efeitos em crianças, completamente alheias a este ambiente, serão inimagináveis. Nós analisamos uma serie de cenários para encontrarmos a solução mais adequada, entre as quais o estudo do Dr Baldwin sobre interacção com expressões positivas, que provou ser um valioso aliado. Naturalmente, teve que ser reajustado para o propósito e o público em mente.

O jogo foi então criado tendo como objectivo reduzir e até mesmo eliminar os níveis de stress e ansiedade em crianças. Ao longo do projecto, o jogo sofreu varias alterações, mas a ideia inicial – interacção com expressões positivas – manteve-se.

Quando chegou a altura própria, pedimos às crianças que jogassem uma das duas versões do jogo enquanto aguardavam no serviço de urgências. Isto não só provou ser uma distracção para elas, mas também uma experiencia educativa uma vez que baseia-se integralmente em equipamento hospitalar. Uma das versões do jogo tem expressões e a outra não, sendo isto o que as diferencia.

Depois de todo o nosso trabalho e esforço, sentimo-nos recompensados porque o nosso projecto era válido e pelas expressões nos rostos das crianças enquanto jogavam. Mas mais importantes ainda, os seus níveis de ansiedade reduziram significativamente durante esse curto espaço de tempo.

Palavras-Chave

Jogos Sérios, Serviço de Urgência Infantil, Stress e Ansiedade

Abstract

This report tells a story which started as an idea that came to us to fight the battle-cry feeling commonly known as stress and anxiety. Before creating the solution of the idea, we first need to understand the feelings underneath and its effects on our well-being.

Throughout the course of our lives, we experience states of weakness and fear. These feelings can arise, for instance, while we are in an emergency room. Needless to say, how much it would have imaginable effects on children, who are unfamiliar to such environments. We ran through a series of scenarios to find the most suitable solution, among them the study of interaction with positive expressions by Dr. Baldwin, proved to be a valued resource. It was reduced due to its length and to be suitable to our public audience.

The game was then created in order to reduce or even eliminate the stress and anxiety of children. Since the game was initially released, some modifications had been made but the original idea - interaction with positive expressions – remained.

When the time came, we asked children to play one of the two versions of the game while waiting in the emergency room. This not only created a diversion for them but also a learning experience as it displayed some hospital equipment. The difference between the two versions is that one provides expressions, while the other does not.

After all our hard work, we felt rewarded because the project proved its worth and we would see that in the expressions on children's faces while they played. Most importantly, their anxiety level numbers were significantly reduced during that short period of time.

Keywords

Serious Game, children Emergency Room, Stress and Anxiety

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List of Acronimus

A-State - State Anxiety

A-Trait - Trait Anxiety

E.R. - Emergency Room

ED - Emergency Department

EMSA - European Medical Students' Association

GAD - Generalized Anxiety Disorder

M-ITI - Madeira Interactive Technologies Institute

mSTAI-TM - The Modified State-Trait Anxiety Inventory using a Modified Talking Mats Method

m-YPAS - Modified Yale Preoperative Anxiety Scale

OCD - Obsessive-Compulsive Disorder

PTSD - Post-Traumatic Stress Disorder

STAI - State-Trait Anxiety Inventory

STAI-6 - modified short-form STAI

STAIC - State-Trait Anxiety Inventory for Children

VPT - Visual Probe Task Demonstration

YPAS -Yale Preoperative Anxiety Scale

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1. Introduction

Behind our project, there was a thought (see Figure 1) that in time lead to an idea, an attempt to answer the problem at hand. Children' stress and anxiety was that problem, children' Emergency Room (E.R.) was the source place that originated the problem and Hospital Hero was the proposed solution, a game which had as main goal the interaction with positive characters.

All of the processes were connected with each other, starting with the brief analysis of the future, continuing to the most important subject by finding its weaknesses, exploring them, pointing them out as a problem and finding a mean to transmit the solution. When we knew every little detail of the problem, the ideas came flying in, but ultimately we needed to choose and develop one of them that reduced or even eliminated the problem at hand.



Figure 1 – The Five Ws and the one H represent the questions. The answers help us create a story. [1,2,3,4,5,6]

1.1. Analyzing the Situation

We climb mountains not only for a sense of perseverance or challenge that it provides us, but rather for an objective: it could be as simple as experiencing that breathtaking view at the end of the climb or leave your mark by writing your initials on a rock. This feeling of accomplishment is not only applicable to climbing mountains but to every challenge we come across in our lives. In order for us to achieve success in anything, we needed to “climb” but bearing in mind that what we climb is not as important as the climbing itself [7] (see Figure 2).

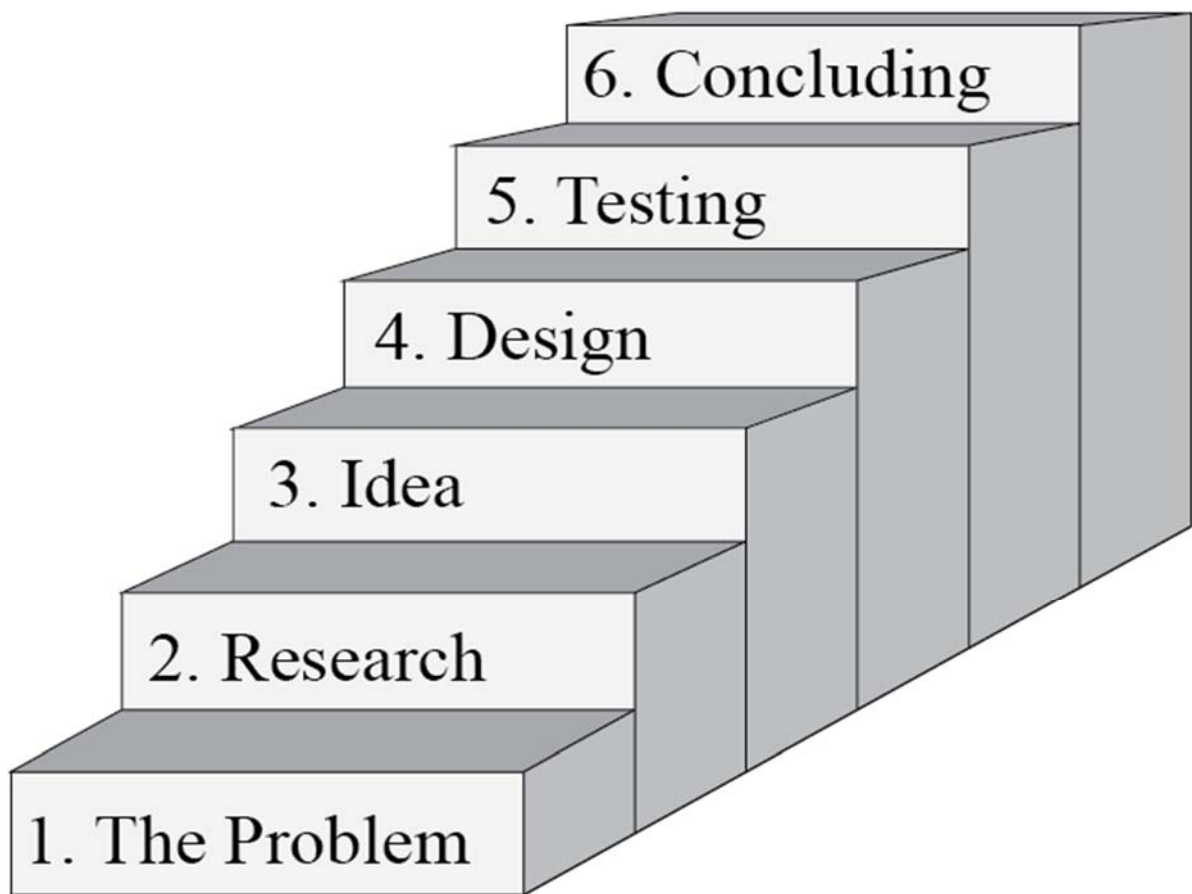


Figure 2 – A Schematic of a staircase, making each step stand as an achievement, a chapter in our life’s journey.

Before taking the first steps we needed to know exactly what the problem was and what we aimed to do.

1.1.1. Our Jeopardized Future

The future depend on what we do in the present and that future belongs to the children. So as they grow, every moment they experience affects their relationship with their surroundings ultimately changing the world. [8]

Children learn by three main ways:

- By association of a stimulus to a response. An experiment of the Russian physiologist Ivan Pavlov, proved that associating the ringing of a bell to the moment when he feed the dog for instance, caused the dog to associate the sound to the food. After the association was made, the very sound of the bell would mean for the dog the anticipation of a meal. The same happens to children, when the sight of a baby's bottle is associate with being fed, developing the children' association between objects in their own environment.[9]
- By rewarding a behavior: if children were rewarded when cleaning the room, probably their behavior will be repeated again in the future. The opposite occurs when they were not so well behaved: punishing them would prevent this action from happening again.[9]
- By observing: their brains are like a blank piece of paper, so everything they watch is imprinted on their minds. [9]

This last one – observation - is how a child's learns the most, affecting their behavior as they are very sensitive, and everything they see, smell and fell is a factor to their future. Hence a new place, an unfamiliar place, like the E.R. could be literally a hell for them.

1.1.2. The Full Image of the Emergency Room

“What happens in Vegas, stays in Vegas”, a famous slogan used since 2005 that has been the origin point of new slogans like “what happens on the road, stays on the road”, “what happens in here, stays in here”, we found it adequate to describe the situation but with the following variation: WHAT HAPPENS IN THE E.R., DOES NOT STAY IN THE E.R.. [10]

The child's first visit to the E.R. could be a dramatic event if she/he is not prepared. [11] The E.R., for some is an unknown word and since we are in a technologic world, the first thing people do when they do not know the meaning of the word, is to google it. [12] In this case the first thing they would see is a reference to a Television (TV) show, the E.R. (TV Series 1994-2009). This would fill the blacks to some questions raised and would provide some entertainment, but life is not a TV show as we all know.

The first time you see any TV shows about an Emergency Room, the main thing you notice are the characters and their relationships with each other. [13] When you enter a real Emergency Room, you notice not the people there, but rather the smells, the sounds, the ambience, the space, etc. [11] For children it represents a new world, far away from his/her comfortable place called HOME. In this new world their feelings only are showed through expressions, not words.

1.1.3. Child's Real Feelings

Our faces are a mirror of our emotions: we have 43 face muscles that when combined can produce up to 10,000 expressions. Even if we tried to hide our feelings, we could not get away with it (see Figure 3). [14]

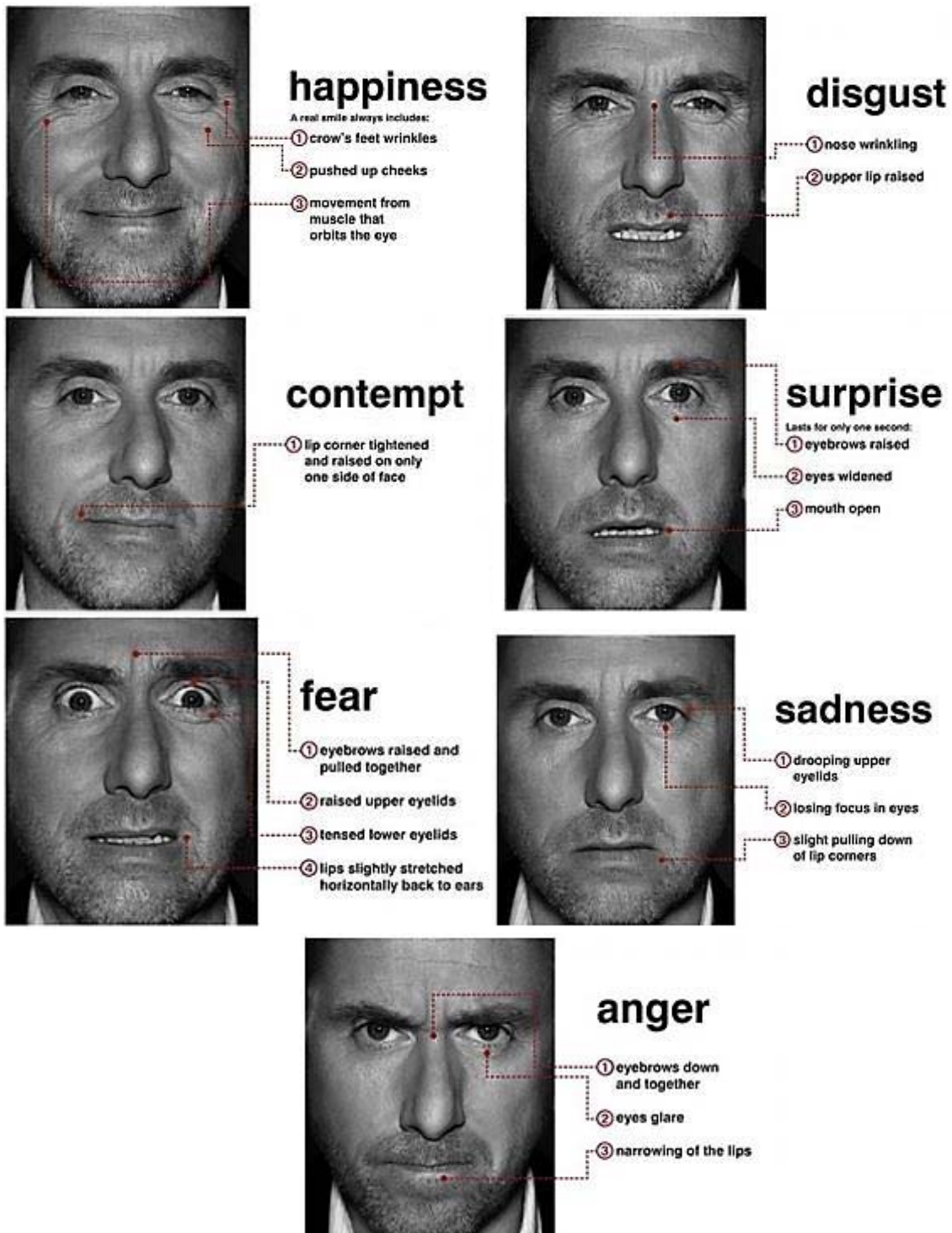


Figure 3 - All of these expressions are universal. Children and adults have similar emotions. [14]

The way a child feels is not always perceptible: “How are you?” is a simple question but sometimes the child does not answer you back and expressions alone are not enough to have the correct feedback. We then have to decipher the child’s body language: is he/she having stomachaches or headaches? Behavioral changes such as moodiness, short temper, development of a nervous habit, such as nail biting, tone of voice, gestures and facial expressions, can indicate an altered meaning all together: “I am scared!”, “I want to go home!”, “I do not want to see the strange man”. [15] This behavior is normal, because children have little information of what an E.R. really is or how they operate. This gives us our problem.

1.1.4. The Problem at Hand: Stress and Anxiety

If you have ever been stuck in traffic, struggled with keeping a deadline or had to face speaking in public, then you have experienced some degree of stress in your life. Usually the stress is a temporary sensation and it ends once the situation you have faced is resolved. If the feeling does not pass, but rather becomes constant and worrying (caused by financial problems for instance), then we are talking about anxiety. [22]

Anxiety is an overwhelming feeling best described by trying to save someone from drowning and having that person instead attempting to “strangle” us with his/her panic. [23]

Knowing the problem a mean to transmit the solution was though up.

1.1.5. Game: Possible solution?

Life is like a game board, filled with pieces, being one of them, us and the rest, obstacles. To achieve victory we need to make a move. [18] Making a move means making a choice and those choices are what defines our personality. We consider a game to be like an oyster, when we open it we receive a pearl, games are like that, when we finish the game we receive the experience that the game provided us and most important, the feeling of success, of finishing something that we started. An example is an image puzzle; why do we do puzzles? We already know the image it will give us. We first start with the corner pieces of the puzzle and work our way through it as our aim in the end, is that feeling of success or rush. [17]

Anything can be transformed into a game, even if we don’t see it at first: even doing simple chores such as, separating the garbage into, metal, plastic and paper containers and turning it into a throwing game. [19] The oldest game in existence is called mancala (see Figure 4), and it can be played with just holes and stones. [20]



Figure 4 - A game where the goal is to get more gems than the other player on the bottom row. [20]

Evolution is a gradual process in which something changes into a different and more complex or better form. That is the process of life. Everyday new things and equipment are being invented: a 3d printer, can do amazing things these days like printing tiny strips of organ tissue and maybe one day we be able to print human organs. [21]

Achievements such as these give us hope that anything is possible even creating a game for children that does not only provide fun but allows them to reduce their anxiety and stress.

1.2. What holds ahead

The name of the chapter alone is not enough. This section is very important to clarify or even awaken curiosity and interest about the events that follow. This project is divided into 6 sections:

Chapter 1 is the analysis for the theme of this project, starting with the choosing of the subject, the problem at hand and a way to transmit the solution.

Chapter 2 is about what was learned, starting with the meaning of stress and anxiety until different aspects that were discovered as means of detecting, examining resources already tested and learning game design principles.

Chapter 3 is the start of the project, where the game is thought up in a visual way, beginning with several ideas originated through requirements and resources. A later elimination process occurred and only one remained.

Chapter 4 is where the idea transforms into a project, starting with the sequence of events that will be unfold and the necessary components (drawing, programming, sound) to fulfill the project.

Chapter 5 is where the project is tested in three groups: university students plus two children that volunteered then children in a comfortable place for usability purpose and children in the children E.R. for validation of the project.

Chapter 6 is the end of this journey where an overall observation of what the problem was, what we did, what we gained from it and our views of what the future holds

2. Literature review

The first step had been made and one by one, the project starts to unfold and reveal its real appearance, accomplishing each challenge with patience and time. We then continued by researching the problem at hand: Stress and Anxiety and finding guidance to designing games.

2.1. Stress and Anxiety

To solve a mystery we first need to check its background. The same applies Stress and Anxiety, to understand it we first need to know its strengths and weaknesses, its sources and ways to detect any existing way to reduce or even eliminate Stress and Anxiety.

2.1.1. In more Detail

We experience life through our five senses: sight, hearing, taste, smell and touch. All of them are used together or individually to identify objects in our life: an apple for instance, is simply an apple because we can see it, touch it and taste it, but does the same apply to stress and anxiety? [24] Can we see, hear, taste, smell or even touch it? Recognizing stress and anxiety is much like a blind person seeing for the first time: can he/she identify an apple or a representation of an apple through the sense of sight alone? He/she will have to learn to develop this sense in combination with the other senses – touch, taste, smell and hearing. [25] We all need to learn how to use our senses but for us to see it we first need to understand it.

- **Seeing the Signs**

Stress and anxiety are like an invisible cape, you cannot sense it until you see some sort of distortion that enables you to behold it. [27] The signs guide our way and we need to look carefully for them as they can literally be anything.

Signs are at the center of stress and anxiety because they provide us the answer to the question “is the child suffering from stress and anxiety”? Hitting, kicking, insomnia, stuttering, indigestion, thumb sucking, pounding heart, grinding teeth, fingernail biting, respiratory tract illness, tattling; are amongst the most common signs that indicates that the child suffers from stress and anxiety but every day we discover new ones. [28]

Even if you can see the signs and understand that the child is suffering from stress and anxiety, it does not tell us what caused it.

- **The Source**

Stress and anxiety are a response of the body to a given situation. That situation is what we need to know in order to reduce or even eliminate the stress and anxiety. Our body has two body sections: the internal - brain, bone, heart, etc. - and the external - hands, eyes, head, etc.- so it is logical to assume that we can be affected by stress and anxiety in an internal and external way.[29]

External sensations are often inflicted by other people: conflicts with family and friends, changes in one's family; or events: being attacked by an animal can bring about a considerable amount of stress and anxiety. Internal sensations, on the other hand, are the result of our own inflictions and struggles: doing well in school, being popular or juggling a heavy schedule like running from one activity to another. [29]

Each one of these can have a huge impact in one's life, especially a child's, causing a type of anxiety.

- **Types of Anxiety**

Growing up, a child faces many fears, especially fear of the unknown. In time these feelings tend to go away but when it does not, then you have a problem. [22]

For every association there is a type: type of apple, type of computer, etc. It is not that different with anxiety as there are eight distant kinds of anxiety: Generalized Anxiety Disorder (GAD), Obsessive-Compulsive Disorder (OCD), Panic Disorder, Post-Traumatic Stress Disorder (PTSD), Separation Anxiety Disorder, Social Anxiety Disorder, Selective Mutism and Specific Phobias. [30]

Generalized Anxiety Disorder (GAD)

Perfection is something that we always want but cannot have. What separates the children with the generalized anxiety disorder from the other is the fact that they do not know that perfection cannot be achieved, despite working the extra mile for grades, having a good performance in sports, receiving the approval or reassurance of others, etc.[30]

Obsessive-Compulsive Disorder (OCD)

We wake up, eat breakfast, brush our teeth, etc. that is, doing our normal morning activities. For a child that suffers from OCD, the morning routine is completely different as they experience unwanted and intrusive thoughts, leading to obsessions, the need to repeat rituals or routines, later becoming compulsions which are all necessary for the child to feel calm. [30]

Panic Disorder

Before an accident happens there is a reaction time where the driver has to make his/her mind to avoid the accident. [31] If we suffer from this type of disorder, we don't have that reaction time as we get into a panic state and are afraid the event may happen again. [30]

Post-traumatic Stress Disorder (PTSD)

Events are what define us and so is the way we face them or are prepared for them. Sometimes the event is so traumatic that it breaks us psychologically in such a way that a person that suffers from this disorder becomes irritable, emotionally numb, unsociable, avoiding activities, people or places. [30]

Separation Anxiety Disorder

As we are born, we create a special bond with our parents, especially with our mother who gave birth to us. As we grow older, we get used to having them around, but there comes a time when the child needs to attend a pre-school. Being the first time they have been separated more than a few hours from the parents, the child may think that he/she is being abandoned. That moment is critical and if not handled properly it could create Separation Anxiety Disorder which includes crying, clinging and calling out the parents many times, refusing to go to school, to bed or to playdates. [30]

Social Anxiety Disorder

Have you ever felt that you were the center of attention or thought you were and did not like it, afraid of saying or wearing the wrong thing, not embracing one's self? Social Anxiety Disorder can make a child avoid human contact in any situation like presentations, using phone, eating out, birthday parties, etc. [30]

Selective Mutism

Comfort is the key word here. If a child suffers from this disorder he/she feels is not in a comfortable place, he/she may refuse to talk, be motionless and expressionless, avoid eye contact, etc. This behavior obstructs the child from making friends and having a good performance at school. [30]

Specific Phobias

A phobia is a constant fear of an object or situation that causes the person to avoid the area or situation but still trying to endure the fear.

Fear of dogs, elevators, bees, airplanes are some of the objects that cause phobias, all of them created by a bad experience, like being bitten by a dog or a

bee, trapped on an elevator for some time, or almost having an airplane crash or losing someone to an airplane crash. [30]

We found out that sometimes stress and anxiety is not necessarily a bad thing depending on the situation you are faced with.

- **A Two Way Street**

Anxiety is like the Dr. Henry Hyde, a fictional character from the book “Strange Case of Dr. Jekyll and Mr. Hyde” written by the Scottish author Robert Louis Stevenson, that tells us about a split personality, one body and two personalities, with different morals, one good and the other evil, Dr. Jekyll and Mr. Hyde. [32]

We can say that anxiety has a split personality, good and bad, it can help us to be better or it can crush us. Since we are born, we face many challenges, first day at school, public-speaking, test evaluation, car accident, or animal attack, etc. Every person is different because of their past experiences, so each person will react differently to a given situation. [33]

“Flight-fight-freeze” is the type of response that will be triggered in a threatening situation; sometimes that trigger can help us define our line of work as every worker suffers from anxiety. What makes a person enjoy their work is how they use the anxiety to help them. A way to do that is to prepare oneself for the task at hand: a police officer, for instance, needs to undergo fire arms training/practice in order to do his/her job properly. [33]

A car is on fire and a person is inside, what you would do: “flight” help the person, “fight” yell for help or “freeze” become very alert. Thinking of our reaction in that situation is different from actually being there, and even if you think that you would have that same reaction it does not mean that particular situation would happen again: it could be with two persons trapped in a car, or have two cars each with one person inside. Every situation is different, it is like a child talking for the first time, the child will eventually talk again but it will not be the same. The first word moment is gone. [33]

Suffering from anxiety or not, might be easy to distinguish through signs but this is just one step of many; we need to know the degree of the anxiety and that can only be known through measures.

- **Ways to Measure**

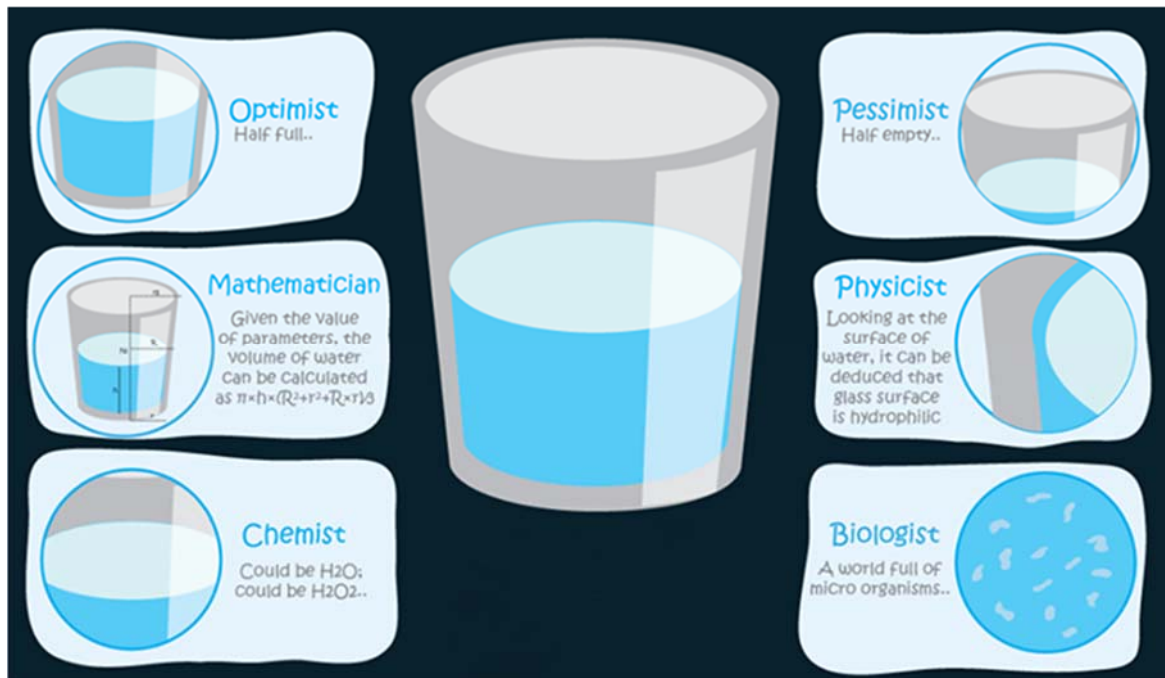


Figure 5 – The Conclusions that were taken by the observation of a glass with water [34]

“Is the glass half-full or half-empty” (see Figure 5), it’s a well-known phrase that defines one’s personality as optimist or pessimism. This of course is measured by the eye alone, if measured with the help of any kind of measure objects, you would only get one type of personality: an engineer. [35]

We use many types of measures during our day, even if we do not realize it: measuring the time left until the bus arrives, measuring the portions of food we eat, etc. it is a subconscious method, like biting your nails when we are nervous, we are not aware of it until somebody points it out. [36]

Measures can be qualitative or quantitative they just need the right question to be answered: from one to five how many animals do you have? Or in three words (sad, neutral and happy) how are you feeling today? Or in seven colors (red, orange, yellow, green, blue, purple and pink) which is your favorite? [37]

In this project the question is “Do you suffer from stress and anxiety?” The answer of course would be YES or NO, but as we mentioned before we need to see the signs, or answer to some relevant questions that lead to the first question.

The Modified State-Trait Anxiety Inventory using a Modified Talking Mats Method (mSTAI-TM)

For every end, there is always a beginning: 1970 is the year were Spielberger, Gorsuch and Lushene created State-Trait Anxiety Inventory (STAI), a Self-Evaluation Questionnaire that contains 40 items that are divided into distinct anxiety concepts (see Table 1). [38]

Table 1– STAI [39].

STAI	Statements	Single choice	Weight ¹	Minimum Score	Maximum Score
State Anxiety (A-State)	20 (about how they feel at a particular moment in time)	1-Not at all 2-Somewhat 3-Moderately 4-Very much so	1-1 2-2	20	80
Trait Anxiety (A-Trait)	20 (about how they generally fell)	1-Almost never 2-Sometimes 3-Often 4-Almost always	3-3 4-4	20	

Years passed and STAI was still being used as the best measure study of anxiety for psychology research, but it was just too long. In 1992 Marteau and Bekker developed a short-form, a six-item form of (STAI-6) also known as the modified short-form STAI that was created to know the feeling at the moment, that is why they only based on the state anxiety (A-state) of the STAI (see Figure 6). [40]

	Not at all	Somewhat	Moderately	Very much
(1) I feel calm	1	2	3	4
(2) I am tense	1	2	3	4
(3) I feel upset	1	2	3	4
(4) I am relaxed	1	2	3	4
(5) I feel content	1	2	3	4
(6) I am worried	1	2	3	4

Figure 6 - STAI-6[40]

¹ except for the items 1, 2, 5, 8, 10, 11, 15, 16, 19, 20, 21, 23, 26, 27, 30, 33, 34, 36, 39 that the weight are reverse (1-4, 2-3, 3-2, 4-1)

The STAI-6 has proven to have similar scores to the full-form but also due to its size it minimizes the number of error responses, unanswered question and its' less time consuming to fill it out. [40]

More and more people are trying and sometimes succeeding in uniting two objects to create something new to overcome their own failures: the wristwatch is a good example. It solves the problem of transport of a watch as you carried it with you on your wrist using a bracelet. In this case we merged the watch, an informative tool with the bracelet, essentially a piece of jewelry with a fashion sense, thus creating the wristwatch. This new piece still continues to keep his fashionable side and combine it with a more practical/informative side. This tactic was used by Nilsson, Buchholz and Thunberg when they combined the modified short-form STAI with talking mats in order to enable children to express themselves without the help of the parents. [41]

Talking mats it is a way to communicate through images that are divided into three parts (see Figure 7), the topic (the subject of the conversation), the options (the choices relevant to that subject) and the visual scale (what are they feeling about the options of the topics, like happy, unsure or unhappy). All of these parts are displayed on a space of your choice: a board, a tablet or even a computer screen. [42]

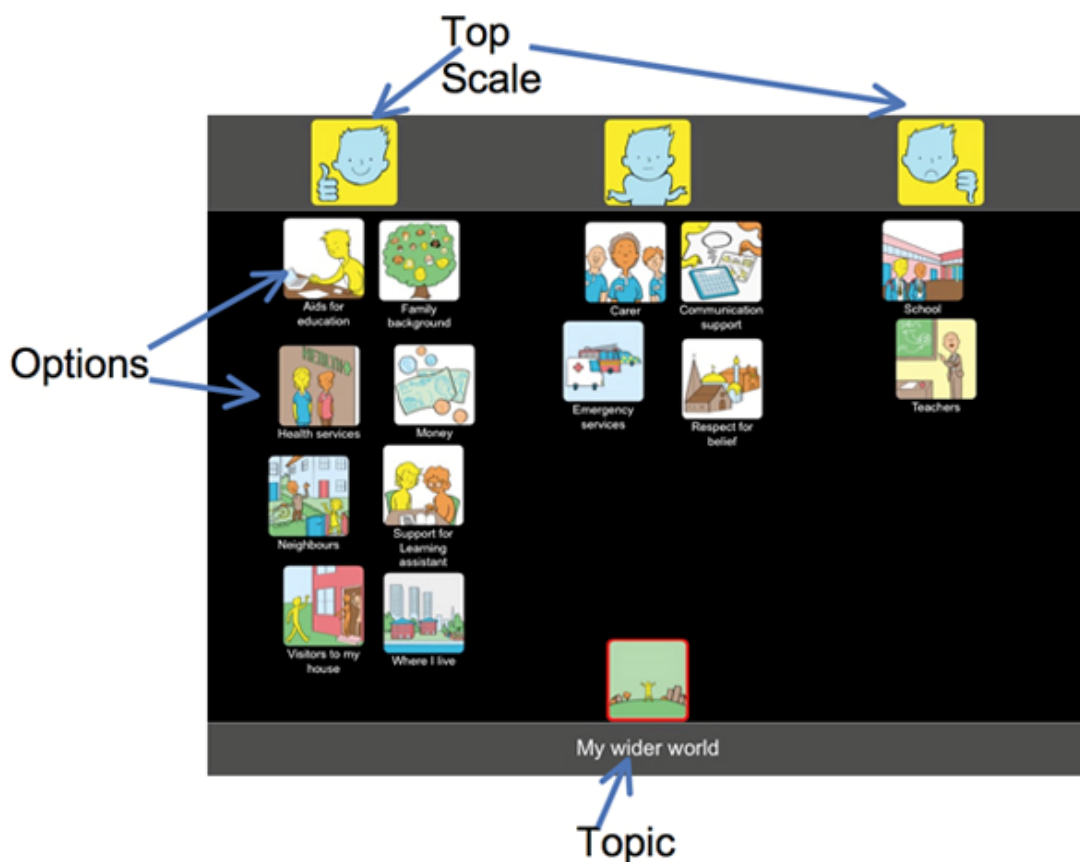


Figure 7 - Talking Mats [42]

Both modified short-form STAI and Talking Mats are completely different, one is expressed through words and the other through images, and one of them went through some changes.

The modified short-form STAI were transformed into 4 faces, two negatives (tense and fear) and two positive (happy and calm) and instead of 4 answers (not at all, somewhat, moderately and very much), the “somewhat” was eliminated, reducing to three that were transformed to circles with different sizes (small, medium, large) (see Figure 8). This will make the scores of the child’s level of anxiety measure from a range of 4 - no anxiety - to 12 - high anxiety. [41]



Figure 8 - The modified short State-Trait Anxiety Inventory (STAI) using a modified Talking Mats method [41]

We might have said in the begging of this section that “To every end, there is always a beginning”. This could be true but the fact is that we will never know if it is truly over. Take the Mayan people for instance: according to their calendar the end of the world would occur on the 21 of December of 2012. Of course this did not happen, as we are in 2014 already, but this proves that we never know when something ends, only that for us, at any given moment, it looks like the end. [43]

Modified Yale Preoperative Anxiety Scale (m-YPAS)

A little competition is healthy but going overboard can create a war. We are not talking about the card game “War”, more about like World War III competition for space, sales, customer. A good example is the competition between Pepsi and Coca Cola or more locally, between Nos Madeira and Meo, but strangely enough this did not happen with the State-Trait Anxiety Inventory for Children (STAIC), the golden standard and m-YPAS, their relationship is more like of a master and a pupil, where the pupil is in search of validation. [44]

This need only emerged after the creation of an observational instrument (YPAS - Yale Preoperative Anxiety Scale) for children undergoing surgery, during induction of anesthesia, with 22 specific behaviors. The age range was from two to six and they only had less than a minute to complete the form with good inter and intra observer reliability data. Later it becomes a need to expand the applicability to a preoperative holding area with children’s of ages from two to twelve. [45]

Nothing is perfect, there are always limitations and the STAIC is no exception to this fact: its long duration (10 to 15 minutes) to fill the questionnaire, not being very practical in the settings of a busy operative room, only created for children over five years, where due to the age some may not yet be able to read. [46]

The Yale Preoperative Anxiety Scale (YPAS) was modified, not in quantity but rather in quality: maintaining the 22 behaviors, divided into 5 groups (activity, emotional expressivity, state of arousal, vocalization and use of parents) only modifying nine behaviors (see Figure 9), with values between 23.4 and 30 without anxiety and greater than 30 with anxiety. [47]

The m-YPAS (Figure 9) proved to have good reliability and validation data, featuring what can be applied to children older than two. It was more sensitive to changes in the anxiety levels than other instruments before and it could be applied in preoperative holding area as during the induction of anesthesia. This was validated through the STAIC but only for children from five to twelve. [46]

Activities

1. The child looks around, is curious, plays with toys, reads (or other behavior appropriate for the age Group); moves around the preanesthetic/treatment room to get toys or seeking family members; might move towards the equipment in the surgery room;
2. The child does not explore or play, may look down, plays with own hands or sucks its thumb (blanket); may sit close to family members while it is playing, or may show a manic quality while playing;
3. The child moves without concentration from the toy to family members, movements are not connected to the activity; movements or play is frantic/agitated; twisting, moving on the table; may push the mask or grab family members;
4. Tries to escape, pushes with feet and arms, may move its entire body; in the waiting-room, runs around without purpose, does not look at the toys, does not want to be apart from family members, clings on desperately.

Vocalization

1. Reads (vocalization not adequate for the activity), asks questions, makes comments, stutters, laughs, answers questions promptly, but is usually quiet; child is too young to speak in social situations or too absorbed in the play to answer;
2. Answers to adults but whispers, "baby talk", only shakes its head;
3. Quiet, no sound or does not answer to adults;
4. Weeping, moaning, grunting, silent cry;
5. Child is crying, or might yell "no";
6. Crying, high pitched and sustained cry.

Expressing emotions

1. Happy, smiling, or concentrated on the play;
2. Neutral, no discernible face expression;
3. From worried (sad) to frightened, sad, worried, or teary eyes;
4. Distressed, crying, uncontrolled, eyes might be wide opened.

State of arousal

1. Alert, looks around occasionally, notices or follows anesthesiologist's actions (might be relaxed);
2. Withdrawn, calm and silent, might suck its thumb, or its face might be like an adult's face;
3. Attentive, looks around quickly, might be startled by noises, eyes wide opened, body is tense;
4. Whines in panic, might cry or shun others, turns body around.

Interaction with family members

1. It is concentrated while playing, is sitting down inactive or shows behavior appropriate to age and does not need family members, might interact with family members if they initiate the interaction;
2. Seeks interaction with family members (gets close to them and talks to family members that were silent until then), seeks and accepts support, might lean against family members;
3. Looks silently to family members, apparently observes their actions, does not seek contact or consolation but accepts it if it is offered, clings on to family members;
4. Keeps family members at a distance or might leave the area when parents are present, might push family members away or cling desperately to them, not letting them go away.

Figure 9- The m-YPAS [47]

Knowing how to see and measure what remains are the solutions created for different reasons but with the same purpose: the reduction or elimination of stress and anxiety.

2.1.2. Previous Work

We live in a world of inventions: a simple empty plastic bottle can be turned into a jar; the act of putting plastic on top of a banana can be used to preserve it for more time. [48] Inventions are made for a purpose: on the TV show MacGyver, the main character always used what was around, even a bubble gum, to help him or somebody else escape, to save the day. For us,

inventions are more like little tricks, allowing us to save money in order to have a better live. [49]

That is the goal of these resources: make our lives better.

Science never tries to fix the problem in only one way [50]:

- **Color**

Have you ever thought if there was a meaning behind the choice of color for products containers: 7up for instance, is green, Fanta is orange and Coca Cola is red. Color speaks louder than words. In this case the manufacturers had in mind one thing: they wanted the client to associate a particular emotion to their product; peace, growth or health for 7up, friendship, cheerful or confidence for Fanta; and excitement, youthful or boldness for Coca Cola (see Figure 10). [51]



Figure 10- Color Emotion Guide [51]

How many colors do you think exist? Too many, if you consider that the source is tree primary colors that originate the secondary colors and so on (see Figure 11). [52] Each color even with short exposure time can provide change in emotion. Keith W. Jacobs and James F. Suess study proves just that: they had four groups of people looking at the screen with one of the four illuminating colors (red, yellow, green, blue) and after each 5 minute complete

the state scale of the State-Trait Anxiety Inventory (Spielberg, Gorsuch & Lushene, 1970). It did not matter if the test's duration was 5 min or 15 minutes, the results were always the same: the red and yellow groups had higher A-state scores than the green and blue group. [53]

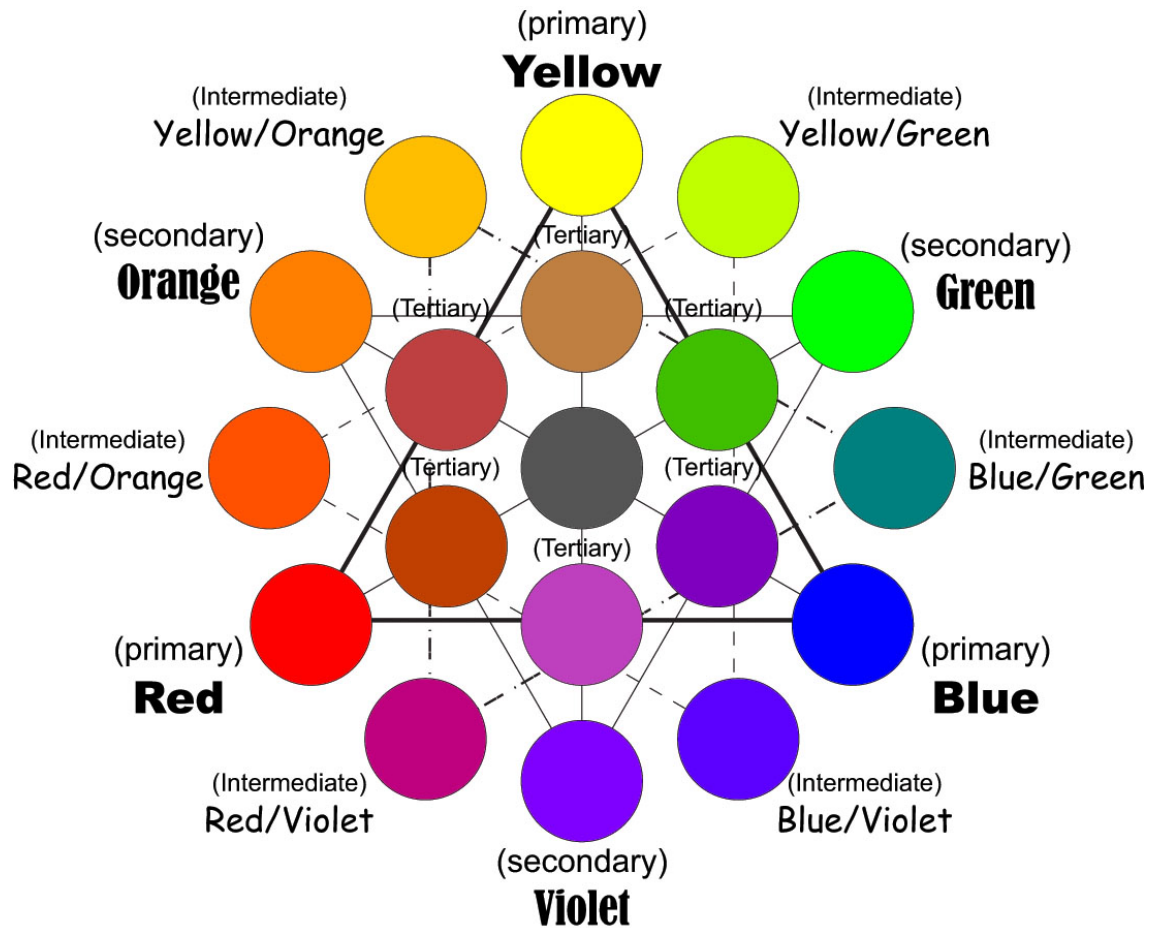


Figure 11 – Color Wheel [52]

It is not an accident that green and blue were the colors that provided the lowest values of A-state, because green is not only the color of hope it is also the color of nature. Nature is a place where we, human do not control with roads, or any other human made constructions; it is a place where we go to relax and forget our problems. Others prefer long walks in the country side or just spending some time outdoors. As for the color blue, a beach with clear waters and blue skies is very peaceful for some. Blue is also the dominant color of the planet earth seen from space. [54]

- **Sound**

When playing hiding and seek, the purpose of the game is that everybody has to hide, except for the one that has to find them. Hiding, despite what you might think, it is not that easy, that is why some people are very

good at hiding while others, not so much. [55] It all depends on one thing, “Do not make a sound”, a vibration that is transmitted through the air or other mean. [56] Any sound can literally expose us, even a sigh, so we need to be very quiet.

Sound and music are sometimes confused with each other, but a sound can be music while music is always a sound. Music is a set of sounds arranged in a way that is enjoyable to listen to. [57] Sometimes music is all you need to relax, to be at peace.

The problem is to listen to the right music: Weiland, Jelinek, Macarow, Samartzis, Brown, Grierson, Winter knew that, but practice is better than theory. Patients in the emergency room were divided into five groups and to each group a specific sound was assigned and heard through headphones. But how do we know if the music makes us feel better, that it really provides relaxation for the patients in the emergency room. Through the Spielberger State-Trait Anxiety Inventory, a self-report measure, filled before and after hearing the sound for 20 minutes, a pre and post intervention, making the first result the base to compare with the second were the Emergency Department (ED) ambient sound increase between 0% to 5%, the headphones stay the same, the electroacoustic composition decrease by 10%, audio field recording + binaural beat decrease between 10% and 15% and audio field recordings decrease 15%, seeing that original sound can reduce the anxiety of patients in the emergency department. [58]

- **Game**

There was a time when children or teenagers would spend some time outside playing in parks with their friends, but then the arcade games came. [59] Games such as Pac-man, Tetris and Space Invaders, became very popular in the 80s, but evolution did not stop there; portable consoles (Nintendo, Wii, Xbox, PlayStation, Gameboy, Sega, tablets) arrived later enabling the children to play those games directly from home. [60] If parents complained before that their children spent too much time outside playing; now they would say that they were always in their rooms playing with the computer. [59]

Every video game teaches us something new, even if we do not realize it at first. The Sims games, for example, they teach us many things but I believe the most important is about friendship, by comparing it to plants, if we do not take care of them, they fade away and die, much like a real friendship. [61] Games do not only teach us, they comfort us, by helping us relax. Not all games are relaxing: fighting/war games, for instance, have as main goal triumph or success when winning a fight. Another example is Candy Crush, a match-three puzzle like bejeweled involving candy with a story mode. This game provides both distractions and relaxation. [62] These are the findings of

the East Carolina University after performing a study where three no violent games made by PopCap Games (Bejeweled 2, Peggle and Bookworm Adventures) provided a 57 percent of reduction in depression and anxiety, improvement in all aspects of mood. [63]

- **Flow, losing the appearance of time**

We are all human, but that does not mean that we are all alike. As individuals we have different tastes in games: some people enjoy puzzles and mysteries while others prefer shooting and strategic games. Enjoying the game is the first step to say “I am in the zone”, the common expression that signifies that we are so immersed and involved in an activity, that we do not even notice the time passing by. This is called a flow, a state where our challenge and skill levels are in the same standard (see Figure 12). [64]

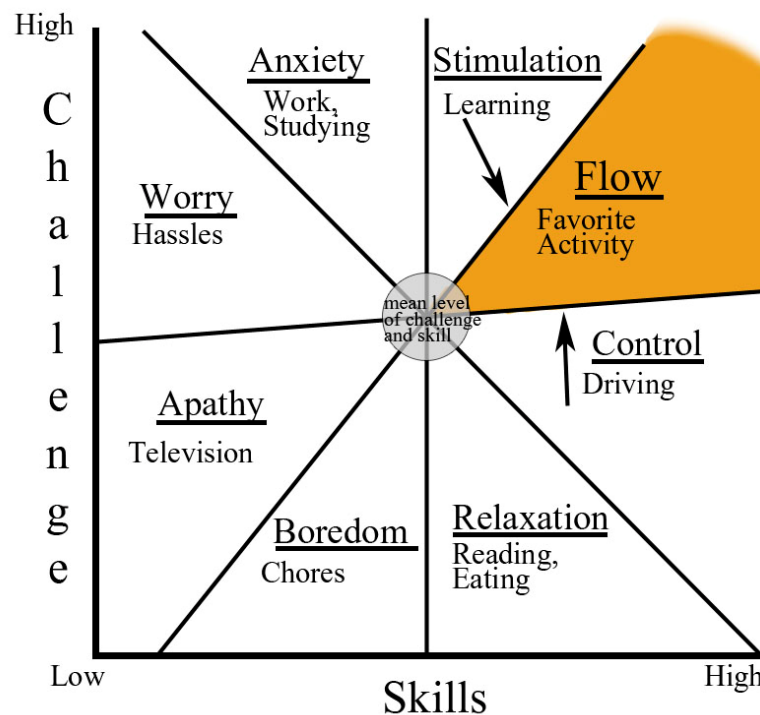


Figure 12–The mental state in relation to a challenge and skill level. [64]

But the enigma is to understand the effects of motivation: Inal and Cagiltay wonder why that in children, that flow occurs more in boys than girls, and that girls were more motivated when the game had an interesting story while boys were more concentrate in winning and passing the challenges. [65]

- **Touch**

The child is behavior inside their own house cannot be compare to their behavior outside; indoors they have already discovered and touched a lot of

elements, while outdoors represents an unknown element, a new place all together. Being an unknown environment, the only way a child can understand it, is by touching, picking it up and maybe playing it with. [66] This often irritates the parents, especially when they are playing in a store where all of its elements are fragile, but that is not the concern of the Morgan Stanley Children's Hospital, as they encourage touching, specially the iPads. "Whether a child comes to us with a broken arm, severe asthma or any medical emergency, we need to do all we can to eliminate the pain they are feeling and get them the care they need" said by the vice president of operations at the hospital by creating the Children's Comfort Program that has many ways to eliminate or even reduce the pain. The best strategy found was the iPad that provided patients of all ages and developmental stages with innumerable entertainments (videos, games, image, etc.).[67]

- **Teddy bear**

Do you remember the old Nokia mobile phones? We are referring to the Nokia 3310 for example; known now as an "indestructible" phone in comparison with the most recent models. The fact is as new technologies evolved throughout the years providing better picture quality, touch ability, etc., the new models are however more fragile than the old Nokia mobile phones. [68] Sometimes new things do not necessary means that they are better than the old things. A teddy bear for instance, probably one the oldest toys in existence, still provides unique comfort and support to children worldwide. Their soft fur and irresistible face are to blame and that is the reason why the European Medical Students' Association (EMSA) chooses the teddy bear as a way for children to overcome their fear of doctors and hospital environment.

The approach is a simple one: a role-play where the child is the parent, the teddy bear is the patient and the medical student is the doctor. As a way to overcome their fear, they go to different sections of the hospital where they talk or express their fears .Consultation, surgery, ward, dentist, pharmacy, ER and even a visit inside an ambulance are among the highlights of the visit. This did not just help them reduce their fear of hospitals and doctors, but aided them to increase their knowledge of what happens there. [69]

- **Expressions**

In our lives there are good and bad days. What defines them is the event that happens; mostly what ruins a day are rejections, criticism and a sense of exclusion. This does not only ruins one's day but threatens our self-esteem, causing stress. [70]

Mark W. Baldwin, Stéphane D. Dandeneau and Jens C. Pruessner were interested in cognitive mechanism of attention to rejection that could be the cause of social stress and individual self-esteem. They pursued it by having three major researches. [71]

Starting by examining the association between attentional process and physiological reactivity through one study where they included cortisol (a critical stress hormone and an endocrine marker of the stress response) reactivity to an acute stressor and the rejection information measured by the Visual Probe Task Demonstration (VPT² - measures reactions to rejecting, accepting and neutral faces). The findings provided evidence that the social rejection is linked to the late-stage physiological process of increased production of cortisol response to psychosocial stress. [71]

Continuing to the second research by modified through repetition of training task through two studies: [71]

- Using the rejection Stroop³ task and the Rosenberg Self-Esteem Scale⁴ as a measure, each participant was introduced to one of these three conditions: the experimental condition find-the-smile, where they were instructed to tap in a touch screen the accepting face as quick as possible (see Figure 13); the control condition find-the-flower was identical to the previous experimental with the exception of having to find the five-petaled flower in the matrix of seven-petaled flower instead of the accepting face; the third and last one was the same as the first experimental condition but you only had to look to the faces and then in the end answer to some questions. [71]

The results of all three conditions determinate that a more active engagement was necessary to train people's attentions to acceptance. [71]

- Using the VPT and the Rosenberg Self Esteem Scale, each participant was introduced to one of two conditions: the experimental find-the-smile and the control find-the-flower. This showed that it is possible to produce at least short-term modifications of cognitive responses. [71]

² Available in <http://selfesteemgames.mcgill.ca/resources/vpt.htm>

³ Available in <http://selfesteemgames.mcgill.ca/resources/Stroop.htm>

⁴ Available in <https://personality-testing.info/tests/RSE.php>



Figure 13 - Picture grid with 15 rejecting and one accepting face. [71]

They finishing by examining the real-world consequences of this training task on people's perceived stress self-esteem and physiological reactivity in stressful situations. [71]

- For five days, consequently before a final exam, undergraduate students at McGill University were randomly assigned to the control or experimental training condition through their homes, being measured through Rosenberg Self-Esteem Scale, Perceived Stress Scale, School Abilities subscale of the Feeling of Inadequacy Scale and a 7-point Likert Scale ranging from 1 (I Strongly disagree) to 6 (I strongly agree), "I am stressed about the exam"; "I am anxious about the exam"; "Today I feel that I will be able to work effectively towards my goals". The training reported that the students were less stressed about the exam that they had completed the experimental condition compared with participants in the control condition. The

stressor - Exam performance – only implicitly become a social threat. [71]

- A Telemarketing representative having to face rejection from clients was considered the ideal setting. For five consecutive workdays they were assigned to the experimental or control condition, filling four-item Rosenberg Self-Esteem Scale, four-item Perceived Stress Scale, providing five cotton swab saliva samples in five different times of the day and daily sales were gathered for 2 weeks before the testing week. The experimental condition provided a significant increase in self-esteem, decrease in self-report stress, lower levels of cortisol release, greater self-confidence, and improved sales performance, compared with the control condition.[71]

Sometime later, they launched MindHabits⁵, an online game available for PC. [70]

Leaving in the end the process of game design.

2.2. Game Design

Every day we make decisions that affect our lives, work wise or personal. Sometimes we make mistakes but the trick is not to discourage but rather learn from them. Game design is not that different as we keep making decisions of what the game should be. To make a decision, first we need knowledge: skills such as animation, business, communication, economics, music, history are very useful but for one person to master it all it is impossible. Still, if we can master a small percentage of that knowledge, even if in an imperfect manner, if we persist and practice, it will improve in time. [17]

2.2.1. The Goal

A game has two types of roles, one is the player, who plays the game and the other is the game designer, who makes the game. Each one has different goals towards the game. The goal of the players is to complete the game, while the game designer has as main objective to hold the player's attention by providing a remarkable experience. [17]

⁵Available in <http://www.mindhabits.com/demo/index.php>

- **Experience is Everything**

Information does not give us knowledge. [16] The moment itself and the choices we make in order to achieve something are the experiences we receive, and that is knowledge.

Experience is actually fictional: if you throw a coin in a well and do not hear it reaching the end, it does not mean that the well has no end, just means that the splash sound was not loud enough for you to hear it, resulting in no experience at all. On the other hand if you do hear it, echoing towards the top of the well, reaching you, that results in an experience, the experience of hearing a sound. [17] The important thing is not how the coin reaches the bottom of the well, but the experience that provides when it does reach it and that is the reason why people play games. The game does not provide the experience but rather supports it.

- **Flow**

A person's sense of fun and enjoyment is a peculiar sensation: when the game is easy we get bored, but when it gets hard we get frustrated. The oscillating between both feelings gives us excitement and relaxation, thus entering in a flow zone. (See Figure 14) [17]

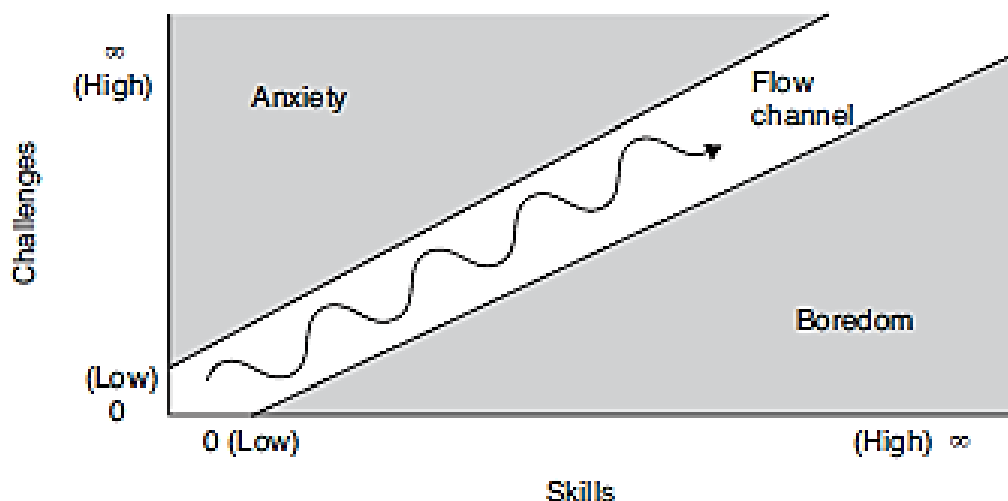


Figure 14 – The flow channel - a state where our challenge and skill levels are in the same standard [17]

Flow is described as “a feeling of complete and energized focus in an activity, with a high level of enjoyment and fulfillment”. [17] A state where we are so immersed and involved in an activity that we do not even notice the time passing by. Common know has being “In the Zone”.

The flow state can emerge in a player with the help of four components found in the game: clear goals, no distractions, direct feedback and continuous challenges. [17]

The question now is how to provide the experience and flow state.

2.2.2. What Consists

The most common learning method since our early years till adulthood is trial and error. To be the best at something, requires two things: understanding the principles and a lot of practice. What makes a game design different from other existing designs, is the knowledge that the game designer has.

- **Development Process**

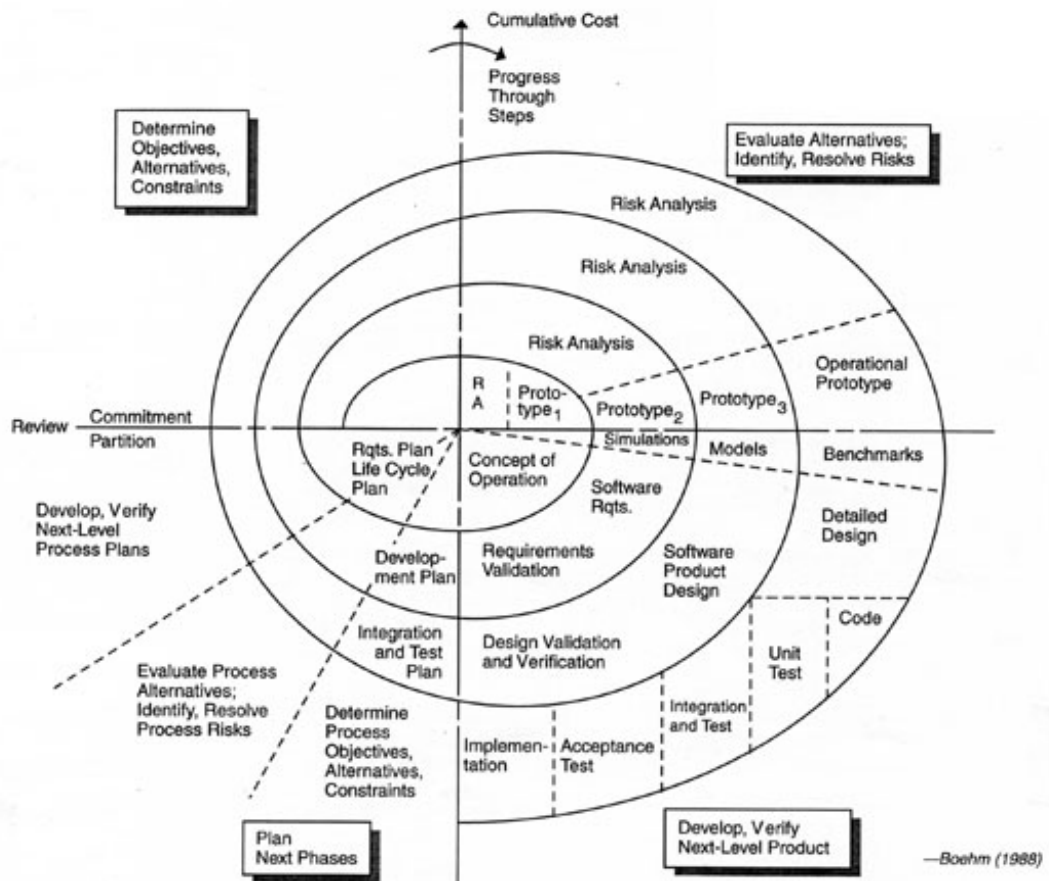


Figure 15 - Spiral model of Boehm, 2000 [97]

Let's picture the game as a spiral: the idea of the game is a dot, which gets progressively further and further away from the point of origin as the idea evolves into the game. As the spiral has a perfect shape, the game must not have any detours despite of the complications that may appear along the way.

We learn from repetition: starting with basic design, risks appear as we advance, making it necessary to create prototypes to overcome them and test to prove that the original idea still remains there. The process repeats itself but with a more evolved design based on what was missing from the previous design. (see Figure 15) [97]

A game is assembled with the help of specific elements.

- **Elements of Game Design**

Earth, Fire, Water and Air are what we call the elements of life, and each one has a purpose; fire to keep us warm, air which enables us to breathe, earth for us to grow food and water to survive. Each one of these elements is unique in their own way but together they support life. [84] The same happens to the elements that create games; mechanics, story, aesthetic and technology are what we need (see Figure 16). [17]

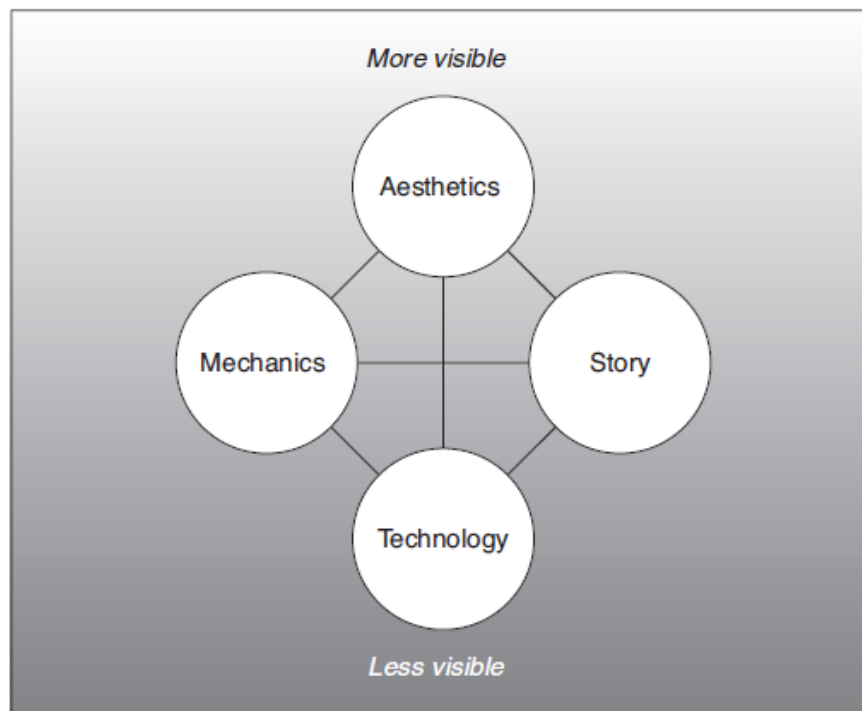


Figure 16 - The Four Basic Elements [17]

Mechanics are the actions that the players can do in the game; Story is the sequence of events that will be revealed during the game; Aesthetics is the appearance that it will provide including sound, looks, feels, smells (it is the player's first connection with the game); and Technology is the resources that make the game. [17]

Technology is the physical objects that together create the game, from constructing to the actual game. There are two types of objects: foundational and decorative but often the two get confused with each other. The difference

between them is that one creates and the other one just makes it nicer. Let's consider for instance a cupcake: a cupcake is a small cake intended to be served to one person. The baking part is the foundational, and it includes both the ingredients and the instruments (without them the cupcake would not exist), while the upper part, the cherry on top is the decorative part, it only serves to attract and appeal. [17]

Aesthetics is what we call the surface details; it is what makes the experience more pleasant. Aesthetics come with the ability to see, for example a glass, we know what it is and what it is for, but not in an aesthetic way; to really see it we need to see its shape, colors, proportions, shadows, reflections and textures. [17]

The Story is the journey of the player's route; it can be divided throughout the game, but it always has a beginning and an end. [17]

We may say that the story is the answer to the simple questions: what happens, how did it happen and why did it happen. To have all of them is not really necessary to grasp the player's full attention; what happens is enough. The how and why are not significant or relevant to the outcome of the game. If we take the example of a conversation between two friends, where one of them mentions an event at work, like a promotion, the other person does not really need to know why or how it happened, just the fact that it happened is sufficient [17]

Mechanics is the actual core of the game: it is what we call the internal pieces that make the game work; not the physical pieces like screws or metal but rather the rules and actions, making the player interact and give a specific response. [17]

To reach a given destination by car we need to follow rules and directions; it is not just the action of driving the car forward, hitting everything in front, endangering our lives and everyone else's we encounter in our way. We may not even notice it, but we are surrounded by sets of rules, and they apply to driving, work, etc. [17]

Having in each element the necessary component of design.

- **Basic Element of Creativity**

In Super Mario Bros what's the first character that comes to mind? Mario, right?

Games have specific elements that make them memorable. Mario is one of those examples: a short, Italian plumber with a moustache that has aerialist jump ability, making him the main character but that does not mean the rest around him (other characters and the scenario itself) is not important. In fact the rest of the game supports the character, defining him and his many tasks or challenges he needs to overcome: enemies to destroy, coins and powers to

catch and objects to jump to. [98] These elements need to be well defined before creating the scenario in order for them to work together. The source of each element is found through creativity (see Figure 17). [82]



Figure 17 – The basic Elements of Creativity [82]

But sometimes creativity is not enough.

- **The Visual Magic of Comics**

The specific of a cartoon character makes it easily recognizable in another context, such as Tomb Raider. The main character, Lara Croft, originally created as a video game character, is now also a part of the movies' scenario, easily identified through her clothes, hair and guns. [99]



Figure 18 – The detail different [100]

Scott McCloud, a comic's theorist believes that the less detail the character has, the more it looks as oneself (see Figure 18).

Each player has a different approach playing a game.

- **Player Types**

Different behavior patterns means different preferences, where a game designer Richard Bartle created The Bartle's Taxonomy of the Player Types (see Figure 19) that explains the player game pleasure preference, through four elements, Acting, World, Players and Interacting. [17]

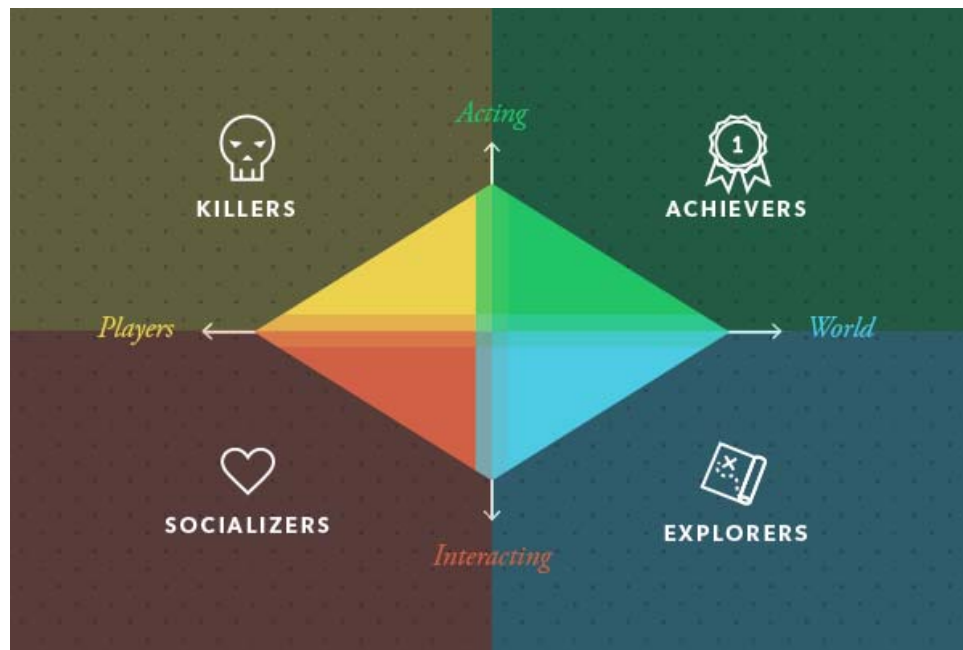


Figure 19 - The Bartle's Taxonomy of the Player Types [115]

Whereas the Achievers are players that want to complete the challenge (goal of the game), the Explorers are players that want to discover everything about the game, the Socializers are players that want interacting with other players and the Killers are players that want to be the best by defeating the others players. [17]

Knowing everything we needed to understand about Stress and Anxiety, the innumerable possibilities to treat it, the experience the game provided and how to create it; the next step is to think of an idea and follow it through.

3. Design Process

The point of having an idea is to solve or replace something in the world that is not working. In this case we wanted to reduce anxiety and stress in children in the E.R. by using a game, a short game with simple design and rules, relaxing music, no aggression and easy to win. [72]

The idea was originated over the flow of ideas with no limitations. As the only source of ideas was our imagination, requirements were created to go through them and during the elimination process only a few ideas remained but in the end only one was chosen.

3.1. Creative Process

Idea or rather the concept of having a light bulb appear on top of the head indicating the birth of an idea, good or bad, needs to evolve to a point where we throw the idea out or use it for our purposes. [73] Ideas are like objects, when you absolutely need them they are hard to find. The more you try the harder it gets.

Sometimes difficult things in a different perspective become easy: some people may wonder how Leonardo Da Vinci created such impressive pieces, how could one man have so many revolutionary ideas, just by doing one thing: SLEEP. We all try to achieve our dreams, why cannot our dreams be a source for our ideas. It is told that Leonardo da Vinci took naps every 15 minutes throughout a 4 hour period. [74] There is a moment when we are almost asleep and our subconscious mind in some way inspires us fills us with many ideas. But nothing was perfect as this tactic has two problems; first you need to wake up: Salvador Dali slept sitting upright holding a key in his hand, between his fingers. As he relaxed and fell asleep, the key would fall on the ground waking him up inspired. The other problem was that you need to be fast enough to write it down on paper, because one small problem about dreaming an idea is if you do not write it down you will forget it. [17]

3.1.1. The ideas

In a universe of a million ideas, this is what escapes (see Figure 20):



Figure 20 - The post-it Ideas

The ideas were written in post it of different colors in order to separate the type of games: shooter, puzzle, platform, adventure and rhythm. The ideas may not be very clear, because we wrote them in a way that we can understand, they are composed of key words for us to remember, it's much like when you listen to a song or see an object and you remember the exact moment when it happened.

In total there were 20 ideas, each one will be explained in detail to better understand and visualize them, some may look similar to one another or to an already existing game but if chosen, can be transformed to become something unique. These ideas were just starting points. It may even occur

that in the end, the game will be completely different from the starting idea. (see Appendix I)

When we came up with ideas for the game, there were no limitations, so anything was possible, but it was time to enforce those limitations, and go through the requirements based on the facts mentioned before, as they will help us reduce the number of ideas.

3.1.2. Requirements

Did you ever notice that when you are in a hurry for something to finish, it does just the opposite: it goes extremely slow. Time is a funny thing; five minutes can sometimes feel like one hour. This is very true in the emergency room, as you are waiting for your turn to be called, but if you are occupied playing a game available there and enjoying it, one hour can feel like five minutes. You may be at any time, it can be quick or take a long time. (see section 2.1.2, Flow: losing the appearance of time, page 21 and section 2.2.1, Flow, page 26)

R1: The game will have a maximum duration of 15 minutes

As our grandparents used to talk about those days before us, and the machines they used, so do their grandchildren talk about the new inventions, specially the touch technology. Children may be small in size but their curiosity is endless, they want to touch everything then see. As we evolve so does technology, from board games to computer games, to tablet games. (see section 2.1.2, Touch, page 21)

R2: the game will work on a tablet

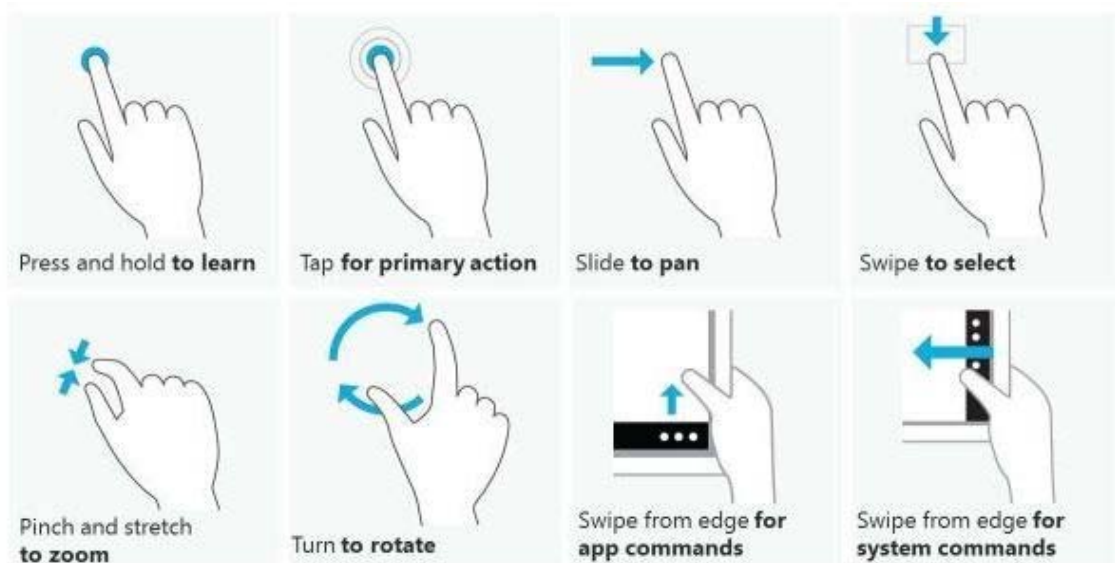


Figure 21 - Multi-touch available in a Touchscreen [75]

The tablet was a unique input device (see Figure 21). Our fingers do all the work on the screen: touching, holding, dragging, separating two fingers or uniting the two fingers. [75] As simple as this is, in a game it can be confusing for the children. In this case simple is better, which is why we created another requirement.

R3: the game will only support single touch

Our purpose was to provide experience that helps the children to be more comfortable and at ease in the emergency room, and what better way to do that than to have a theme, a design around a single theme that makes all the elements reinforce each other, working together to a common goal, to a better Hospital experiment. [17] No other than having a theme about a hospital.

R4: the game will be about a hospital

A hospital from the outside was just a building, but on the inside is filled with elements that really make a hospital: the people, the equipment, the corridors, etc.

R5: The game will have characters and equipment of the hospital

Seeing is believing. In this case seeing the aspect of the instruments is just one step to reduce anxiety, they needed to see their purpose and how they were used on them. (see section 2.1.2, Teddy Bear, page 22)

R6: The game will have some means of showing how the instruments are used

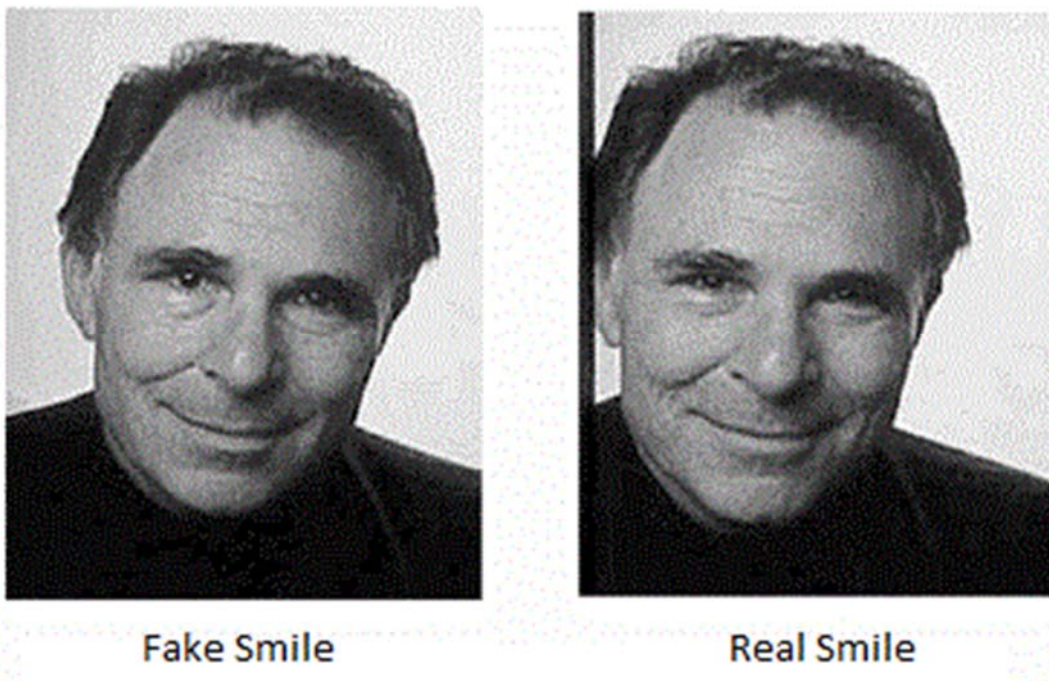


Figure 22 - The difference between real and fake smile [76]

There is a difference between a real smile and a fake one (see Figure 22). A real smile could be contagious as it makes you and the other person feel better, while a fake one, a smile that is forced, doesn't provoke any emotion. (see section 2.1.2, Expressions, page 22) [76]

R7: The game will have an important expression: the happy face.

When you have been working a lot, have not had a vacation in a long time, your mind starts imagining a deserted beach with yellow sand and calm water, hearing only the sound of the waves and the birds (see section 2.1.2, Color, page 18 and Sound, page 19)

R8: The game will have a calm and relaxing environment

R9: The game will have relaxing Music

Nobody likes to lose, especially when we're under stress as it can create some sort of aggression. Having problems at work or at home or even when your favorite club is playing and they lose the game, can trigger violent behavior, such as throwing the remote control against the wall. (see section 2.1.2, Game, page 20)

R10: The game will be easy to win

R11: The game will have no Aggression

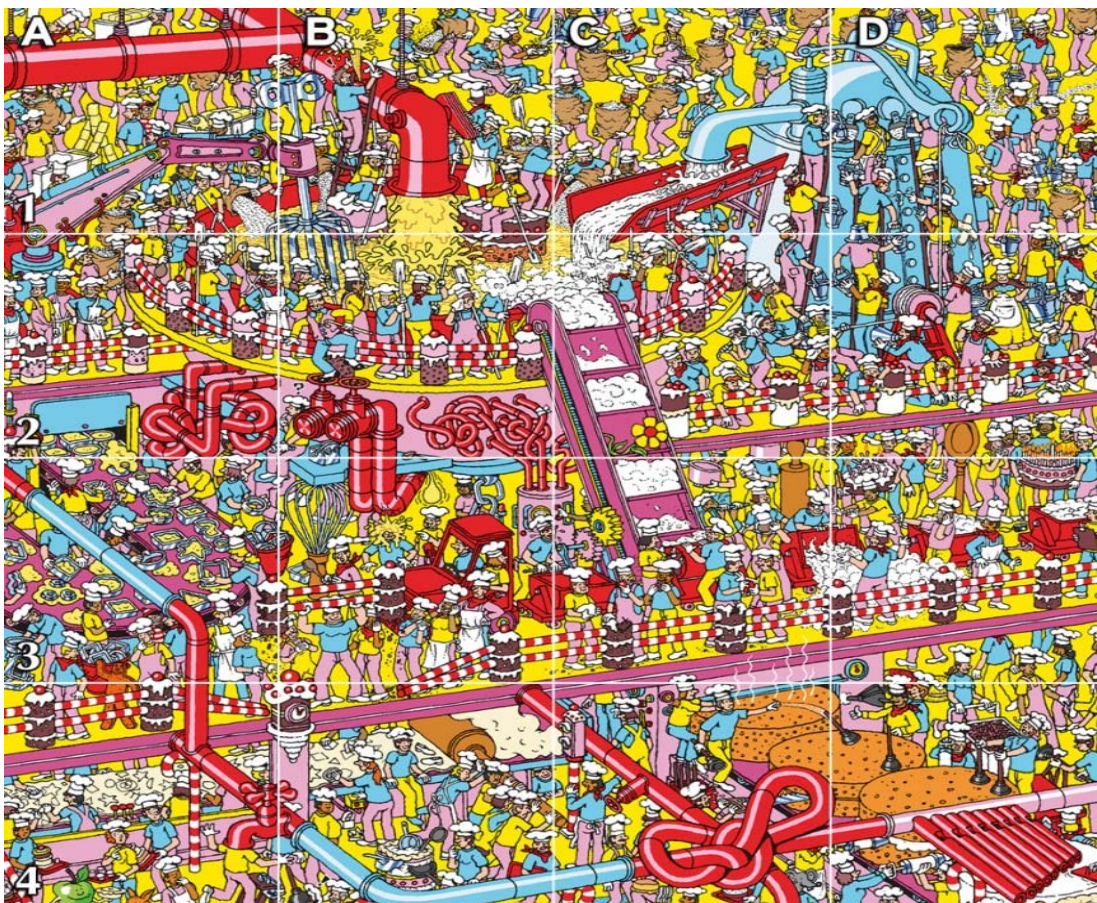


Figure 23 - Where Wally/Waldo? [78]

Where's Wally/Waldo? A collection of children books that consists in finding a character named Wally/Waldo, easily identified by a red and white striped shirt, a bobble hat and glasses. Knowing what the character looks like make it easier to find him as he is always surrounded by a crowd of people.(see Figure 23) [77]

Did you find him? If you did, how long did it take you? More than a minute? It's normal because at first you only see the confusing. The author somehow wanted you to pay full attention in finding Wally/Waldo and while you're looking for Wally/Waldo, you will see the story and characters that the image offers. [77] Visualization was an important part of the game, but a game has to be like a photograph. At first you see what all is about, and then you take your time exploring that world.

R12: The game will have a simple Design

In every game there are rules, that's what makes a game, for example tic tac toe. This is a two player game where on each turn the player has to mark on a grid 3x3 with a cross or circle, the first to have 3 cross or circles in a horizontal, vertical or diagonal wins. [79] If there were no rules, there would have been a lot of arguments to see who won the game, but even if these exist, sometimes they are not interpreted correctly or are too complicated to begin with.

R13: The game will have simple Rules

All of these requirements are not about the game itself, they are about what the game needs to provide the children with: a calm, relaxed and prepared state to see the doctor. Any idea that didn't fill all of the requirements was eliminated.

3.2. The refinement

"You are the Weakest Link, goodbye!" a famous catch phrase from a game show The Weakest Link, that uses this phrase to eliminate a person from the game, with no emotion. [80] That's what we had to do with the ideas, only one can survive.

With the ideas previously mentioned suffering the necessary adjustments to support the requirements, the true colors of the ideas surfaced, eliminating the ones that did not make sense. In the end a hard choice had to be made with the remaining ones.

3.2.1. Focusing

Despite the fact that some of the ideas did not have anything to do with the requirements above, they were still taken into consideration.

Some ideas were immediately eliminated, like idea #1, #2 and #14 as they are about shooting or hitting which provokes aggression. (see section 3.1.2, R8, page 36)

The music ideas do not have anything to do with a hospital atmosphere, to insert equipment, happy faces and associate it with music would be virtually impossible, so #3 and #4 are also eliminated. (see section 3.1.2, R4, R5, R6 and R7, page 35 and 36)

Simon says, a simple game that according to the requirements is too long, so #5 is eliminated. (see section 3.1.2, R1, page 34)

Platform games were unique because they enable the control of the player, from walking to jumping obstacles, in which a lot of functions require a lot of buttons, complicating the rules of the game, making idea #7 and #17 eliminated. (see section 3.1.2, R13, page 37)

For a player to say that the game is easy to win, implies that the player understands the game and the level of difficulty. Deducing may be difficult to children leading to lose interest, thus eliminating idea #15. (see section 3.1.2, R10, page 36)

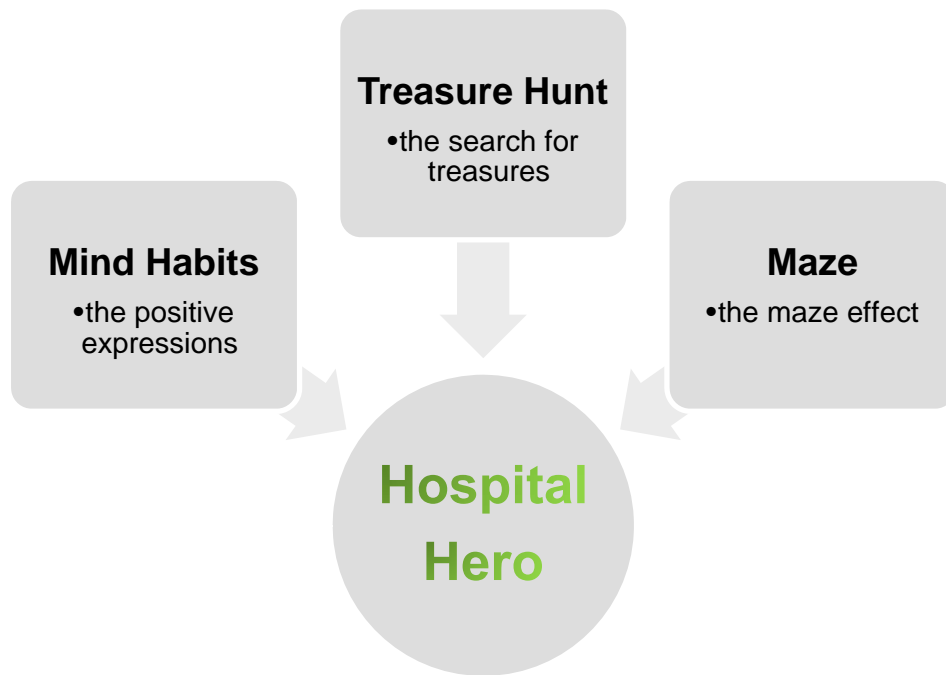
A touch screen game, like angry birds, is restrictions free for the player. If at some point he becomes confused, he will try by all means to understand it. Touching, dragging, sliding, etc., are tasks that prolong the understanding of the game, thus the idea #8 is also eliminated. (see section 3.1.2, R3, page 35)

There came a time when you still had a few ideas left and no more reasons or requirements by which to eliminate them. When that time came, we had to choose one by using our intuition, but never throwing out those other ideas as they may become useful in the future.

3.2.2. The final choice

Having eliminated half of the initial ideas, a hard choice had to be made eventually.

We wanted the game to be more than a simple puzzle game, so instead of choosing just one idea, three were selected with the purpose of using the specific elements that they featured, for the creation of one unique game.



With that idea in mind, the next step was to create the game itself having the start of the game in a sketch approach and evolving to a more defined technological design.

4. Game Overview

This was the start of a project and although it may look simple enough with time and effort, it will become great- It's like when they say: ***Rome wasn't built in a day.*** [81]

As with everything, an idea first starts in our minds but it then needs to be more defined and have the necessary programs organized through preparation. Only then can we pass to a deeper development with the designing of the elements, creation of the sound and finishing by connecting all together, to become a masterpiece.

4.1. Preparation Phase

Having an idea and putting it on paper does not mean the job is done or in this case, that the game is finished. An idea is like clay, it is just a means to an end. Everything we build has to go through a preparation; even clay has to be soft and flexible before entering the potter's wheel. The same happens with the idea; it has to be properly defined before we start to create the game itself. [82]

The idea is a simple description of the game, which occurs in the hospital having a maze in mind, involving a treasure hunt with hospital instruments and emotional characters where the player has to touch the happy faces.

Designing games is similar to cooking. You can follow a recipe or you can just wing it, if you wing it there are two possible results: the rare one, the creation of a master piece, or the most likely, a non-edible dish. It is possible to create a master piece but we need to know some basics, how can you run if you do not know how to walk, we all need a guideline. [83]

To follow a recipe we need ingredients and utensils, with games it is no different; the ingredients are elements of game design (See section 2.2.2, Elements of Game Design, page 28) and the utensils, the software needed to create the game itself. [83]

4.1.1. Elements of Game Design

Each one of us uses the elements of Game Design in their own way. We like to use them in the beginning to see what we have and in the end to see if all of the elements work together.

- **Technology**

In this game the tablet screen and the tablet itself is the foundational plus the material needed to its creation (pencil, paper) while the decorative is his shape and color.

- **Aesthetics**

Considering the game at hand: its aesthetics is surrounded by the appearance of an ocean that is represented in the walls of the hospital and the floor is the bottom of the ocean, that is, sand. The game has four different characters: boy, girl, nurse and the doctor, with one of the two expressions available in the game; sad and happy. As the player interacts with the game a sound effect is eared.

- **Story**

The story of this game is similar to a treasure hunt: the treasure in this case is some hospital equipment that got lost. This gives the player a reason to play as throughout the game clues are given in order to find the “treasure” – the equipment that was lost.

- **Mechanics**

The mechanics of this game consists of moving through a maze in a 3D appearance with arrows and interact with the characters for clues to discover the instruments.

4.1.2. Software Tools

We have some similarities to our ancestors in the prehistoric times as we also create tools; the difference is its purpose. Long ago, the tools were used for survival purposes – survival of the fittest. Let’s take the discovery of fire: used for warmth, cooking and protection against possible predators as the animals were afraid of the fire. The tools we create nowadays are really to improve our lives, gives us more comfort or stability, as clothing or technology. [85]

As we evolved, so did our technology. These days we have a lot of tools that serve the same purpose. Mobile phones are an example: there are so many types of models and brands, but ultimately what helps us to decide which tool to get is the price.

For a touch capability game, paper and pencil is not enough; a computer software that supported windows and our ideas was mandatory.

As with each movie or life itself, we encounter main and secondary characters; the same happens in a project, where the secondary (3d objects, visual, sound and statics) only exist to support the main one. [86]

- **Main Tool**

Unity 3D was the chosen main software, a game creation system (supports the program language C# and JavaScript, being the JavaScript the one implemented), that was not only chosen for the 3D ability but because it targets to multiple platforms, as the android was the platform we had in mind (see Figure 24). [87]

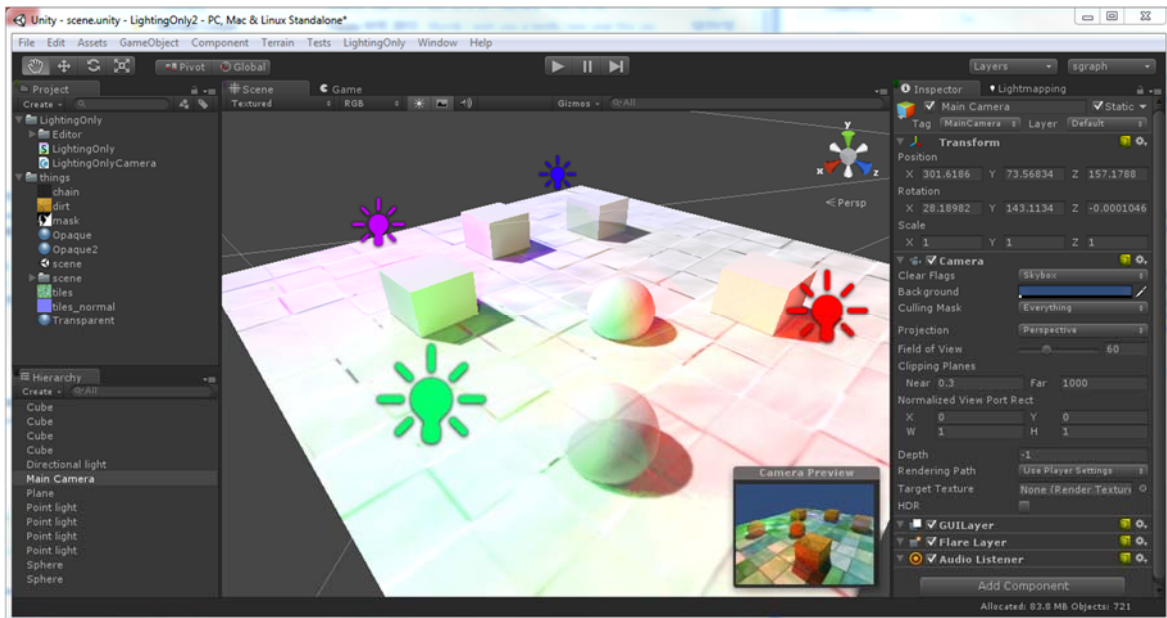


Figure 24 – Appearance of Unity 3d [88]

- **3D tool**

Not knowing much of 3D programs, Autodesk Maya 3D was chosen due to the high-end character and effects toolset, being comprehensive 3D animation software. (see Figure 25) [89]

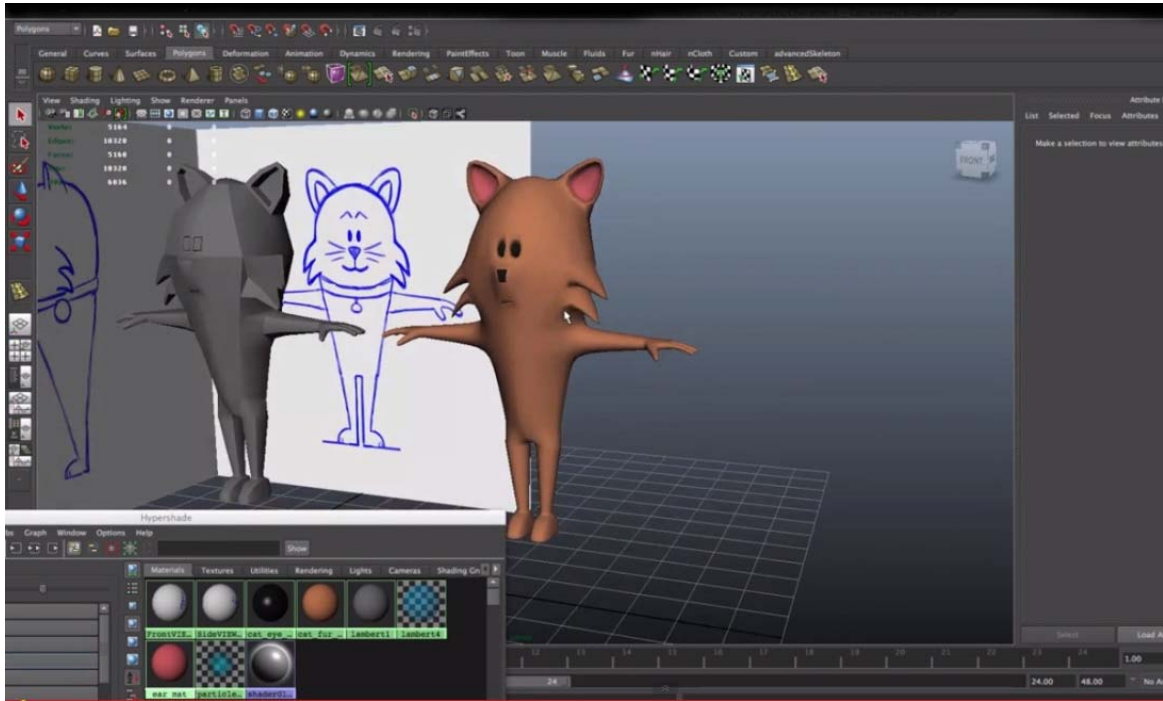


Figure 25 - Appearance of Autodesk Maya 3D [90]

- **2D Tools**

Adobe Illustrator was chosen due to having some knowledge of how to work with it, as it was used for the structure of the 2D image (what the game could be like)(see Figure 26). The Adobe Photoshop was on the other used for dimensions and color alterations of the 2D image that we see in the game (see Figure 27). [91]

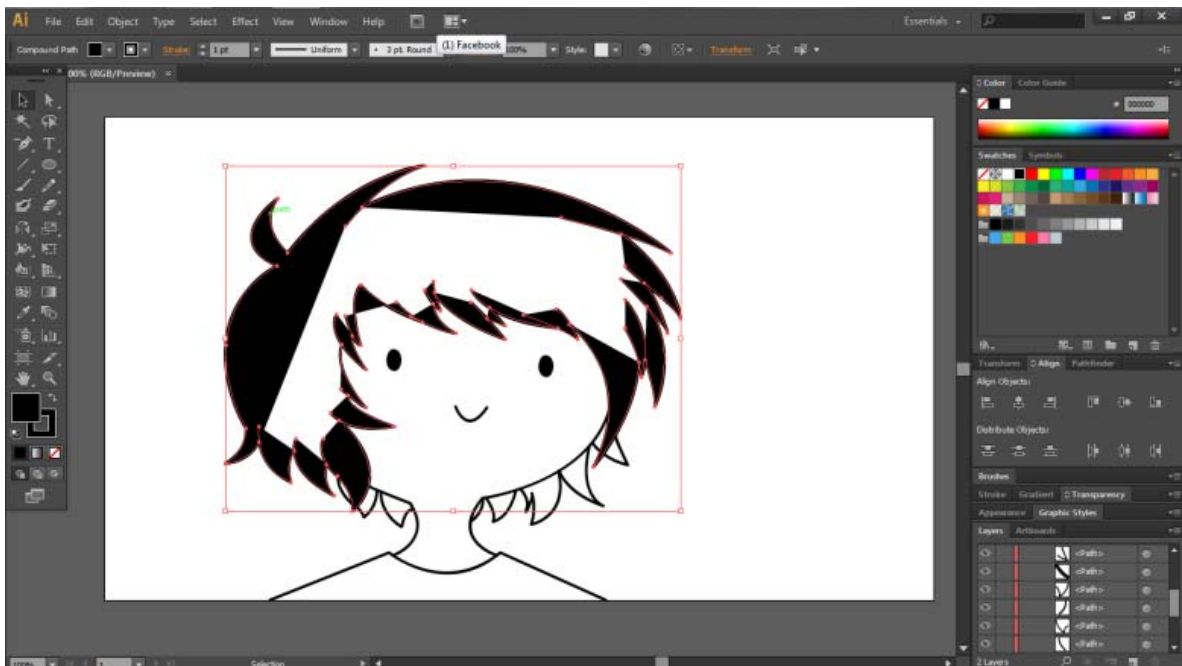


Figure 26 – Adobe Illustrator [93]



Figure 27 – Adobe Photoshop [92]

- **Sound tool**

With the help of a 5 years girl and a 9 year boy, we recorded specific sounds with the help of a microphone. Due to some language difficulty (English speaking), the GoldWave program was chosen as we were familiar to it in view of previous work. This program was used not only to increase the sound but for cuts and merges (see Figure 28). [94]

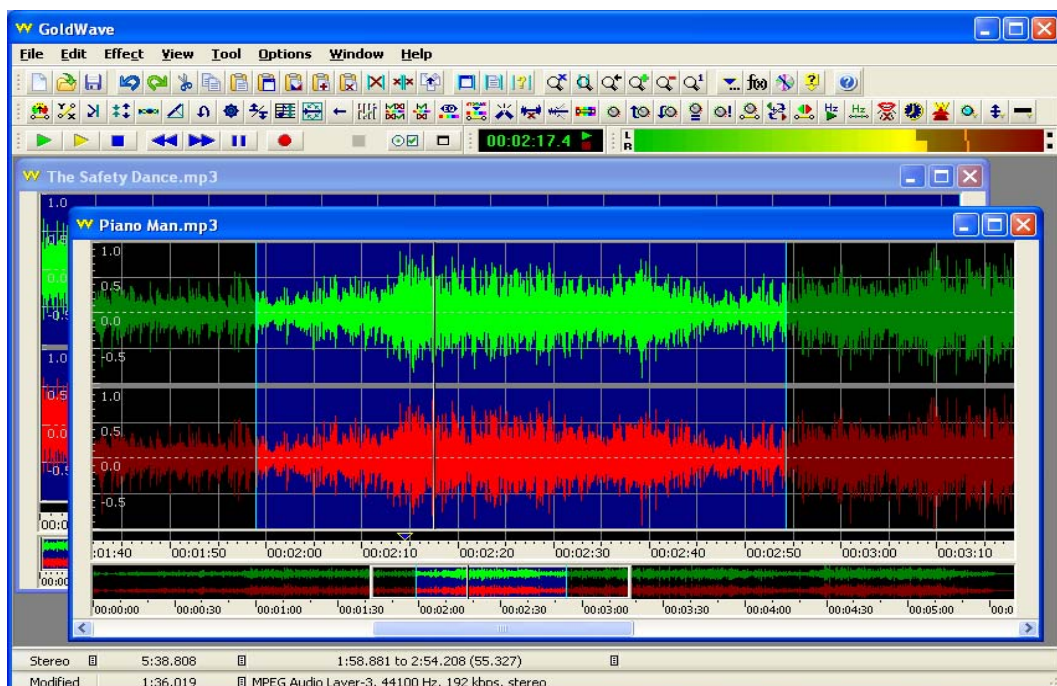


Figure 28– Appearance of GoldWave software [94]

- **Statistical tool**

R, a programming language, was used for statistical software and data analysis, chosen not only for being free software but for its wide variety of statistical and graphical techniques (see Figure 29). [95]

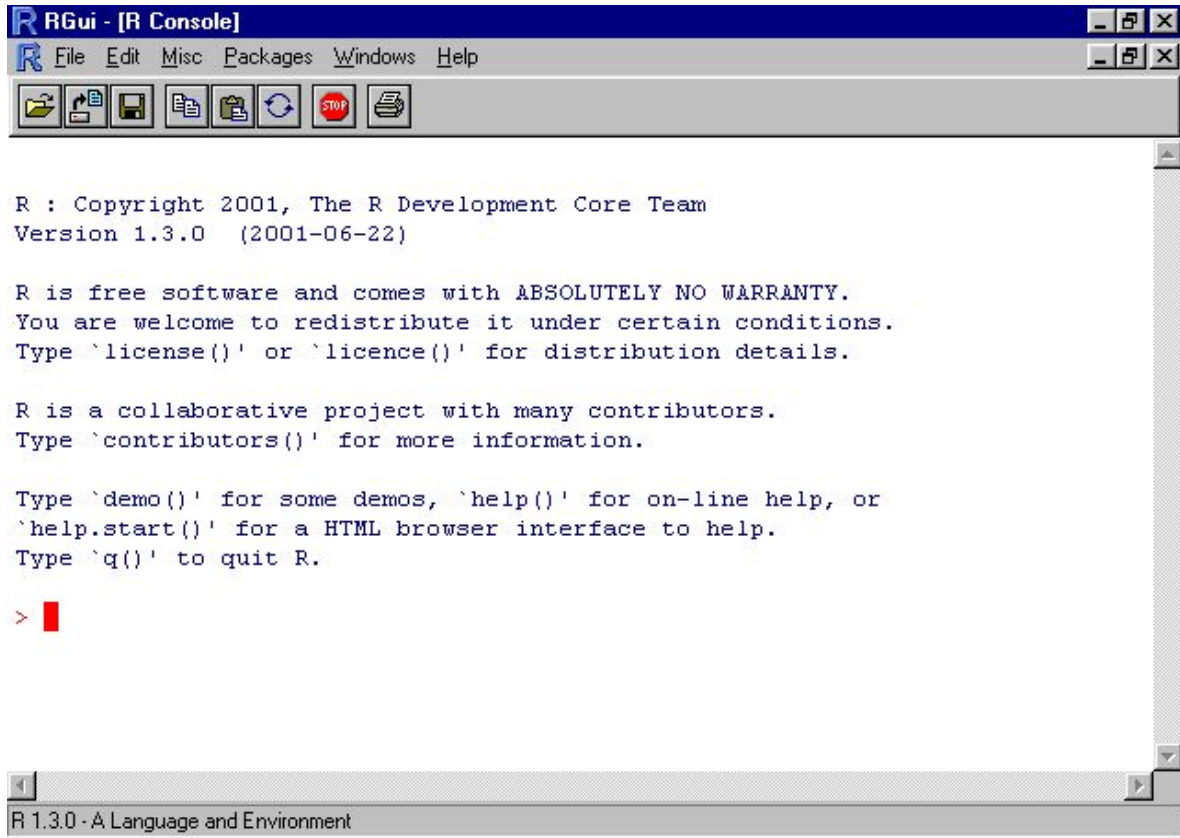


Figure 29 – Appearance of R software [96]

At the moment we knew what we had in each of the elements and the software that we would use, it has time to combine everything and fill in the gaps to create the game we had idealized, but we will never have the expectation that the finished product will be exactly the same as the game we have mentally visualized.

4.2. Building phase

Using the Spiral model of Boehm, 2000 (see section 2.2.2, Development Process, page 27), the game starts to develop. There is a line where imagination differs from reality. This in reality is not that perfect, leading to having some risk with the basic design:

1. Getting lost in the maze
2. Not having time to visualize the game

3. Not distinguishing the positive from the negative expressions
4. Not being sure if children know what to do in the game
5. Not having the enough interaction with the positive expressions
6. Not visualizing the shape of the arrow
7. Not understanding at first glance that the level is a hospital
8. Not understanding that some arrows aren't possible in some positions

Nature as a non-human creation can be viewed in comparison to the creation of a game. Each nature component is defined as a process in the creation of a game: trees, animals and grass, are all visual objects that can be designed; birds signing, water dropping, all sounds that you find in nature that can be create or altered; animals moving, leaves moving through the wind, all actions that can be implemented or enhanced.

4.2.1. Design

Using the method of the basic elements of creativity (see section 2.2.2, Basic Element of Creativity, page 29), some elements were created.

- **The Character**

The game supposition is that the interaction of certain expressions will affect the child relation with the Dr. Mark W. Baldwin study (See section 2.1.2, Expressions, page 22), making it reasonably the first element to be created.

The choice of the expressions was easy due to the choice of the anxiety test (Assessing Children's Anxiety Using the Modified Short State-Trait Anxiety Inventory and Talking Mats) having based the four expressions (scared, happy, sad and calm) (see Figure 30).

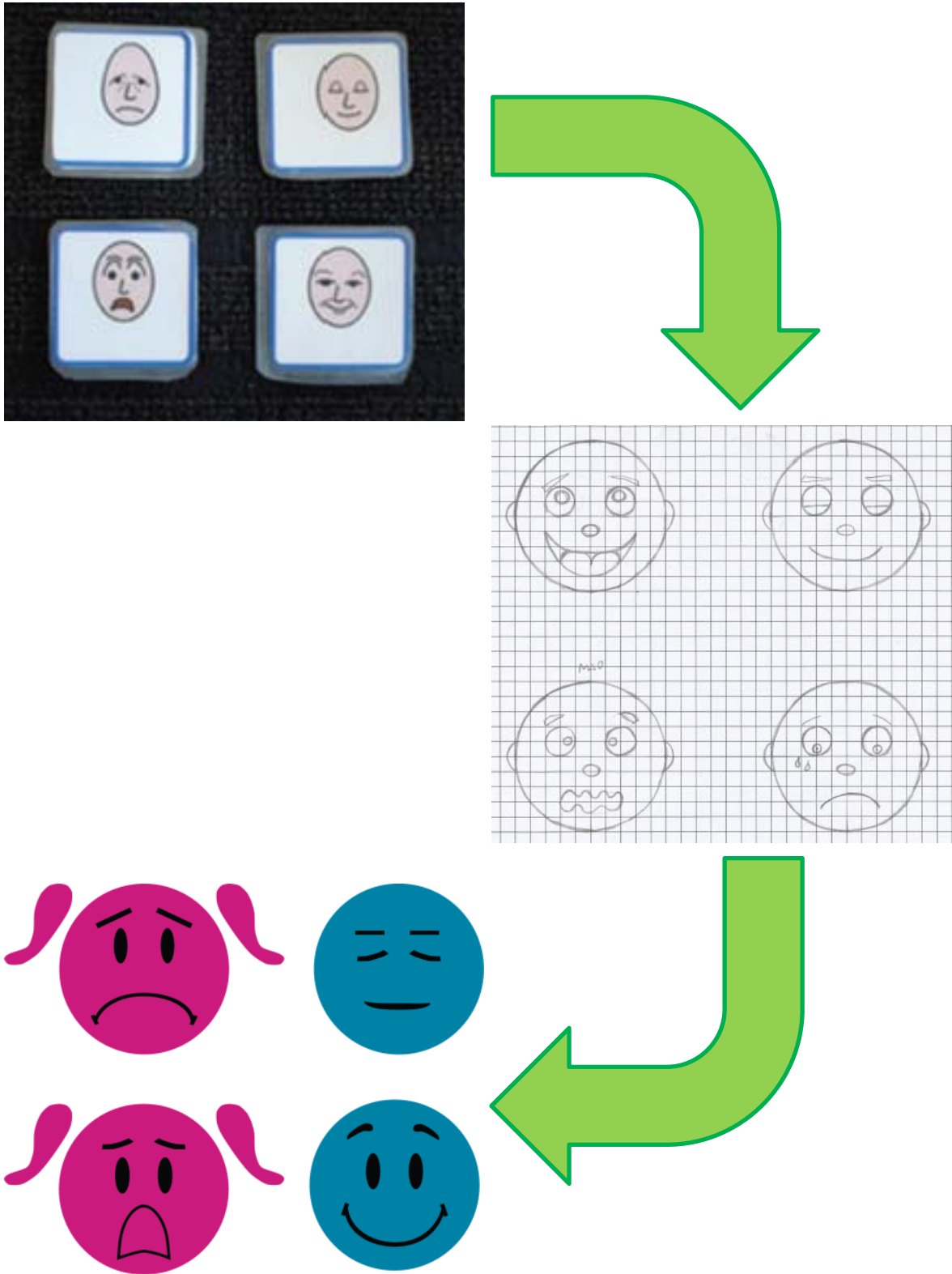


Figure 30 – The expression evolution

Scott McCloud's approach (see section 2.2.2, The Visual Magic of Comics, page 30), making it the real reason for maintaining the simple design (see section 3.1.2, R12, page 37), for the child to identify him/herself in the game, basing the messenger icon as the character (see Figure 31). [100]

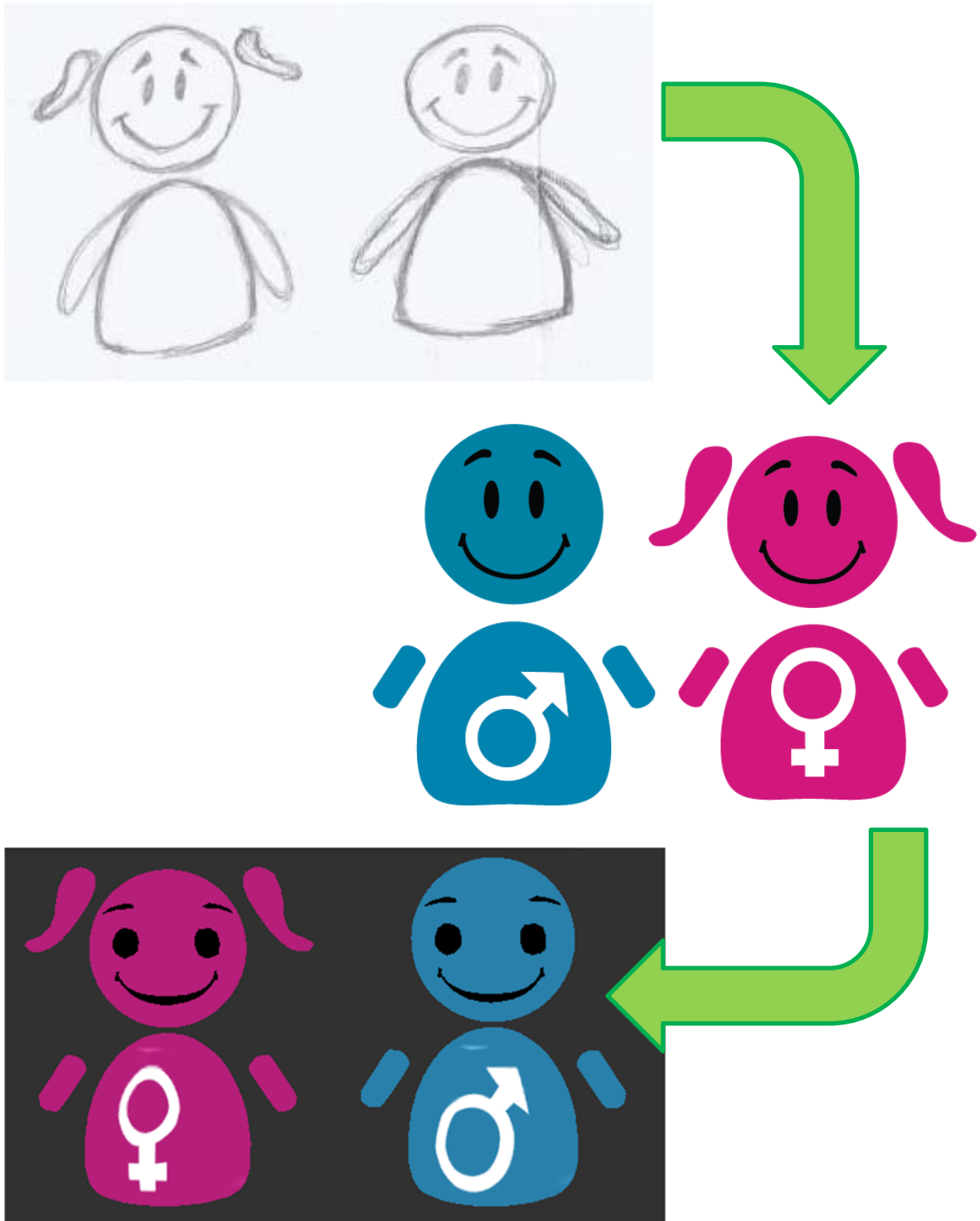


Figure 31 – The evolution of the character

To support the theme of the Hospital (reducing risk 7, see section 3.1.2, R4, page 35) two more characters were included, the doctor and the nurse (see Figure 32).

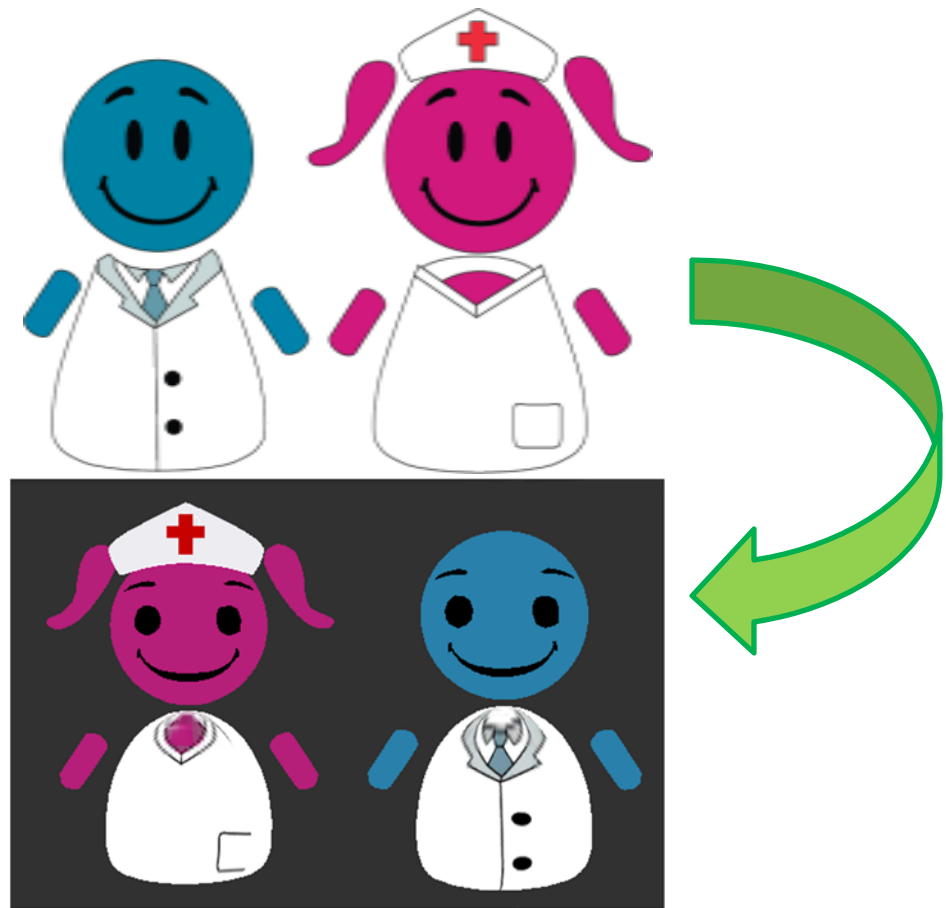


Figure 32 – The 2D design and the 3D design

- **Prizes**

The word Hospital means a place of hospitality known as the act of generously providing care and kindness to whomever is in need. Basically, this means that the hospital is not only a building but the aggregation of the specialized staff, equipment and patients.

Knowing the equipment is an important part of the hospital, so what better to do than to have the player find it. This is their task/goal and only seven pieces of equipment were necessary due to the clarity of the images based. (see Appendix II)

To increase the number of interaction with the positive characters (reducing risk 5) and to support the story created, two more elements were created: the safes and the keys. Each key and safe is designated as a color of the rainbow colors (thus the seven colors) (see Figure 33).



Figure 33 - The Keys and Safe by order

- **Navigation**

Ready or not, here I come! A popular phrase of a children' game, hide and seek, where one child has to cover their eyes and count to a hundred (depending on the child's age, could be a smaller number) while the other children hide. Once the countdown is over, the child has to find them. [101]

A maze and Hide and Seek game have some similarities. Hide and Seek can be played anywhere, indoors or outdoors, but the quantity and the quality of the hiding places are the definition of an excellent Hide and Seek.[101]

The maze, on the other hand, is defined by a serious of dead ends and the challenge here is to find the best way to reach a place. As the theme of the game is the hospital, what better defines it than to have the word HOSPITAL as the shape of the 3D maze. (See Figure 34)

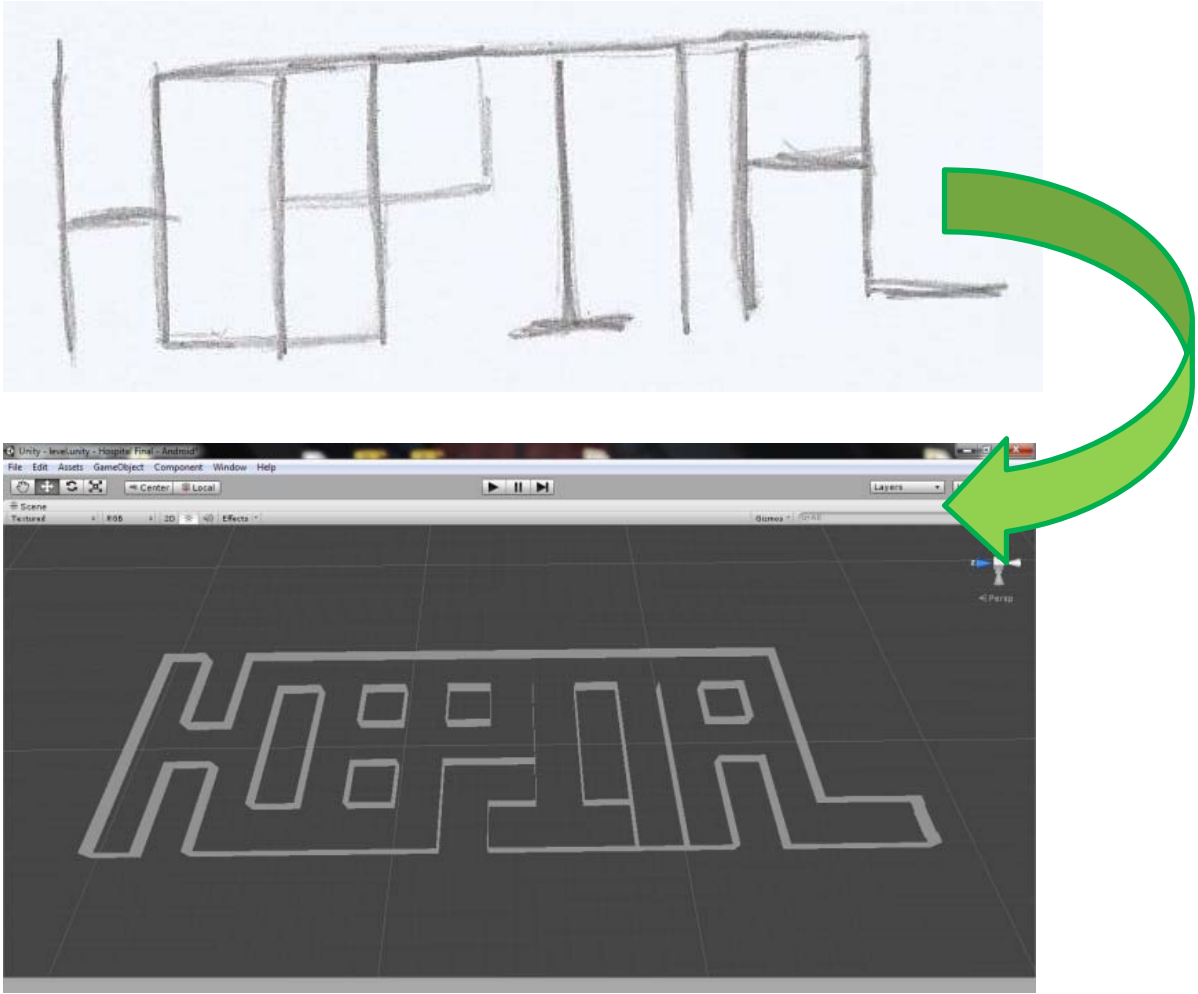


Figure 34 - From a sketch to a unity design of the maze

Having established the shape of the maze, the next step was to decorate it (see section 3.1.2, R8, page 36) The bottom of the sea was chosen due to its relaxing and calm environment. Then, portions of elements of the sea (various fishes, pirate ships, treasure chest) were made to fill the walls, making the floor appear as sand and the ceiling as sky.

The number of walls was considerable high to decorate, having in mind that every wall had to be different from each other. Then a thought came to mind: if this game was intended for children in the first place why not ask them for their help?

We printed a sheet with the appearance of the wall (see Figure 35) along with the elements of the sea. Then they were all plasticized front and back, except for the elements of the sea which were only plasticized in the back. This was of course for the purpose of having the children painting them and use the plasticize to stick them on the sheet which symbolized the bottom of the sea (see Figure 36).

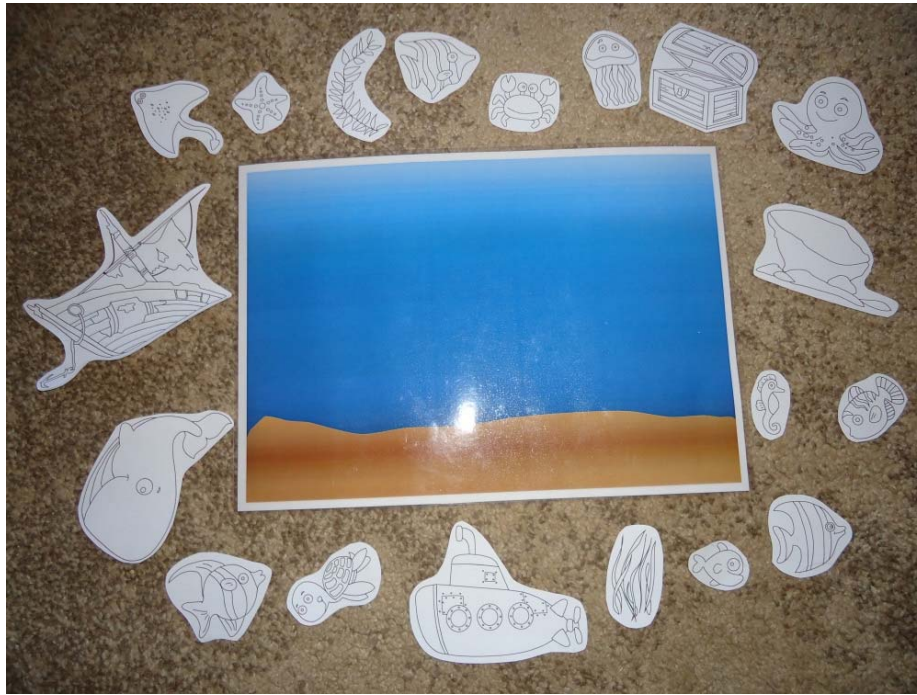


Figure 35 - The sheet and sea elements that was provided to the children



Figure 36 - The children painting

For every model that the children made, we asked for their signature and to have their picture taken to put it in the actual game. (see Figure 37) To complete the appearance of the maze, the doors for the entrance and exit were made along with some shapes of light.

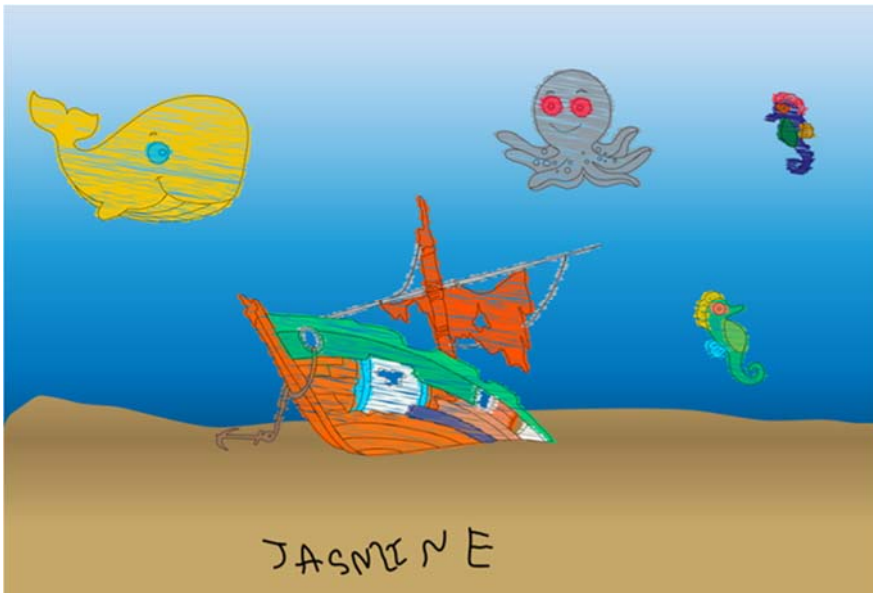


Figure 37 – The transformation of the child's picture for the wall of the level

As the public audience was all children, arrows with the appearance of 3D buttons were created to navigate the maze (see Figure 38).

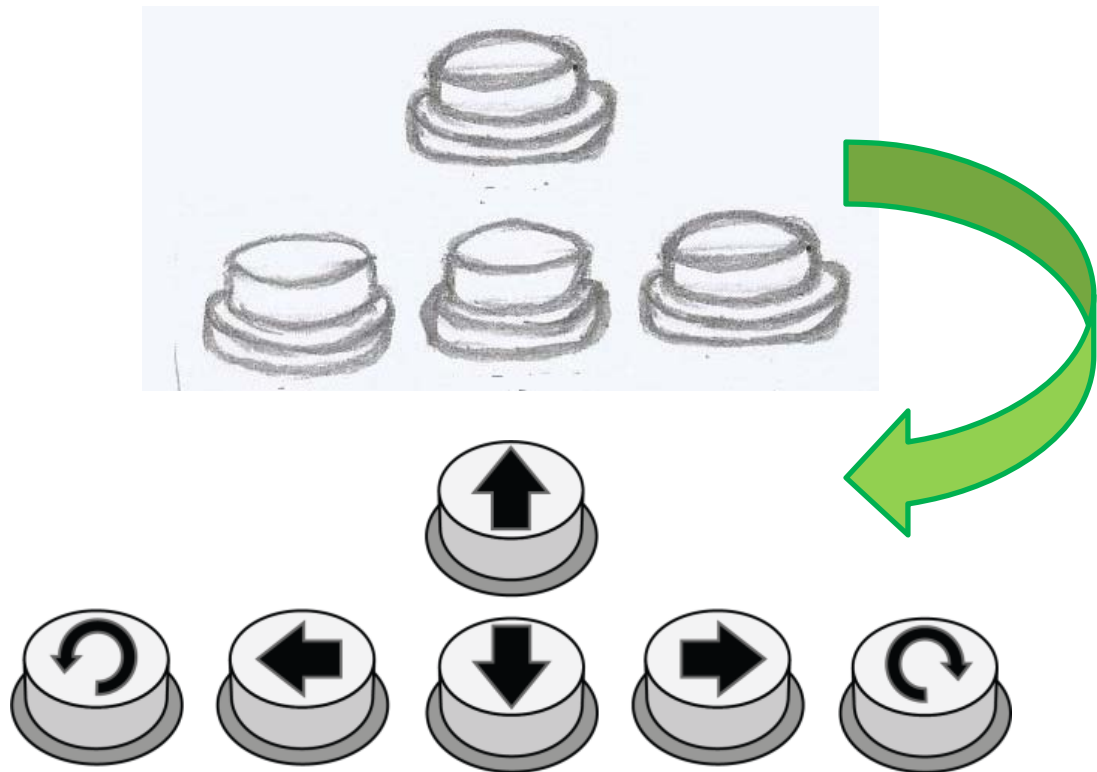


Figure 38 - The basic arrow (front, back, left and right) was created but being a 3D maze and for better visualization of the arrow (reducing risk 6), the angle of the button and additional arrow for rotation (to the left and right) was required to interact with possible characters appearance.

- **Logo**

We live in a world where everything has a name, sometimes more than one, a scientific name or a made-up name. This game is no exception: both a name and a logo were created. This was no small task as we wanted to incorporate the letter “H” to symbolize the hospital. In the end we came up with the perfect name: HOSPITAL HERO (see Figure 39).

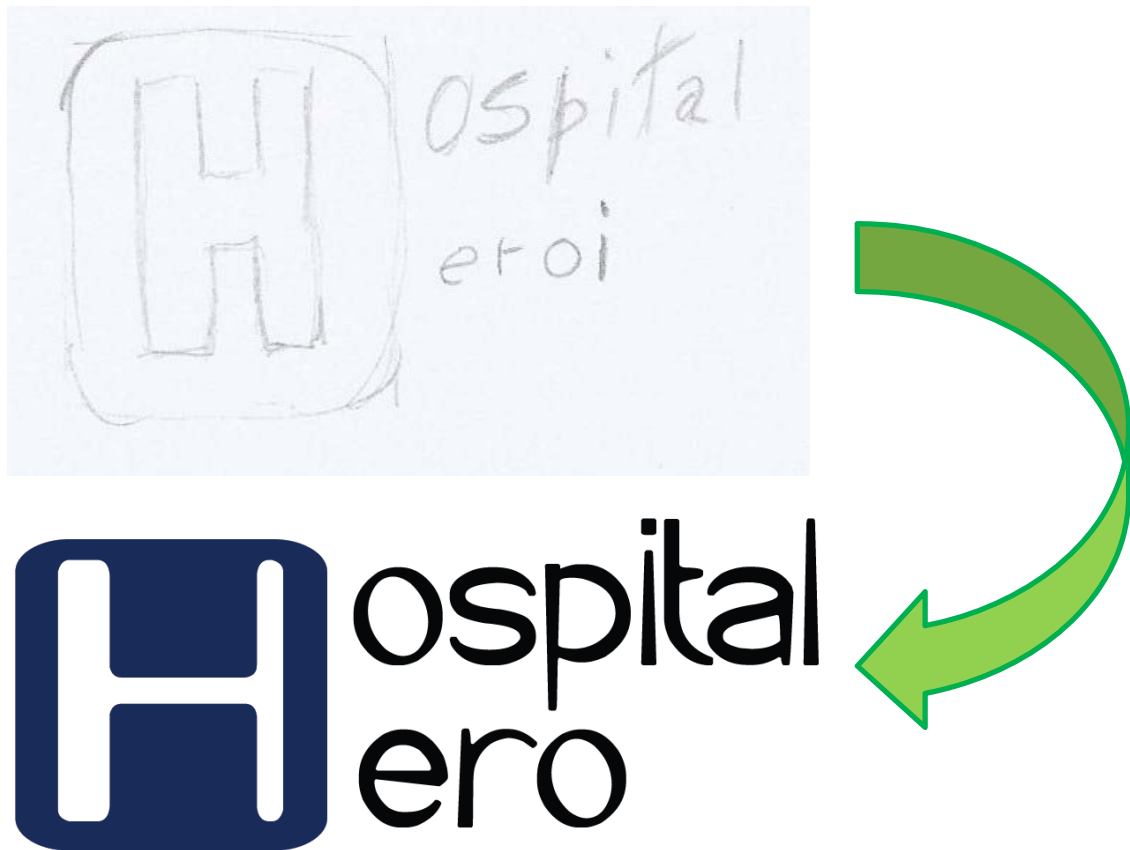


Figure 39 – The logo though

4.2.2. Sound

Sounds exist to warn, inform, and entertain us: from sound of cars, subway information of the next stop to a simple music. But they aren't perfect, they can be misinterpreted: a car can be a bus, not understanding what the next stop is or even singing the wrong lyrics of the song. This misinterpretation is due to distraction, bad pronounce and noise. [102] This last one is what occurs most in the children' emergency room.

Because of that, the visualization was the most important element to work on, but not to a point that no sound was created.

- **Voices effects**

Normally stories are told when the child goes to bed, to help them relax from the excitement of the day, to fall asleep and maybe dream about the story. The choice of the story itself is important, but the way it's told is equally important, as it can induce either a calm or nervous state of mind in the child. For example, this phrase: "Let's put a smile on that face": simple and innocent words right? Not threatening at all you would think. Well as it so happens this

sentence was a line in one of the Batman's movies for the bad guy, the Joker, so the intonation of these words and their significance changes dramatically, as it had to convey fear on his opponent. [103] For the purpose of this game, we used the voices of actual children for the image interpretation (English and Portuguese) (see Figure 40).



Figure 40 – The recording process with a female and male child for the voices of the game

- **Sound effects**

E F E F, these words by themselves do not mean anything, but as music notes, they represent one of the scariest sounds ever produced in the Jaws movie. Every time someone hears that, it's immediately associated to a shark approaching. [104]

The point of having sound effects is to make them memorable when you listen to them. Good examples are, Super Mario Jumping or Pac-man running, etc.

For the sounds effects, various free websites were used for the background noise, as well for the interaction with the characters, arrows, safes, etc.

4.2.3. Implementation

What makes video games different from boards games is the sequence of events that lead to the game, for example monopoly. This board game consists of choosing one player to be the bank, who then distributes to each player the amount established in the rules, choosing the token to play, unfold the board and put the decks on the positions marked on the board. The game begins when each player roles the dice to decide who plays first. [105]

Angry birds is a video game that consists in pressing the button play on the menu where a grid of number appear indicating the levels. At the beginning of the game only the number 1 is available. After pressing this, the story is told and then the game starts.

The order of sequence of events is not important for the board game but it is for the video game. How can you slide from a slider if you do not climb first, sit down and finally slide? The order of events is very important: can you imagine doing it in a different order, it would not be possible. How can you reach the top of the slider without climbing? Flying perhaps or maybe teleporting.

The game itself has to be like a collection of paintings, each one shows details that can only be made by focusing all the attention one painting at a time. That's why the game is divided into four sections: the order is as the child sees it happening; first the menu, then the story, the level and finally the end.

From the very first touch to open the game app, a new world is showed. From the beginning to the end arrows are showed as a way to go through the game to maintain the game mobility.

- Menu

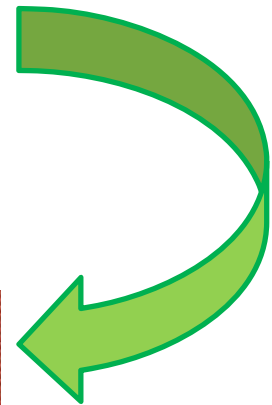
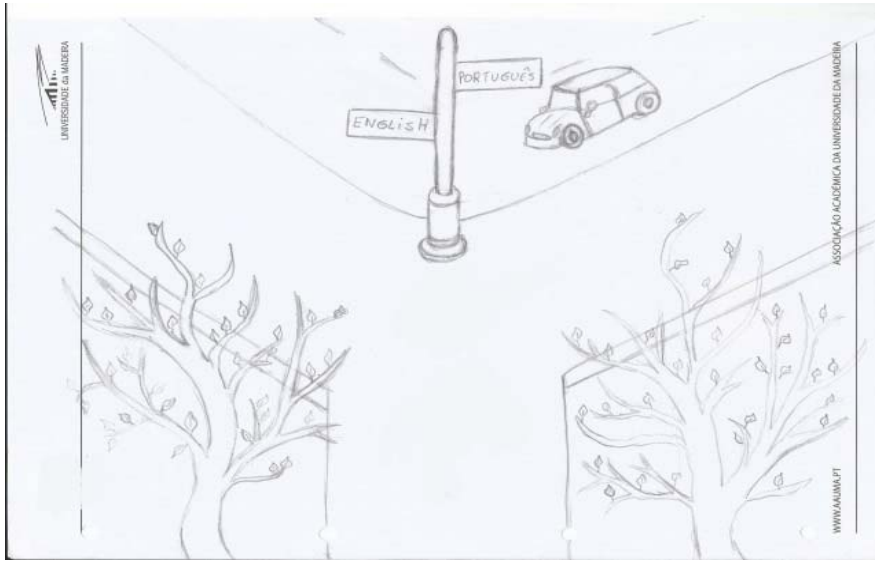


Figure 41– The first decision of the player is to choose the language represented here through flags of both countries

The first seconds of the game are important not only as it gives us a sneak peep of the game appearance but also because in those few seconds the players make an important decision, continue to play or close the game. We believe from our own experiences that players normally close their games for three main reasons: it is boring, has shocking graphics that hurt our eyes or the most important, they do not understand it. When someone talks to you in the same language as you and you do not understand the words, it's like they are speaking some foreign language. In this situation two things come to mind: ask the other person to repeat what they just said or forget it and move on. In games if you do not understand them, you lose all interest and close the game.

Normally games are made in English, as it is a universal language, but for our game, both Portuguese and English were used. Portuguese because this

project has the purpose of being available in emergency rooms in Madeira, an archipelago whose mother language is Portuguese and English (as it is a universal language) because Portuguese children are not the only children who feel anxiety and stress in the emergency room. (see Figure 41)

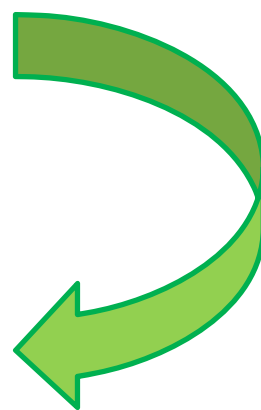
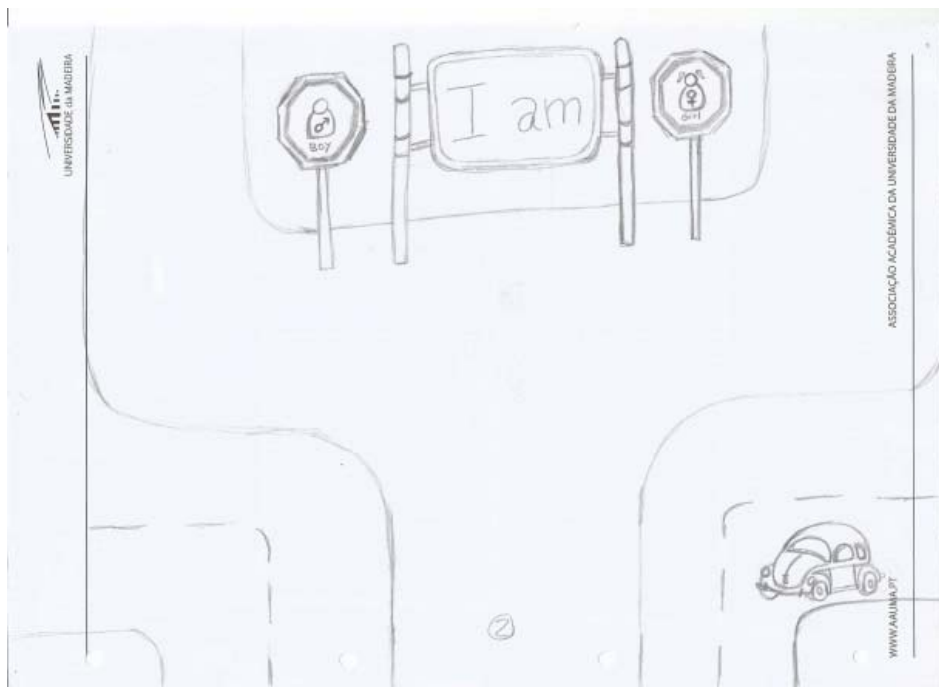


Figure 42 – The genre section where the buttons with the genre sign are indicated to better understand the purpose of the arrows

The selection of the language was not the only reason for creating a menu; the main purpose was the anxiety test. A simple test based on the research mentioned before (Assessing Children’s Anxiety Using the Modified Short State-Trait Anxiety Inventory and Talking Mats – see section 2.1.1, page 13) where four expressions are given to children to symbolize the way they feel, but for that to happen, someone else needs to be present to give the expressions to the child and say their meaning. The game consists on having someone; games for just one person are not considered strangers, to first select the genre to have the test anxiety more directed. (see Figure 42 and Figure 43)



Figure 43 – The anxiety test where three button are showed for Yes/No/Maybe answers

As the anxiety test is for statistic purposes only, can we conclude that this game can really provide relaxation to the child? That is why the anxiety test is given before (menu) and after (end) the level. But there is a lot more statistic data we can withdraw from this test, for instance, the age of the child. Seeing that this game was designed for children from 0 to 17 years old (see Figure 44), despite showing words in the menu, it does not mean that the child needs to read them all: for every word available there is always a corresponding image that represents the word and sound. In the end, this game aims to have a more visual aspect than reading.



Figure 44 – Having every time the plus sign is touch a number is increased as a candle is inserted in the cake

With different sections of selection, a course was created to unite those sections with specific time transition so that the child does not miss anything, starting in the tunnel and finishing by entering the hospital, with the time in seconds (reducing or even eliminating risk 2 and 7), having both times in the Portuguese version (see Appendix III). To give a preview of how to move thought the maze, the previous buttons were altered: they are not physical buttons, so the sensation of pressing them was made through sound and the illusion of the button being pressed. (see Figure 45)

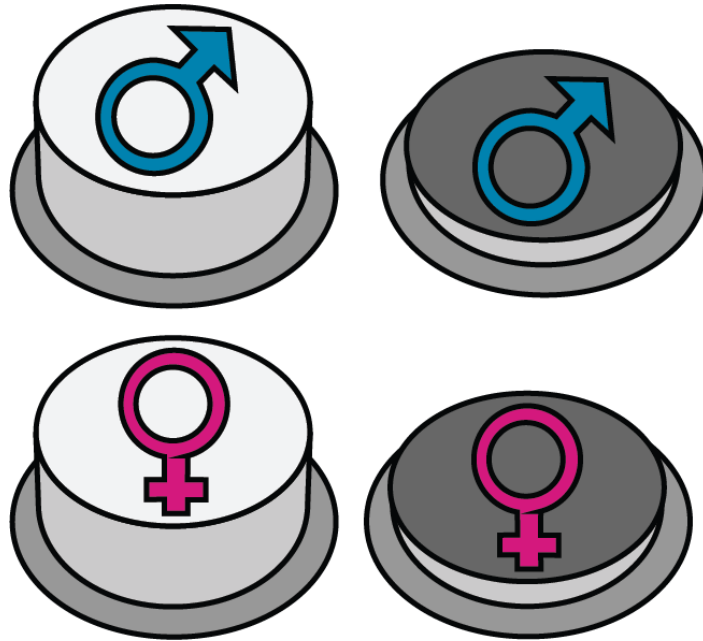


Figure 45- In the genre selection, after touch the male or female button, an illusion of pressed is showed

- **Story**

“Once Upon a Time”, words that remind us of fairy tale stories, the beginning of an adventure or an exciting story that makes us want to be just like the main character of the story. [106] That is what a game provides, to be a character of the story. As it happens in books or movies, the story needs to capture the child’s attention; to give a purpose so that when the story ends the child will know what to do.

This game story was a challenge, but with time and patience a story was established by having a sequence of images (with a total duration of 40 seconds (reducing or even eliminating risk 2)) that shows that the doctor lost his seven instruments/equipment needing help in retrieving them and the nurse telling that the instruments/equipment are in safes but the keys are missing.

As a way to maintain the same course, an extra challenge is given where after finding the 7 instruments/equipment the player needs to find the exit.

- **Level**

Play time is a favorite time for children, it does not matter what the game is, just that they are having fun, an important element for the success of the game. The interaction also is essential to provide a reduction or elimination in stress and anxiety.

Having the initial knowledge of the story, the player has to find the keys and safes, keeping in mind that a specific key will open a specific safe. As there are seven items, a section in the upper part of the level was created to help and remember the players (see Figure 46).



Figure 46 - With seven keys and instruments to find, a box was created to inform the number of instruments found, accessible to them by touch (see Figure 48). Seven holders were created to place the missing keys that when found appear with the designated color. And a book was created as way to help how to play when touch (see Figure 47)



Figure 47 – Four points are showed demonstrating that the instruments are in safes and to open them a key is needed. Each key is associated to positive expressions

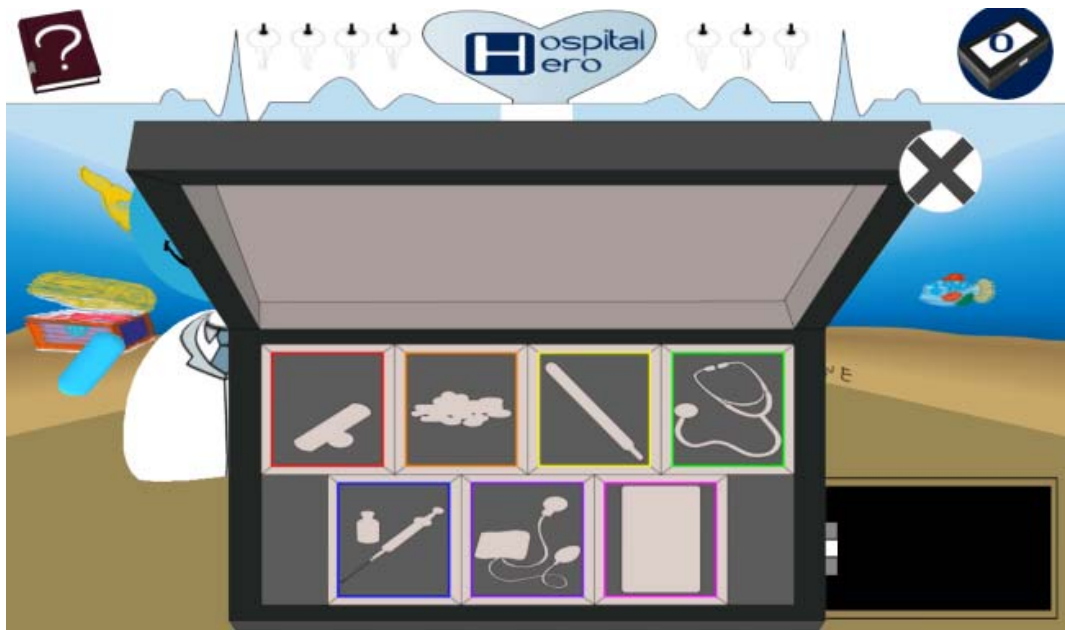


Figure 48 – The box at the beginning and the end of the level

Having the player move through the maze, step by step, it took more than 15 minutes (see section 3.1.2., R1, page 34). Three solutions were thought in a way that doesn't take away the player's freedom (see Figure 49, Figure 51 and Figure 52)

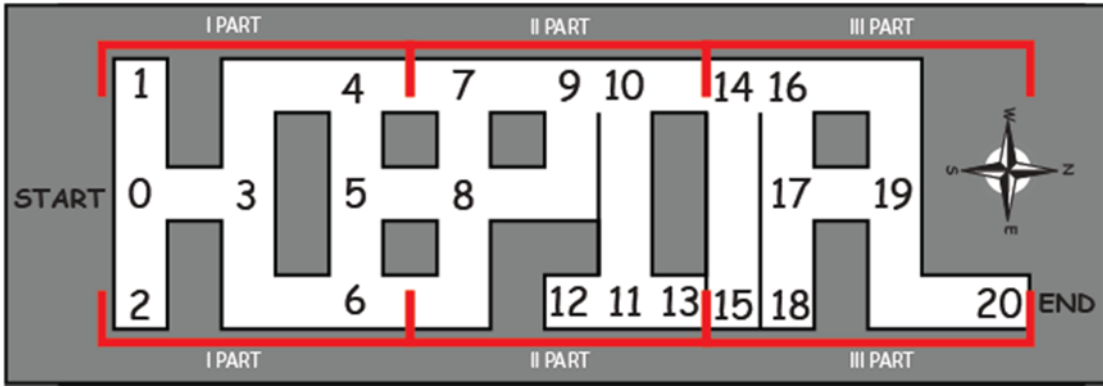


Figure 49- Several points in the maze were created only stopping where a decision on direction was required, having each point an orientation, starting the level in 0N and ending in 20N, having different time stamps (see Figure 50). As a way to present some challenge in the level, the maze was separated into three parts (7 points each).

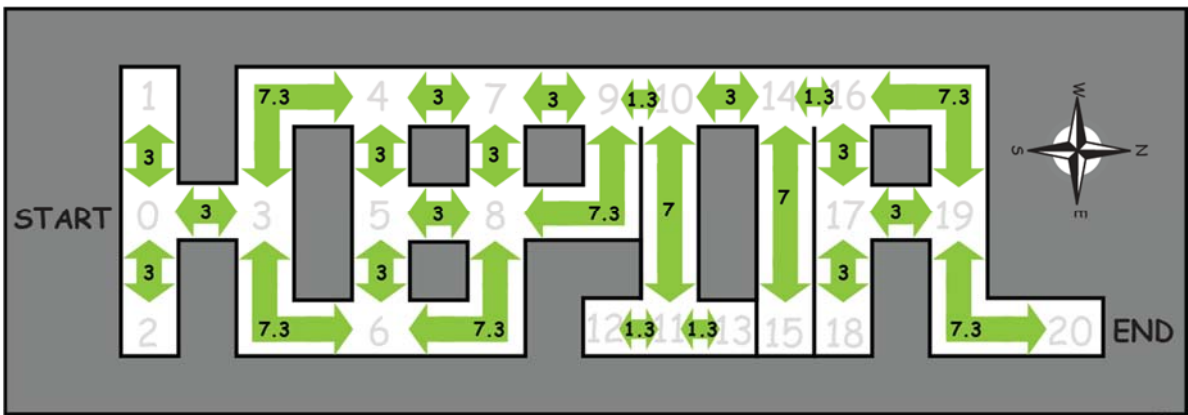


Figure 50 - The time in second of the transition from one point to another without rotations, having 90 degrees rotation 1.3 seconds and 180 degrees 3 seconds (reducing or even eliminating risk 2).

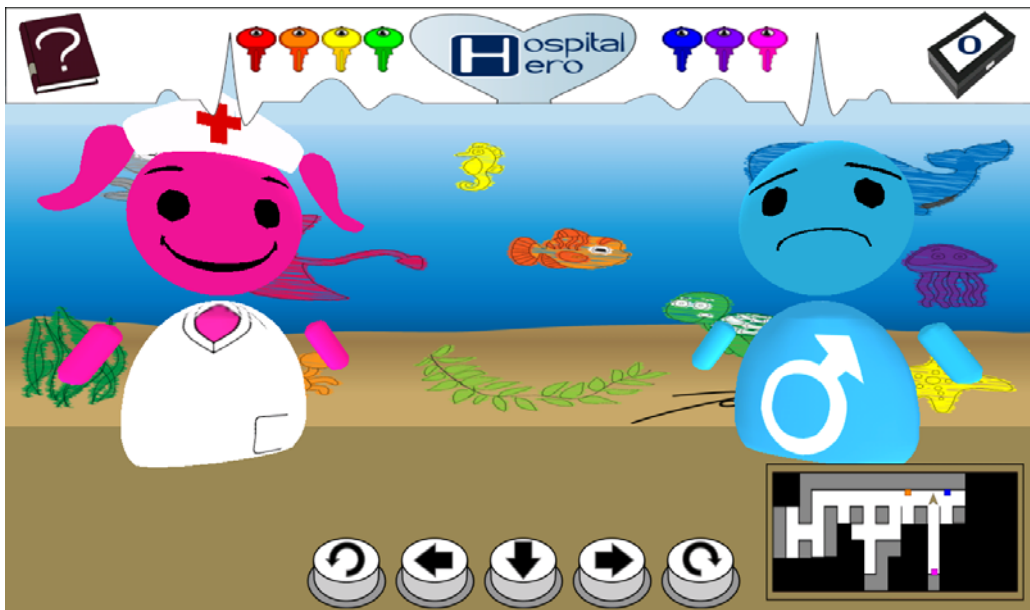


Figure 51- To facilitate the children navigation through the maze, only the arrows possible to make that happen would appear. In this particular case, every arrow was a possibility except going forward (eliminating risk 8)

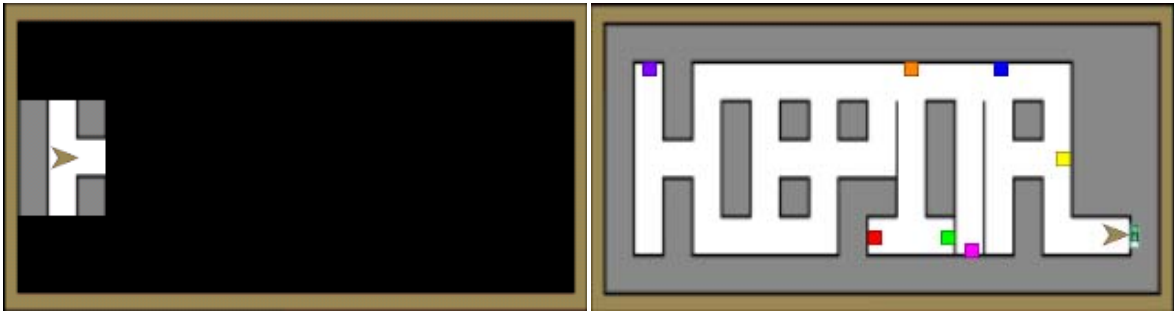


Figure 52- Having a map location revealed as it passes, avoiding being lost (reducing or even eliminating risk 1), plus having record of the passing of the color safes.

Having four expressions seemed to be misperception for children (without the audio backup), so we reduced to only two expressions, one positive and one negative: happy and sad are the most common expressions in the world (reducing or even eliminating risk 3).

The player in order to win the level has to interact with the positive expression but to interact with them he/she need to find them. Each point has eight possible positions and one type of expression per orientation (see Figure 53).

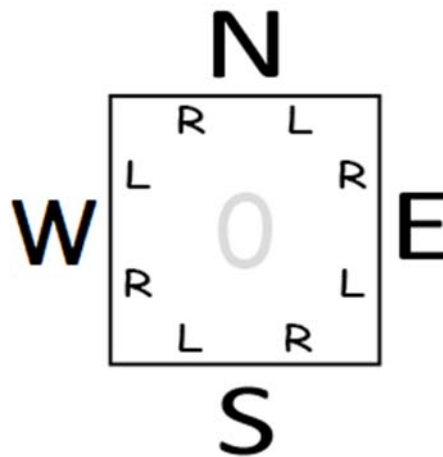


Figure 53 - Each point is composed by an orientation, and each orientation has a left (L) and right side (R))

It required some challenge to maintain the flow balanced (see section 2.1.2, Flow: losing the appearance of time, page 21 and section 2.2.1, Flow, page 26), as the number of each type of expression in each point is measured by the location of the points, and each expression is randomly chosen by genre (female or male), character (patient or staff), orientation (N, S, E and W) and side (Left and Right) (see Figure 54).

- I Part – 100% positive with 25% negative (points 0 - 6)
- II Part – 50% positive with 50% negative (points 7 - 13)
- III Part – 25% positive with 100% positive (points 14 - 20)

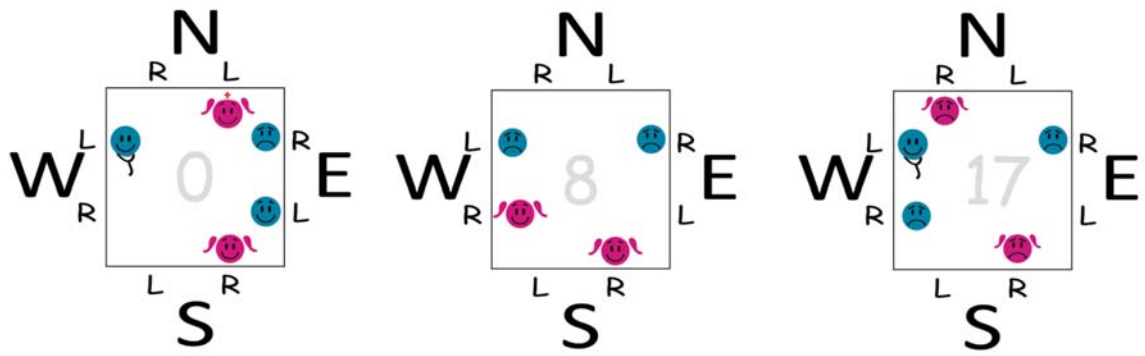


Figure 54- In point 0 we have four positive expressions against one, in point 8 it's two for two, while in point 17 it's four negative and one positive.

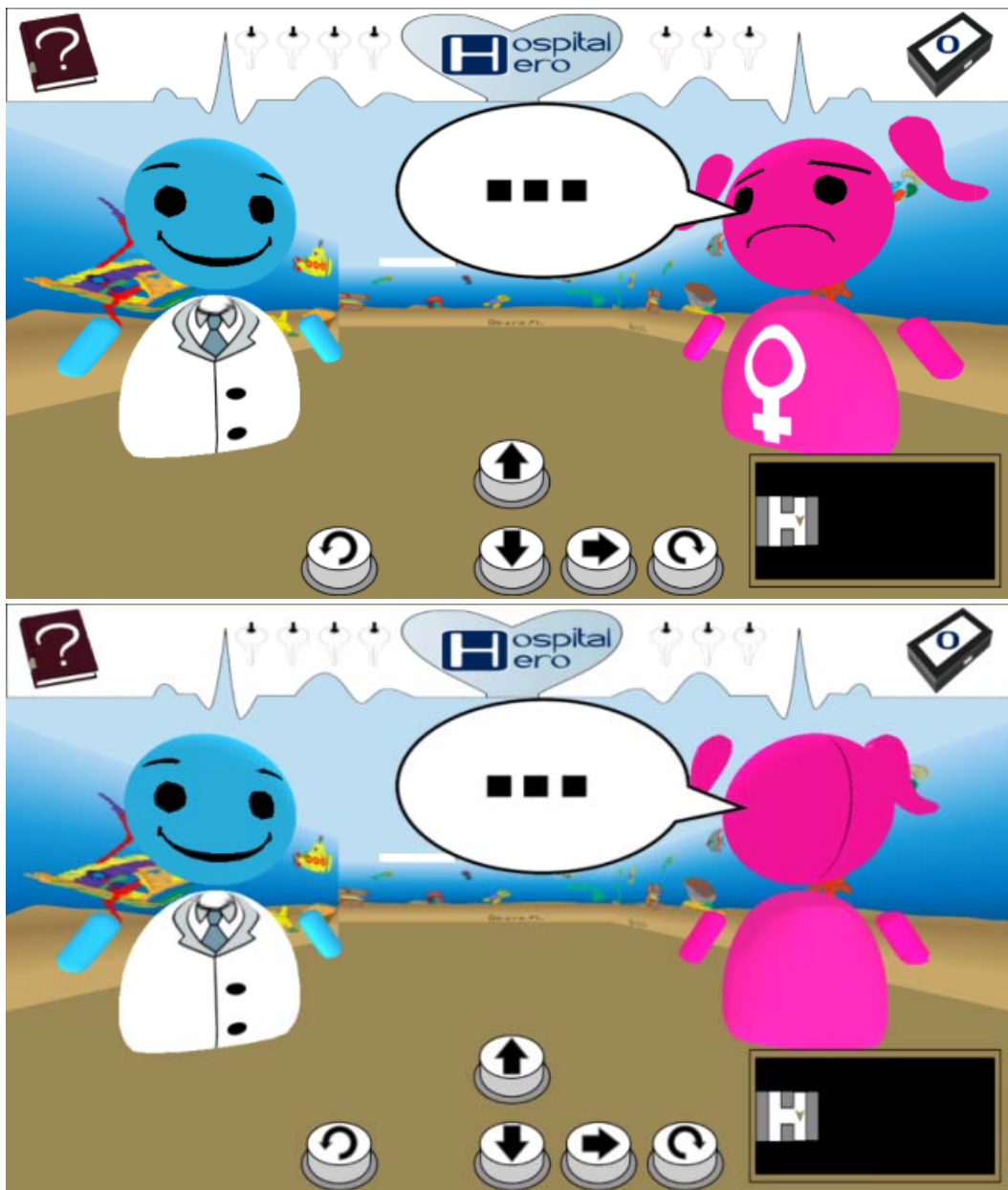


Figure 55 - The negative expressions do not give you a hint and turn their back on you

The two types of expression (positive and negative) were created with the intention of having somehow, a good and a bad guy. Each character has a different interaction response, whereas the negative character always gives the same response (see Figure 55), the same does not apply to the positive character as it has four different types of response:

1. Hint about the location of the key where by order (red, orange, yellow, green, blue, purple and pink) the player is directed to the right place, by means of comparing the key location (point plus orientation plus side) to the player's own location (point plus orientation). If the key is in the same point as the player, the orientations are compared indicating the faster way, but if the key is not in the same point as the player, what is compared is the point. (see Figure 56)

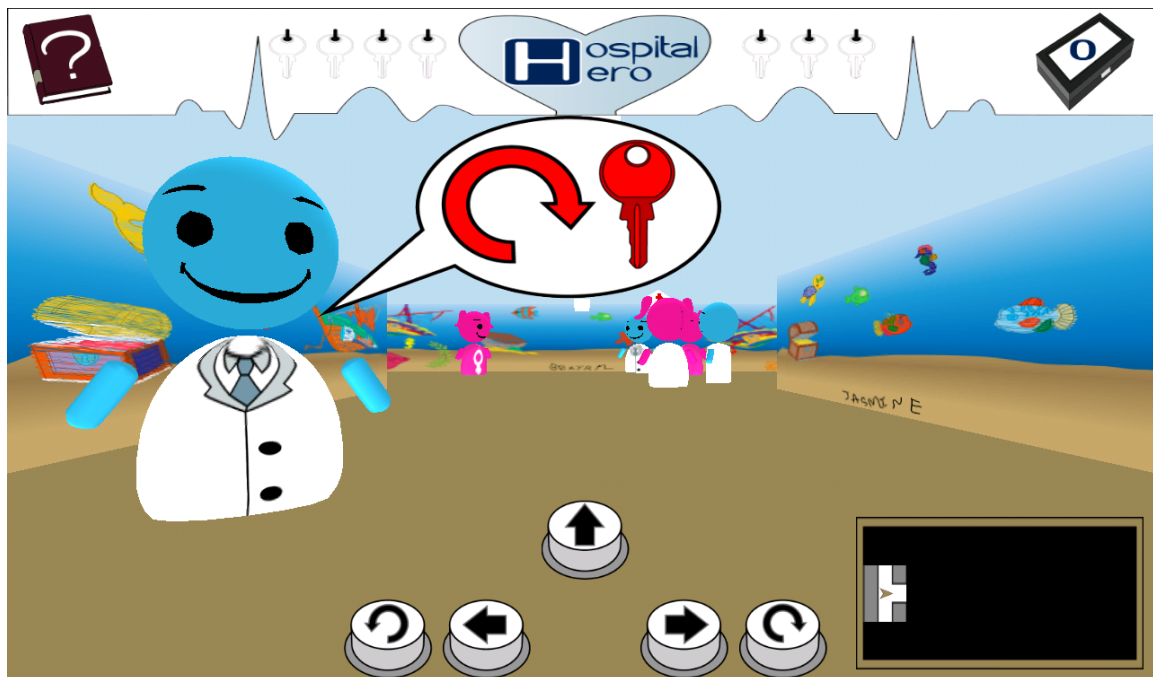


Figure 56- In this case being in the point 0North and receiving a hint to rotate right suggest that the red key is on 0East or 0South.

2. Receiving the key happens when the key location is the same as the character interacted.(see Figure 57)

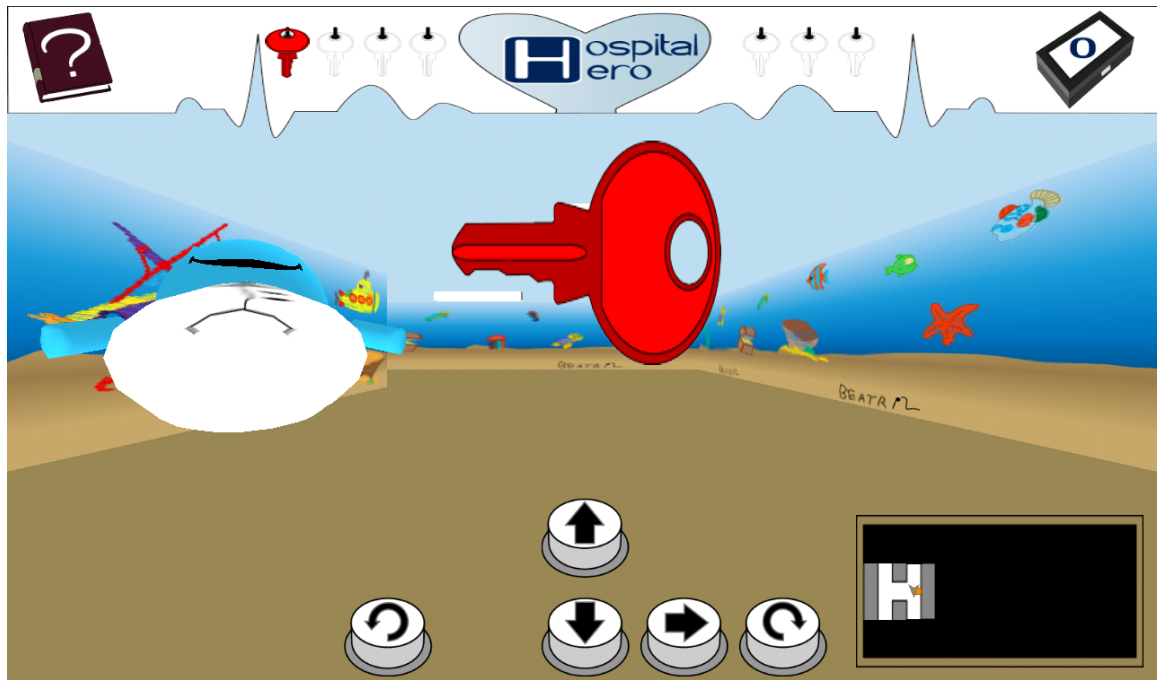


Figure 57– As the key is show to the player, the character does a backflip

3. Hint about the location of the safe is the same as the hint of the key with the exception of not having a side (right or left). This hint only happens when he/she has already found a key, whereas the hint is for the safe of that color (see Figure 58)

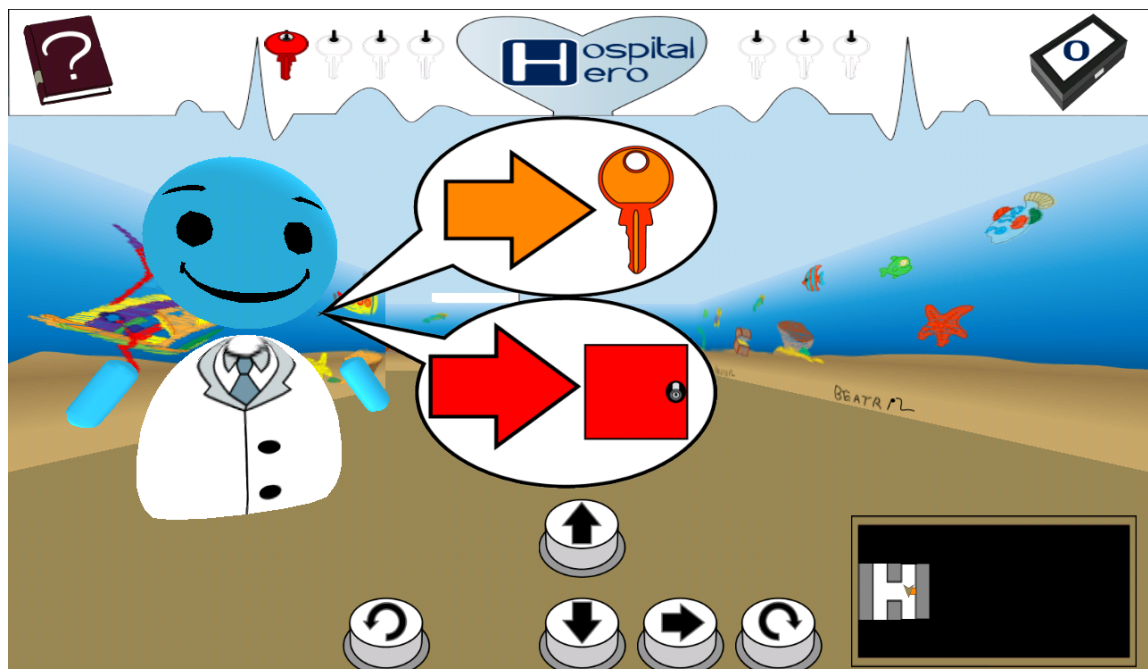


Figure 58 - To have the options on the table, the hint of the key and safe can be showed at the same time, and the safe can also be found through the map

4. Hint about the location of the exits the same as the hint of the key just comparing it to the exit location 20N. (see Figure 59)

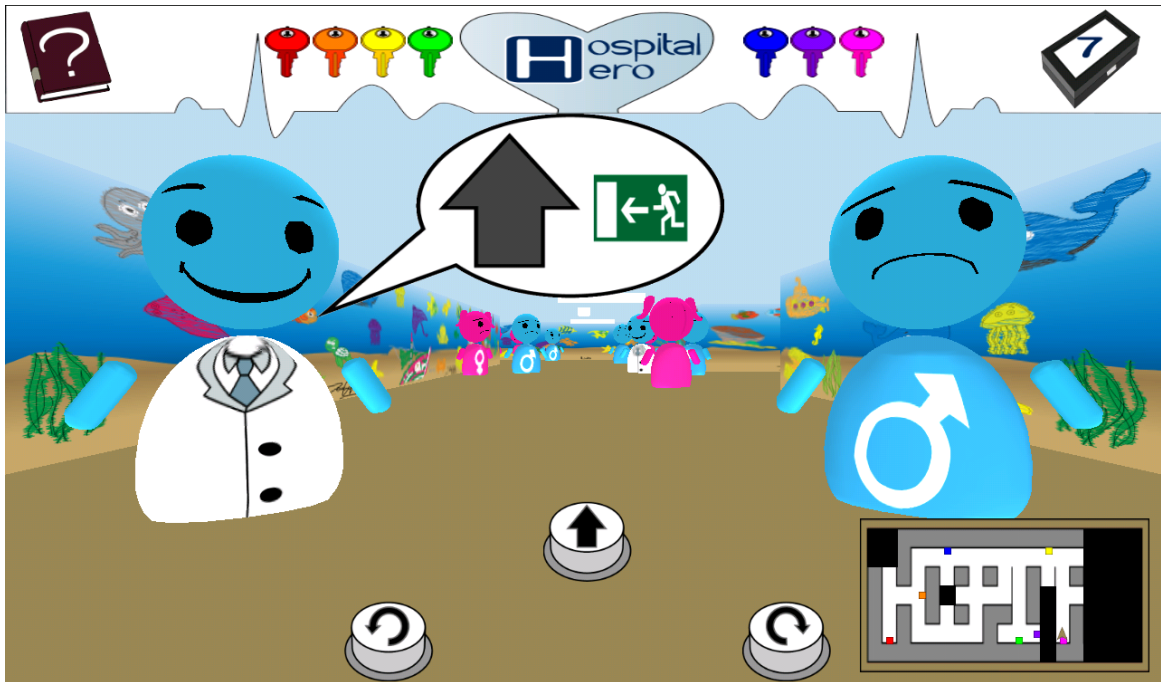


Figure 59 - The exit can also be found through the map

With the purpose of playing more than one time, each key and safe were randomly positioned.

The keys go to the positive characters already positioned (through points 0 to 20) thus making it possible for one character to have more than one key.

The safe (with the designated instrument inside) is more restricted, making it necessary to attach a wall to it, eliminating point 0, 8 and 20, where the safes are randomly positioned through one orientation per point (1W, 2E, 3N, 4W, 5S, 6E, 7W, 9W, 10W, 11E, 12S, 13N, 14W, 15E, 16W, 17S, 18E and 19N), not having more than one safe per point.

Not every sickness can be diagnosed by means of observation with the eyes alone. Sometimes equipment is required to better evaluate the situation or a wound needs dressing or medicine to make it heal faster. To enlighten a child's understanding of what the emergency room is all about, a demonstration of the instrument retrieved is showed when the child recovers the corresponding key to that safe (see Figure 60). If that does not happen, a warning that the key is missing is showed (see Figure 61).

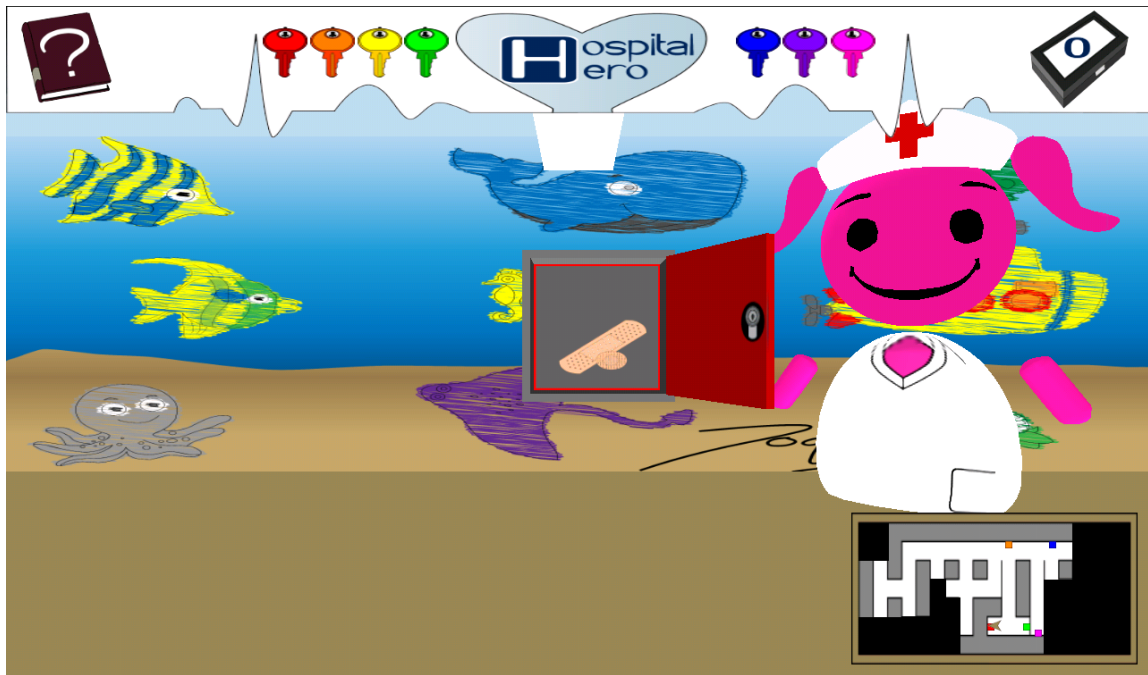


Figure 60- Opening the red safe, in this point the arrows disappear for the preparation of a small slice show

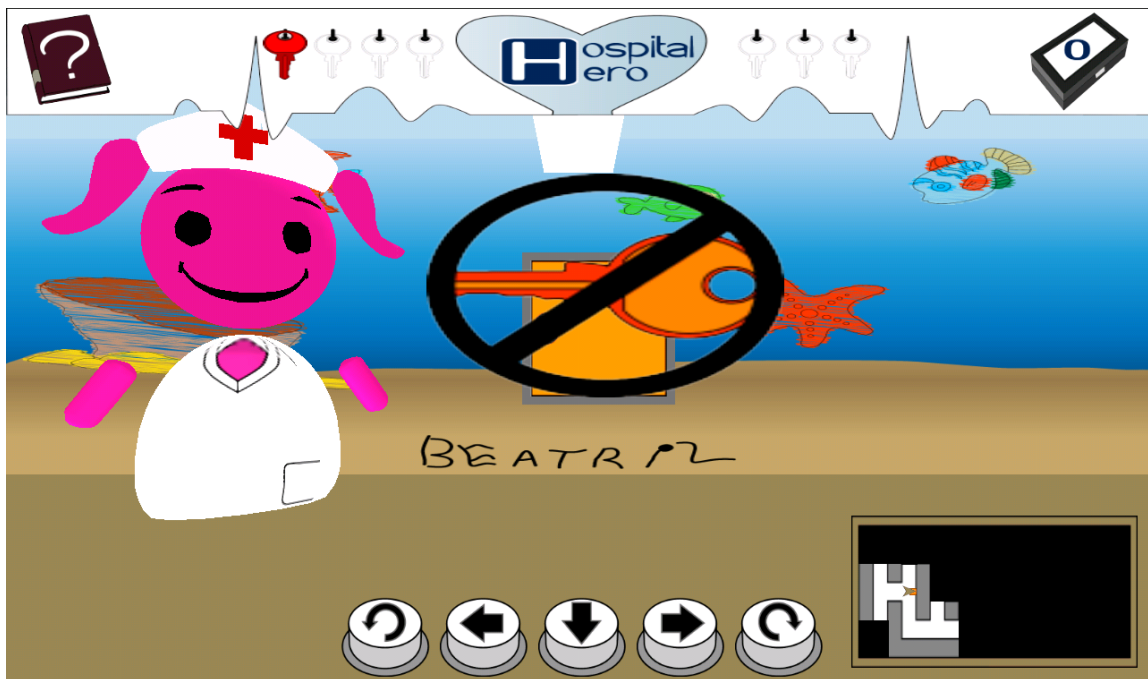


Figure 61- A warning is shown indicating that the corresponding key color is missing

As the game was made through moving, to finish the game the player needs to ask the characters to find the exit of the maze.

- End

The level may be over, but the game itself is not. As we reach the end, a familiar test appears, with the difference of size where the credits (see Figure 62) are showed with a Portuguese children song (“Todos os Patinhos”) singed by the female child (who volunteer) as the four questions are answered.



Figure 62- The credits are showed followed by a children' song

Having tried to solve some of the previous risks, what usually happens is that others appear:

1. Not understanding how to play the game
2. Not having the enough interaction with the positive expressions
3. Not having enough time to observe the demonstrations
4. Not distinguishing the arrows
5. Not understanding the game

With the game completed and tried on to discover as many problems as possible, it is time to pass the torch to fresher eyes. Although the advice is appreciated, it does not necessary mean that it has to be followed.

5. Testing Begin

The moment of truth is here as the game is set free. Behind us are the achievements of endless challenges, and now the game must be experienced by unfamiliar individuals and win their hearts or be knockout, but for every time we fall, we will get up.

We started with the testing phase: analyzing the game for malfunctions and the knowledge it will provided the player with. We then proceeded to testing the game in a stressful location to prove our hypothesis that the interaction with positive expressions in a short time reduced the levels of stress and anxiety in children. For every game played a record of the touches was made (see Appendix IV) and a questionnaire had to be filled. For each version created an installation was required (see Appendix V).

5.1. Usability Testing

Our concentration is due to our eyesight and retention skills, and depending in our ability to focus and retain information, we require either a quiet room to work or are able to work well with distractions. [107]

Despite which one we use, there comes a time when we suffer from eye fatigue due to forcing the eye to work harder. [108]

The process of creating a game is very demanding on our eyes causing even vision loss, a limitation of visual capability resulting from overseeing and avoiding important details. Another pair of eyes was required then in order to test the game, whereas the first outside view is for usability purposes only, the main reason underneath it was to understand how the game works.

- **University students plus children's**

There are two types of anticipation: for the one who already knows every detail of the game and for the one who is playing it for the first time. Each one will have different knowledge of the game which provides different ways to how to play as they encounter unseen problems. [109]

When everything needs to be perfect, that is usually when disaster happens, from the thought that everything works perfectly to questioning oneself for missing that small detail. Students of the University of Madeira plus two children (who volunteered for the voices) were the first subjects to test our game.

The process

Starting from a point that our mind was blank towards this game to having some knowledge of it in the end, a questionnaire was made to ascertain that the right image got through (see Appendix VI). Having two different types of users (university students and children) meant having two different processes. On the one hand, the university students can fill the questionnaires on their own but on the other hand, we needed permission from the parents before actually talking to their child as they would eventually need help to fill it up. In both situations, the anxiety test needed to be filled before the game.

As they started playing the game, no help was provide except for the game itself, as we had queries about some actions. At the end of the game, our help was asked again to fill out the rest of the questionnaire and thanks were provided to the players. The game was tested in a neutral place, Madeira Interactive Technologies Institute (M-ITI) (see Figure 63).



Figure 63 – The space used to test the game [110]

The results

The only way to know our knowledge is by testing it, and that was the main reason behind the questionnaire, where with only six question, we can assess the player knowledge by analyzing their wrong answers, having half of the players understanding the game perfectly (see Figure 64).

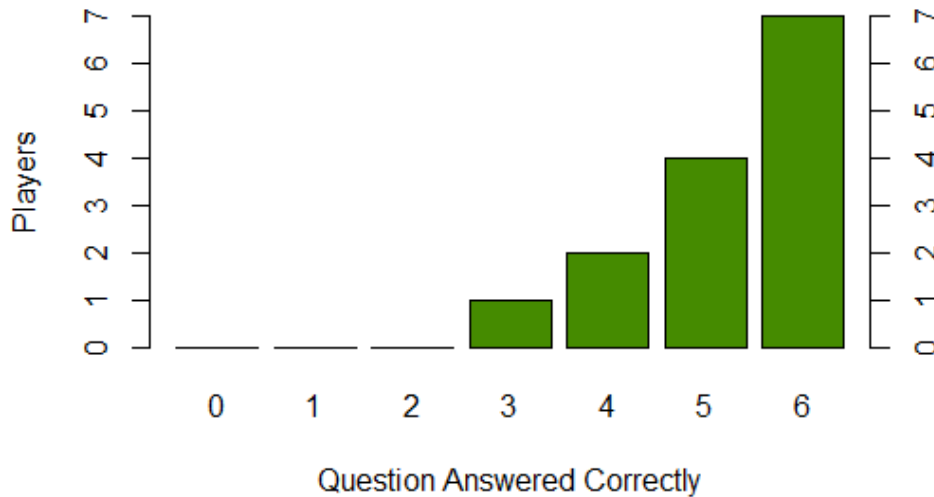


Figure 64 – Players comprehension of the game

Whereas through the questionnaire we find out about the knowledge of each player, through the file created after each game with every touch of the players, we can analyze the players thinking through the game.

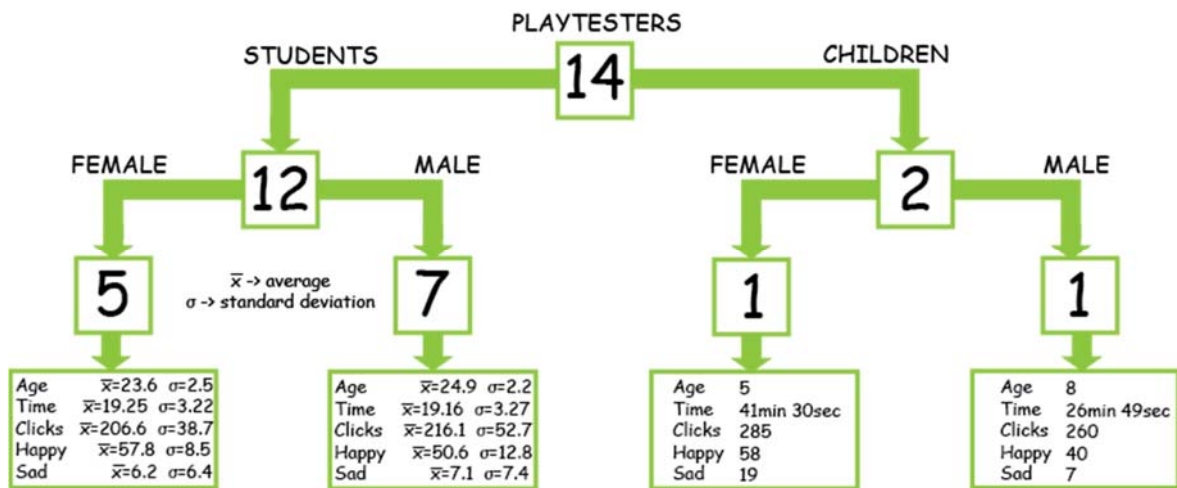


Figure 65 – Having 14 minutes 5 sec and 13 minutes 48 sec the fastest time for boy and girl

There results were grouped (see Figure 65) to obtain a common ground. The female students had an average of playing 19 minutes and 25 sec with a deviation of 3 minutes and 22 seconds and the male students were faster by 9 seconds with a deviation of 3 minutes 27 seconds, while the children values were higher than 25 minutes.

As the stress and anxiety statics were only just being used for usability purpose, and though was not necessary, we examined that there was not any increase of stress and anxiety values.

With the analyze of the firsts testers, some of the risk did not appear, eliminating them (risk 3, 4 and 5) but others appeared

1. Not understanding how to play the game

2. Not having the enough interaction with the positive expressions
3. Waiting too long for the animation of moving from point to point
4. Having six arrows seemed confusing
5. Loosing time going back and forward

With the alterations we reviewing on the next sub-section, we can hopefully reduce or even eliminate the risks above mentioned of even appearing.

Alterations

Time is a variation that we cannot control as seconds become minutes, minutes become hours, so we need to make the most of the time we have. In an emergency room, as with every stressful situation, the opposite often happens: seconds seem like hours, thus being a factor to increase the stress and anxiety.

Time was definitely a priority for this game but being the interacting with expressions even more, as we had to work with having an uncertain amount of time until the child is called to be treated and as per previous results, more than 25 minutes was required for children to finish the game. This was necessary in order to ensure enough interaction time to provide a reduction in the stress and anxiety. Through observation of the children' way to play, the solutions was unmistakable. (see Figure 66 and Figure 67)

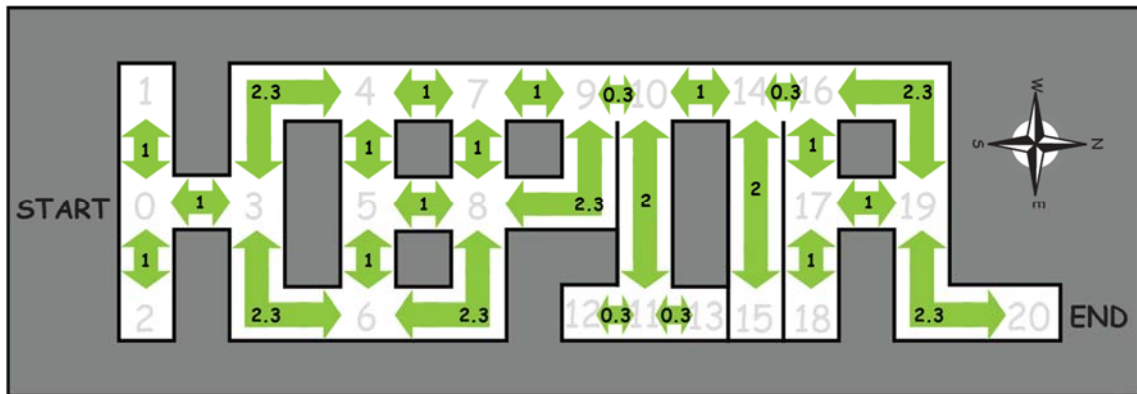


Figure 66 – A decrease of time (in seconds) of the transition from one point to another without rotations, having 90 degrees rotation 0.3 seconds and 180 degrees 1 second (reducing or even eliminating risk 3) Also decreasing the time of explaining the story of the game to 30 seconds.

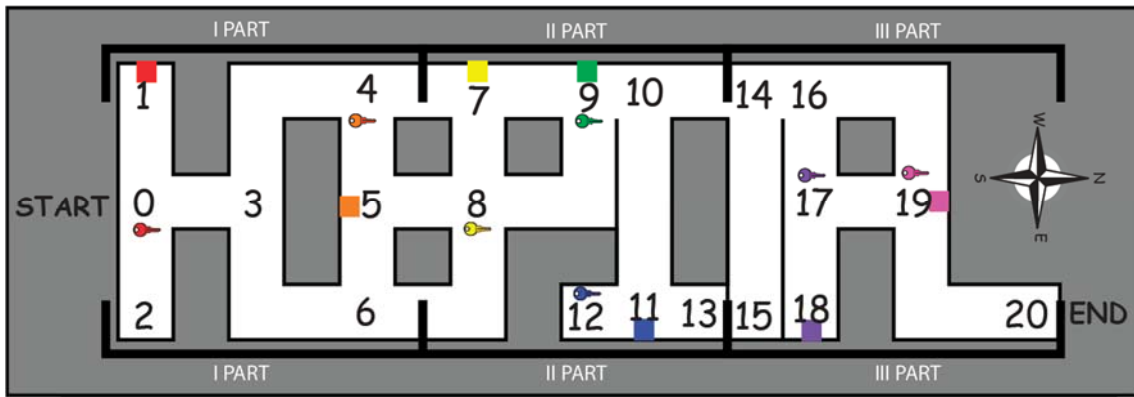


Figure 67 –Restricting each color key to a close by perimeter of his safe and for a more homogeneous map, the safes were distributed through the three parts of the map, having the point 1W, 2E, 3N, 4W, 5S and 6E possible positions for the red and orange, 7W, 9W, 10W, 11E, 12S and 13N for the yellow, green and blue, 14W, 15E, 16W, 17S, 18E and 19N for the purple and pink (reducing risk 5).

We live by our choices and for each problem a specific number of choices will come to us, although having too many choices tends to complicate our decision. This also applies to the smaller choices in this game; having six arrows to choose from, not only took longer for children to select it but to search for the arrow the hint provided. (see Figure 68)

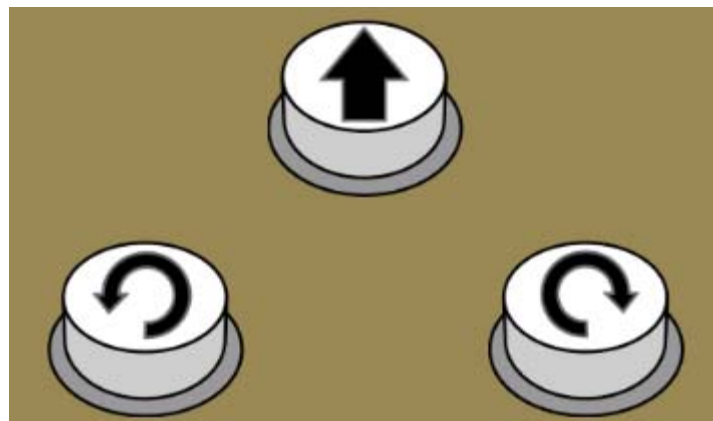


Figure 68 - The six arrows are reviewed with the point of leaving the more important, remaining three arrows (to move forward, to rotate to the left and right) (eliminating risk 4)

Using a smaller number of arrows to facilitate the decision and observation of the child, created a new problem as it would complicate the search for the key. (see Figure 69)

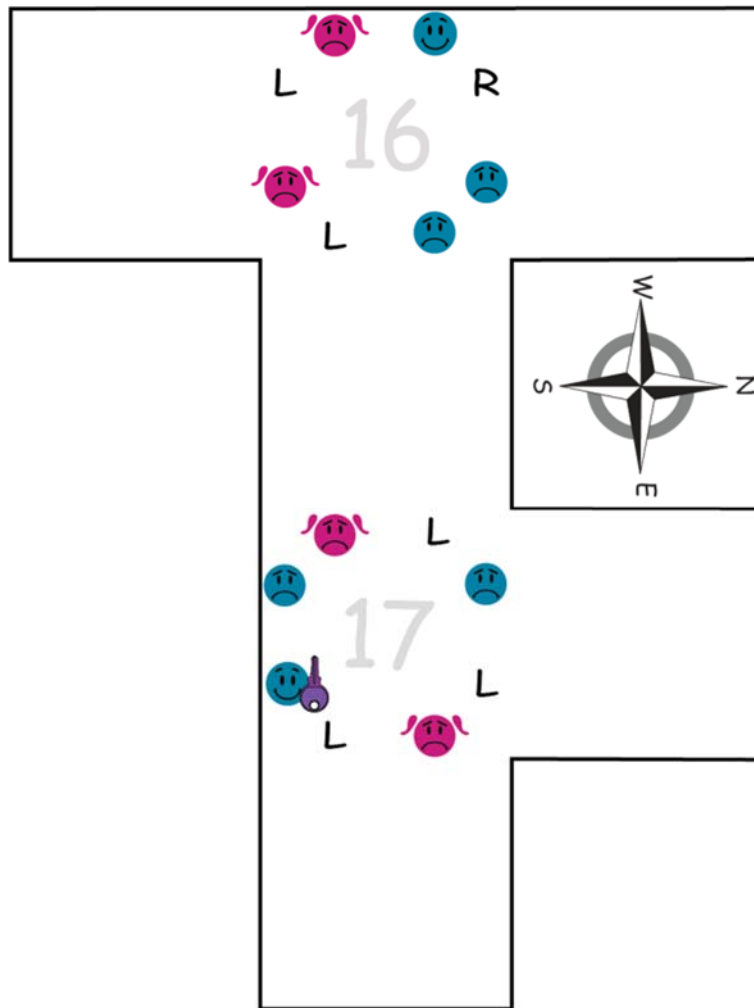


Figure 69 - In the three part of the map (points 14 to 20) there is only one positive character per point, not providing the enough information where the key is located. In this example the positive character is in the 16W and the key is on 17S, the hint only would say a rotation (reducing risk 2)

With this new problem, an opportunity for a bigger number of interacting appears, having in each orientation a positive character only varying the number of negative characters as a mean of distracting (for challenges purpose) (see Figure 70)

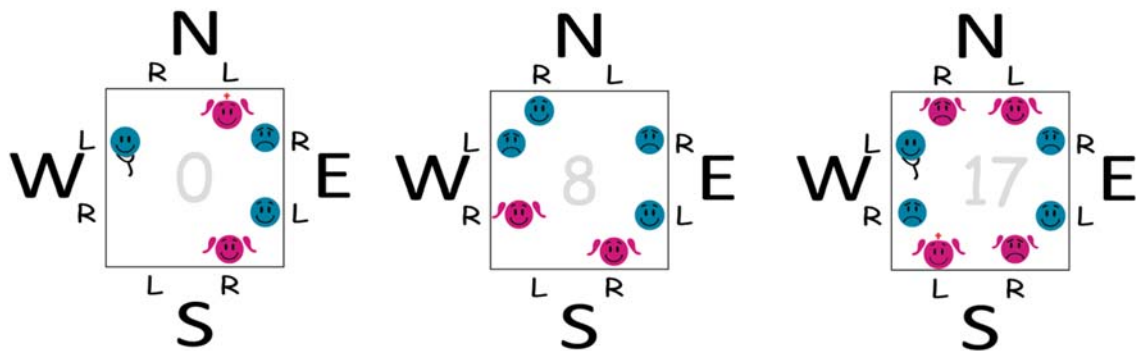


Figure 70 - As the player passes to a part of the map, the number of negative character doubles, having in part I (points 0 to 6) each point with one negative character, part II (points 7 to 13) with two and part III(points 14 to 20) with four.

With the help of university students not only functionality problems was solved, but improvements relatively to playing were made (see Figure 71, Figure 72 and Figure 73).



Figure 71 - For feedback information, the color of the keys when used turn grey, providing the information of already being used, like in this case, having found the red, yellow and blue key, already used the orange, green and purple only missing the pink key.

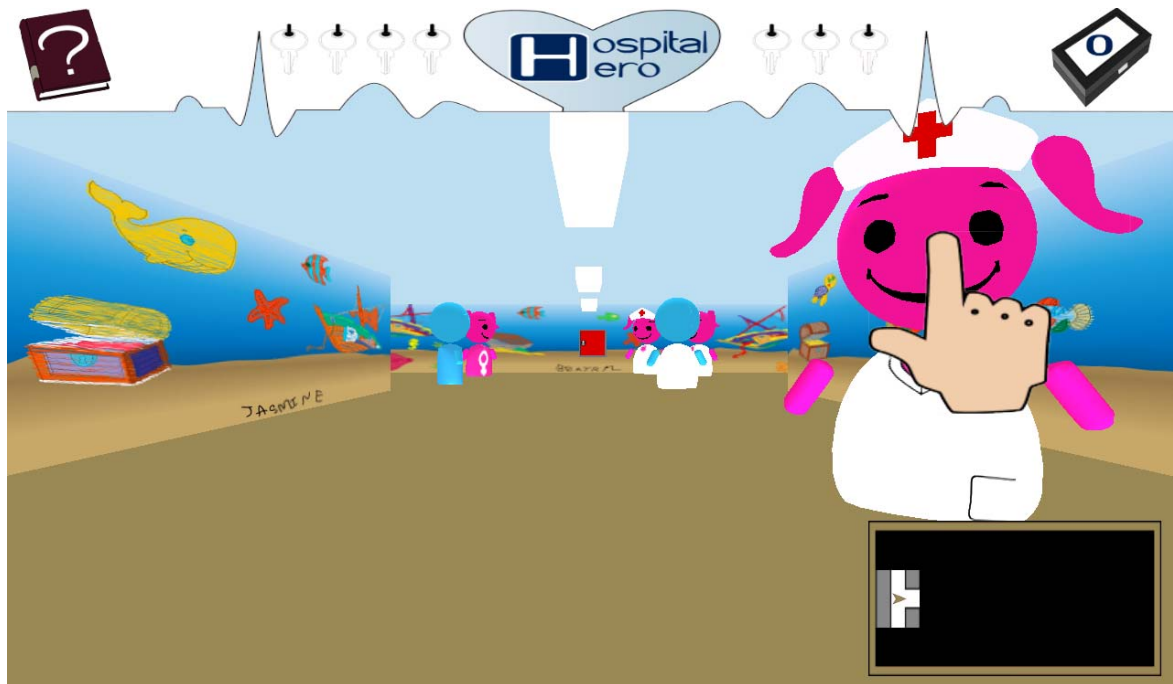


Figure 72 - To provide a clear understanding of how to play, a guideline was provided with the indication of a hand that the child had to touch, having this help until he/she finds the first key.

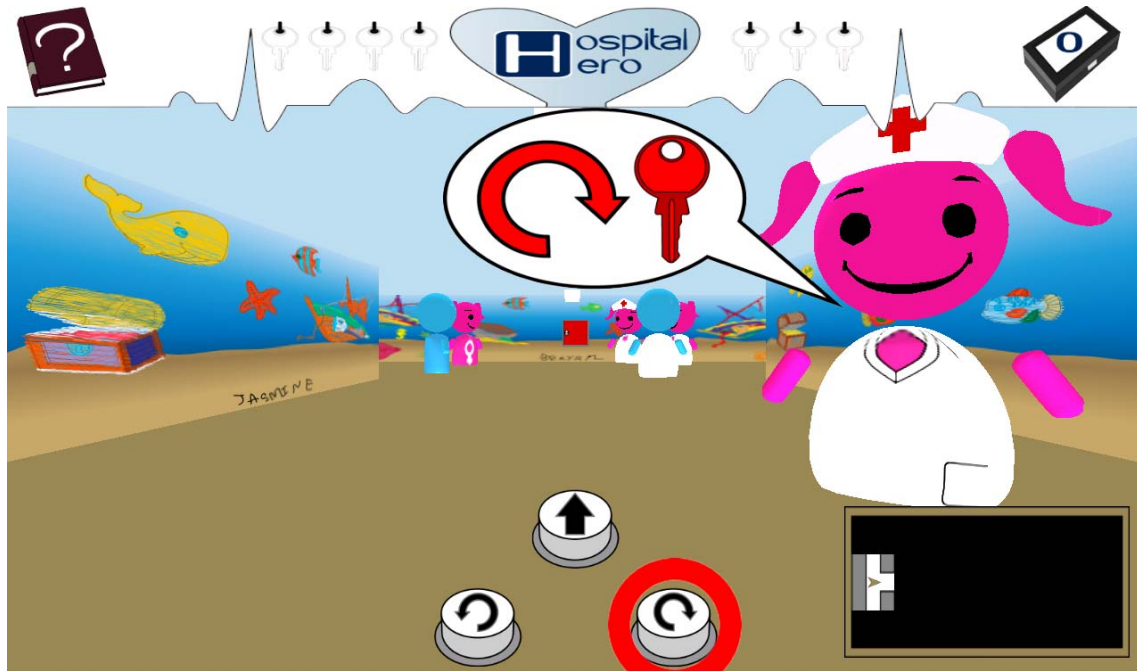


Figure 73 – To provide a clear understanding of how to play, a guideline was provided by indicating a halo for moving the corresponding button.

Having in the end reduced to some risks:

1. Not understanding how to play the game
2. Not having enough interaction with the positive expressions
3. Loosing time going back and forward

We learn from our mistakes, and the ones we make stay in our memory with the purpose of not repeating them again. And by correcting them the game comes closer and closer to its full potential. [111]

- **Children in a happy environment**

Having a good reaction of the players in the first usability test creates a higher expectation for the second one where questions about the knowledge of the game were removed and replaced by one new knowledge question: in each body part was that equipment used (see Figure 74).



Figure 74 – An example of a child setting of each instruments corresponding to each gender

We change for two purposes, to correct or to improve. Having to test them again was necessary to see if it's was a good or bad decision. We were strongly convinced that those changes were enough, but just to make sure a last usability test was made, where the users would be merely the target audience.

The process

Following the same process as the previous one, using only one type of player, the children in a happy environment (see Figure 75).



Figure 75 – The gardens of Santa Luzia [112]

We asked the parents' oral permission to allow their children to play the game and we had some questions made before and after the game. The questions were based on the anxiety test but we used it in a different approach (see Figure 76).

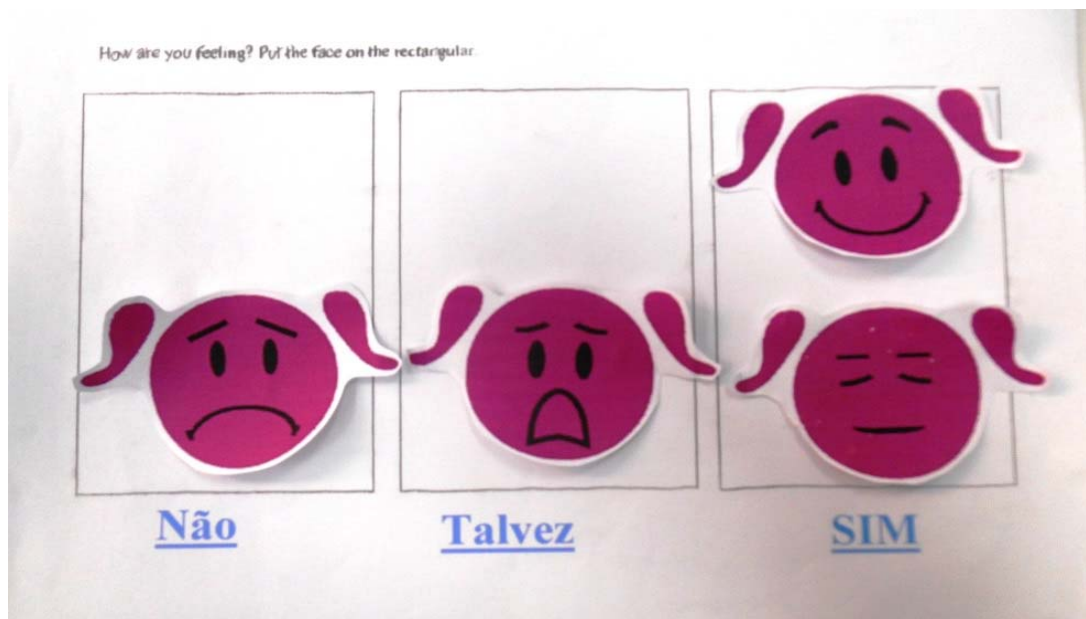


Figure 76 - Each character shows a specific emotion (happy, sad, scared and calm) and they were all given to the child one at a time to place them in the middle of the three possible square representing the three answers (no, maybe, yes), having a female and male version.

As per the previous usability test, the game was the only source of information used and at the end they had to fill in a questionnaire (see Appendix VII) with only one question but this time the answer was given

through visualization. This was the same approach applied in the anxiety test made in the beginning and end of the game.

Thanking them in the end for their time.

Results

The results were calculated just like before, but the time the child played was the reason for this usability test, the time and touches of the level alone were calculated also. (see Figure 77)

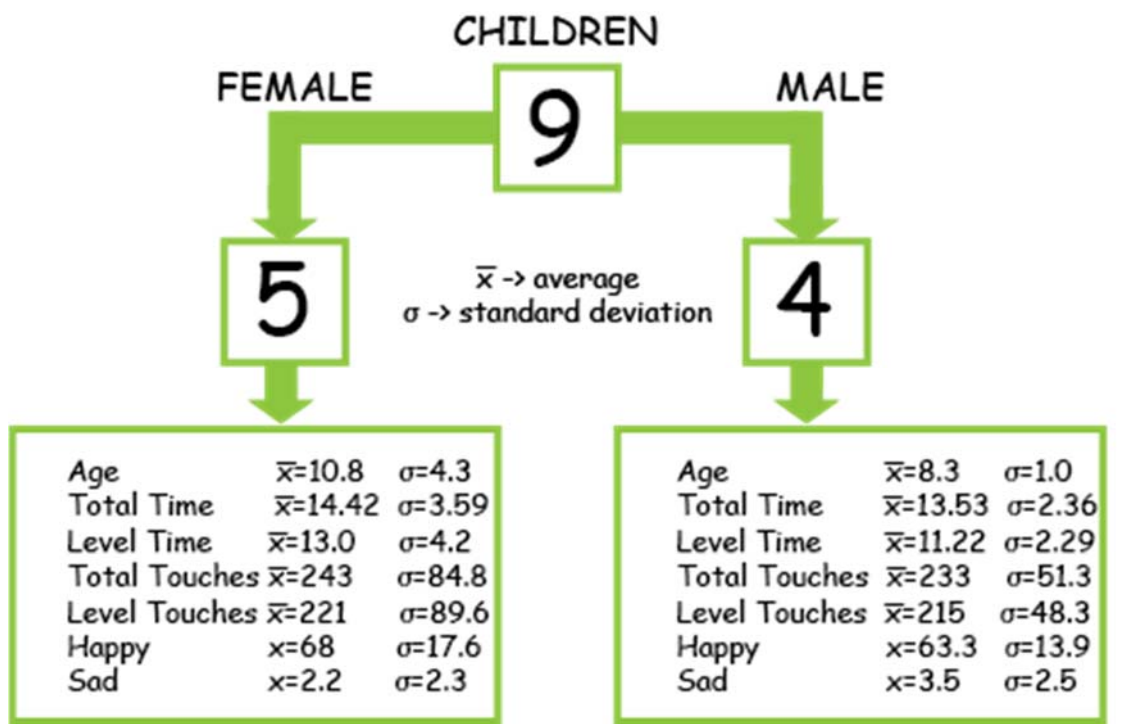


Figure 77 – The results separate by gender

The results were satisfying as in average both female and male child have times lower than 15 minutes. That didn't influence the previous results of the levels of stress and anxiety, not having an increase.

Has for the new knowledge test, all children responded correctly, having previous or receiving knowledge.

Having better results that the previous it did not create new risks only removed:

1. Not having enough interaction with the positive expressions
2. Loosing time going back and forward

Alterations

With the purpose of really testing if the interaction with positive character would improve the children levels of stress and anxiety, a new version of the game was created with the substitution of the positive and negative face by a face with no expression at all. Having two versions, the experimental condition (with expressions) and the control condition (without expressions) (see Figure 78).

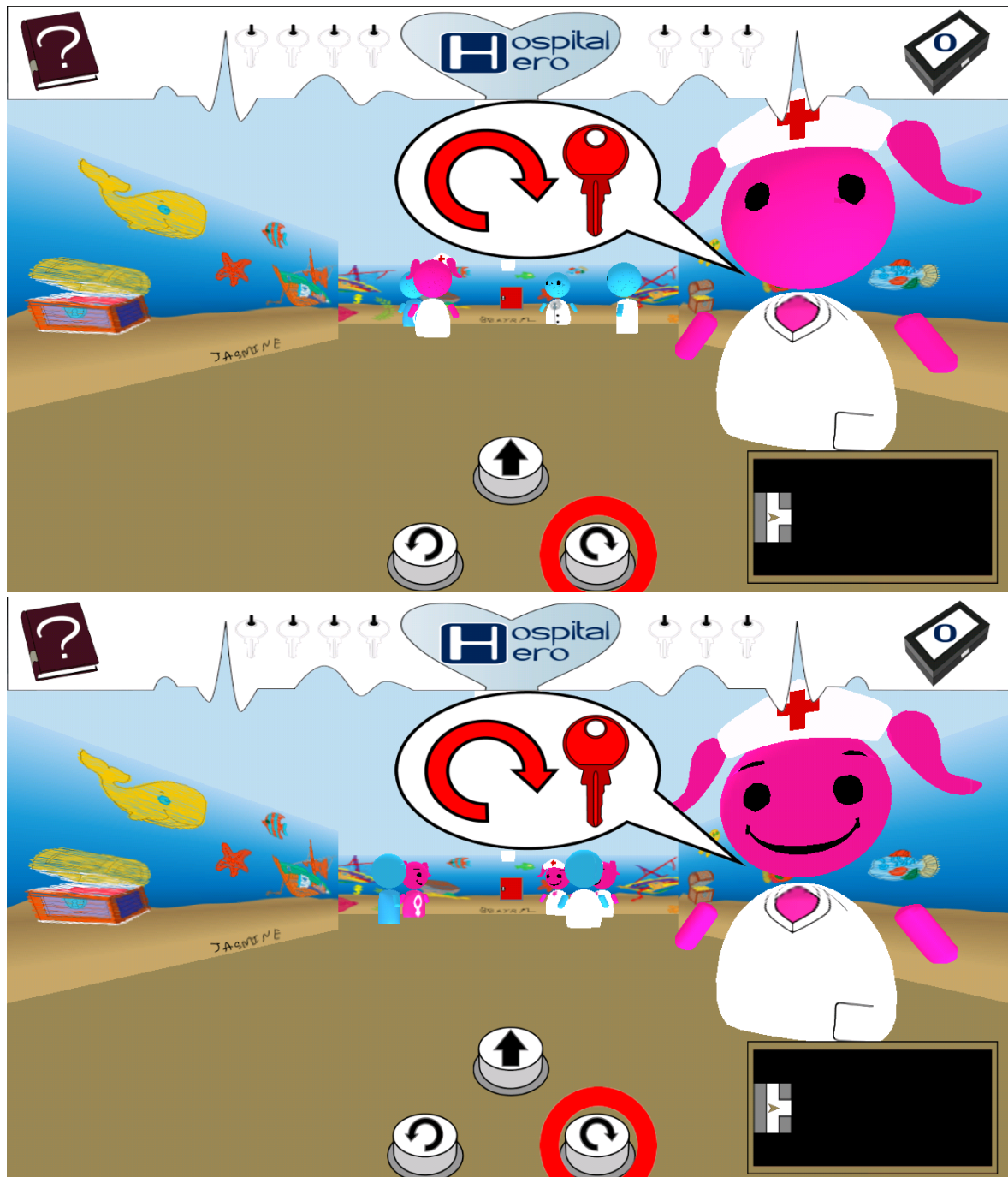


Figure 78 - The difference of the experimental condition and the control condition

With the maintenance of the four types of characters (doctor, nurse, girl and boy) but with only one face, the no expression, the numbers of characters required in one point was reduced, only having four per point, one in each orientation.

With this alterations and being the next step to test in the children emergency room new risks appeared:

1. Not having enough interaction with the positive expressions
2. Loosing time going back and forward
3. Not having Anxiety levels difference between the experimental and the control condition
4. The child being called in or having to leave while playing

5.2. Play testing

Two gestures can literally define this game, thumbs up or thumbs down, each one representing a positive and negative reaction of the children in the emergency room, where the child's state of mind affects his/her understanding of the game and way to play, being that the real and biggest test the Hospital Hero went through. [113]

While the approval of the child was necessary for personal confidence, the decrease of the levels of the stress and anxiety was even more necessary for the validation of this project.

Process

Time is an enemy, despite having a time played in the usability test below the 15 minutes mark, there was a concern that the game plus the questionnaire (see Appendix VIII) would not be done in the available time. So some changes were made, the mSTAI-mTMM in the questionnaire that has to be done by the child was changed to be filled by the observer, due to having already the possibility of the child to fill the mSTAI-mTMM in the game. And some elements of the questionnaire were removed (the Affair option and the instruments location in the body).

The children emergency room chosen was located in the Hospital Dr. Nélio Mendonça (see Figure 79) where permission was given to stay in the children E.R., and the children were chosen by the m-YPAS values (higher than 30) and after doing the triage (blue, green, yellow, orange and red, being the blue the less urgent). [114]



Figure 79 - Children Emergency Room

The play test lasted two weeks and the process started with the realization of the m-YPAS and the mSTAI-mTMM having after approached the parents of the child for permission by introducing oneself and explaining the project. A written permission was made for the parents to sign but they preferred to give oral permission.

The versions of the game, the experimental condition (with expressions) and the control condition (without expressions) were randomly chosen and initiated through the tablet (Toshiba 10.1') that was provided to the child and throughout the game the child's thought was asked.

Ending the game, the rest of the questionnaire was filled having questions for both the child and parent. At the end we thanked them for the time provided.

The process was then finished with the realization of the m-YPAS and the mSTAI-mTMM.

The results

From the 43 children tested in the children emergency room, we only had the complete data of 30 children total (15 girls and 15 boys) due to overwhelming pain (2 children) or not being anymore in a condition to play (2 children) or being called by the doctor (9 children).

As the level (where the interacting action occurs) was the most important part of the game, only the data collected from the start of the level up to receiving the last instrument was used. The rest of the game was used for support only.

Both the questionnaire and the file with the touches of the player were combined to create a table (see Appendix IX). Due to the massive information received and for better analyses purposes throughout the program (R), csv files were created, one for each player, being each one identified with the version played (H_SUB1.csv for the experimental condition and N_SUB_7.csv for the control condition).(see Appendix X).

The data was analyzed first in a general way, where for every achievement made (finding a key or opening a safe), having in total 14 achievements, there was an amount of touches made indicating the player's difficulty during the course of the game (see Figure 80).

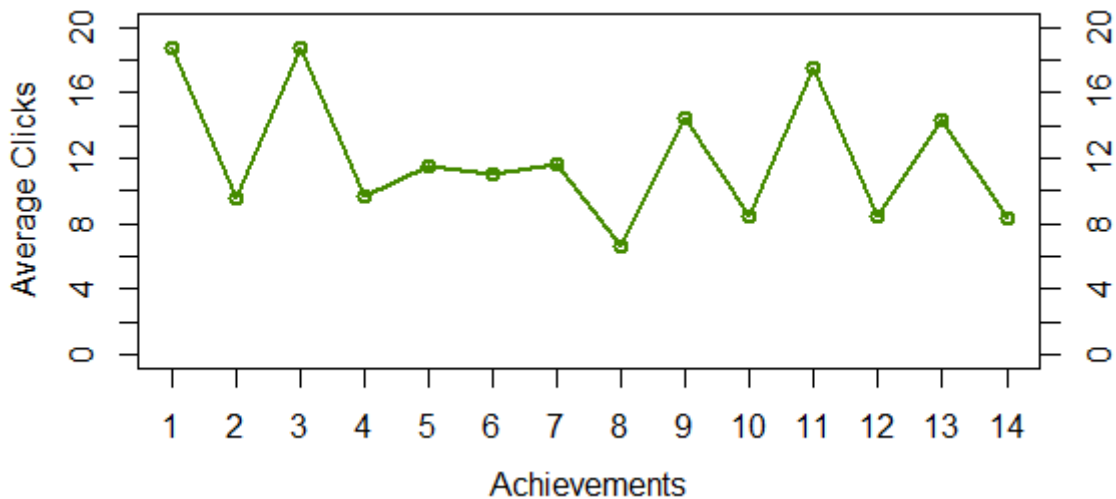


Figure 80 – Average of the Players Touches for each Achievement

By analyzing this data, a repeating cycle emerges due to having periods where the level of challenge was high hence requiring more touches, followed by periods of low challenge, implying less touches. This providing the flow channel with a wave movement (see section 2.2.1., Flow – Figure 14, page 26) which probably demonstrates a more interest of the player in the game than a straight line. [17]

Throughout the game, the players engaged with different elements (see Figure 81), demonstrating that the game interaction was merely done with the arrows and characters, having interacted the most with arrows. One point of improvement of the game would be to have more interacting with the characters than the arrows.

There's clearly a difference of color concentration, which shows difference in the behavior patterns. Seeing that the most active player was going back and forward, possessing a darker map while the less active player appeared to just go in one way, forward, possessing a lighter concentration, completing the level faster than the most active player, with 6 minutes and 20 seconds against 12 minutes and 2 seconds.

Analyzing the players game pleasure preference (see section 2.2.2., Player Types, page 31) with this game only permits two types of styles, achievers and explorers, being the completion of the game an achievement and having the map revealed an explorer.

Three types of achievers were revealed and distinguished themselves by the strategy taken to complete the game. The primary goal was to find the lost instruments, and it was replaced by a secondary goal of finding the keys and opening the safe (finding the instruments). The finding of a key and the opening of a safe were considered to be achievements.

The order of finding each element is not restricted, only having the first achievement to find a key (any color) and then a safe (any color), being the order in the middle depending on the player:

- Keys First: The group of players that prefer finding all the keys available before going to open the safes
- Keys plus Safe (pair): The group of players that prefer to find a key (any color) and open the corresponding safe.
- Others: The group of players that finds keys or opens safes as they appear

We tested 30 players, 15 with the experimental condition (With Expression) and 15 with the control one (Without Expression). Each version had players of the three types of achiever (see Table 2), where the strategy of finding a key and opening the corresponding safe was the most used.

Table 2– The number of players in each type of achiever

	Keys First	Key plus Safe (pair)	Others	Total	Percentage
Without Expression	1	8	6	15	50%
With Expression	1	7	7	15	50%
Total	2	15	13	30	100%
Percentage	6.67%	50%	43.3%	100%	

With a close by percentage between the Key plus Safe (pair) and others with 50% to 43.3%, a more close observation of those groups was made through the path they made to find the instruments. A scale of colors was then designated to establish the number of times visited in each point (0 to 20). (see Figure 84 and 85)

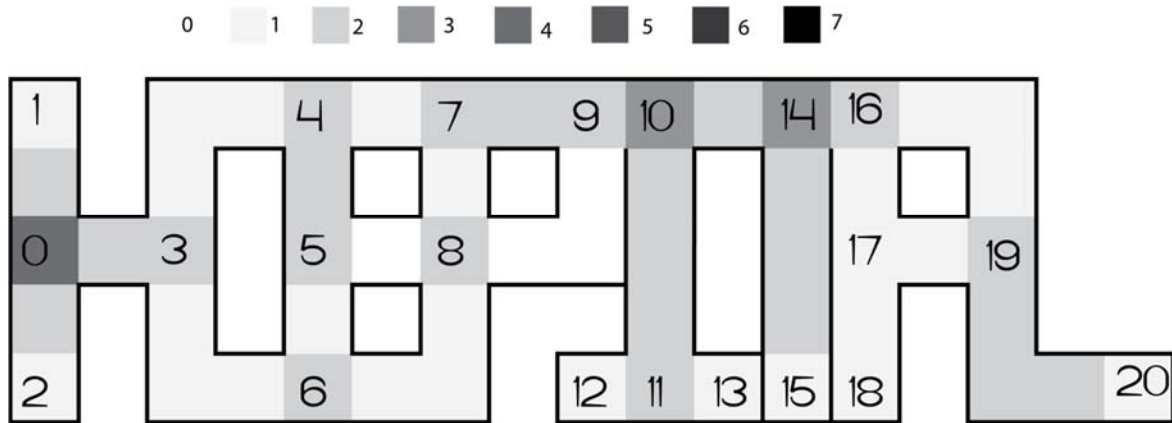


Figure 84 – Path of the group key plus safes (pair)

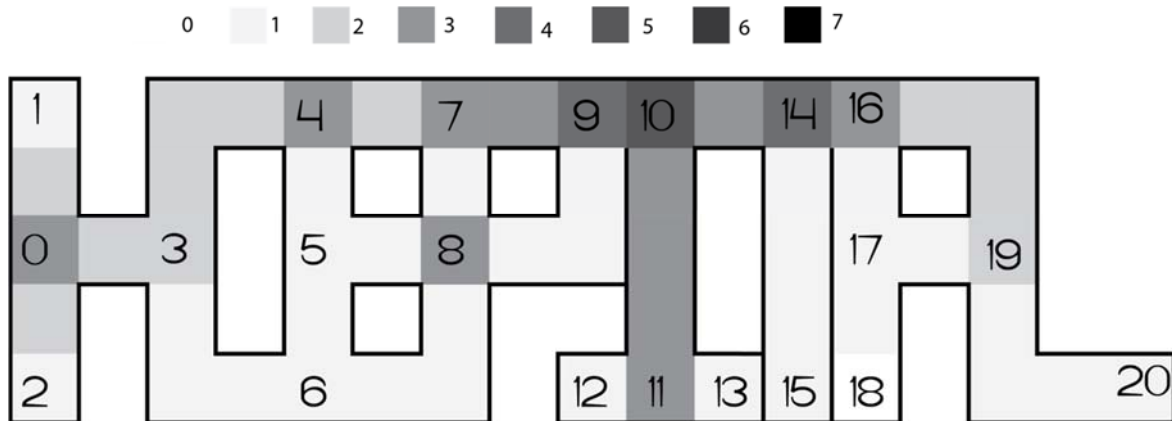


Figure 85 – Path of the group Others

The Key plus safe (pairs) group had a more balanced map, going from one point to the other, only having a more concentrated color on the intersection points. The others group, on the other hand, seemed to have missed keys or safes making them turn back.

Having the longest game played with 25 min and 47 seconds and the shortest with 5 minutes and 23 seconds, an analyses about if the versions (experimental or control) of the game and the strategy taken (keys first, key plus safe-pair or other) was made to see if any group had an advantage in time. (see Figure 86)

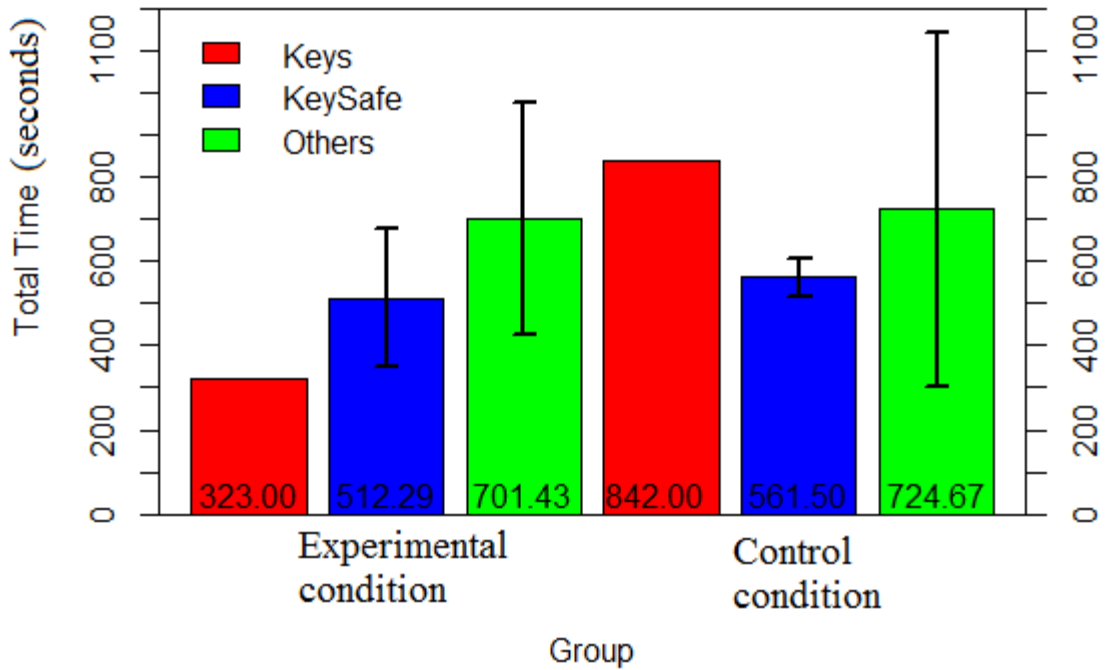


Figure 86 – The average of time it takes to finish the game by versions and strategy.

No significant difference was observed going for a less specific analyze only using the strategy. (see Figure 87)

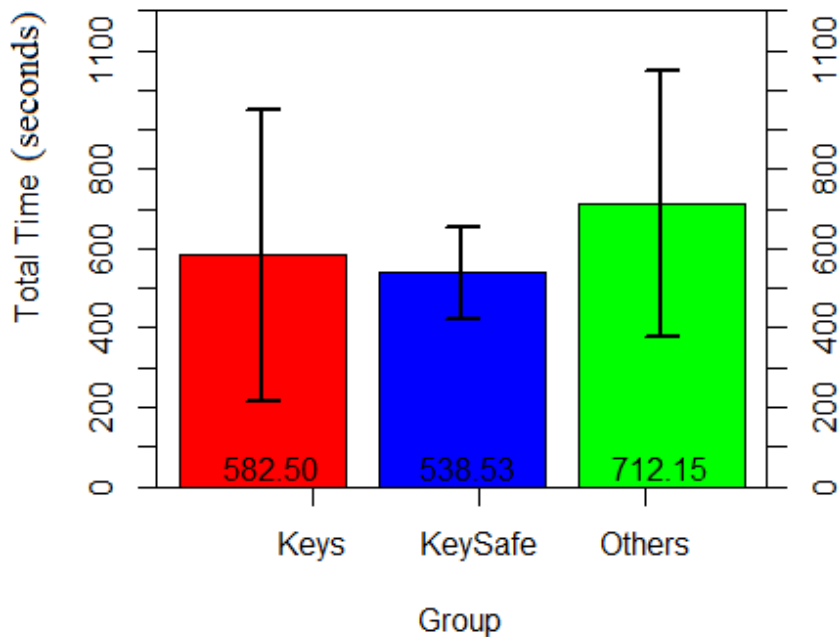


Figure 87 – The average of time to finish the game by strategy

With the same conclusion as before, of not having significant differences, we determined, that the type of strategy does not mean the player will finish the level faster, having in average played the game in 10 minutes and 17 seconds.

Finishing the analysis with the ultimate question of this thesis: does the game provide a reduction or even elimination of stress and anxiety by interacting with positive characters or is it just an interesting game? (experimental condition VS control condition).

Using the three measures carried out before and after the game (two observed, m-YPAS and mSTAI-TMM, one self-report, self mSTAI-TMM) separated by condition, the answer would finally be answered.

With Figure 88, we can observe the before and after of the three measures as the two conditions have suffered a reduction in values, having the highest value represent high anxiety and the lowest, low anxiety levels.

Analyzing separately by measures, we can say the true impact of the reduction values:

- The m-YPAS has a significantly reduction in the experimental condition with no overlapping of the errors bars while in the control we notice a large overlapping having no significant reduction.
- The observed mSTAI-TMM also has a significant reduction in the experimental with no overlapping of the error bars while in the control we notice a small overlapping having a significant reduction, but not as significantly as the experimental condition.
- The self mSTAI-TMM, being the child self-report shows significant reduction in both the experimental and control condition, with a small overlapping of the error bars. The experimental, though, has a smaller overlapping of the error bars, having the experimental condition a better reduction than the control one.

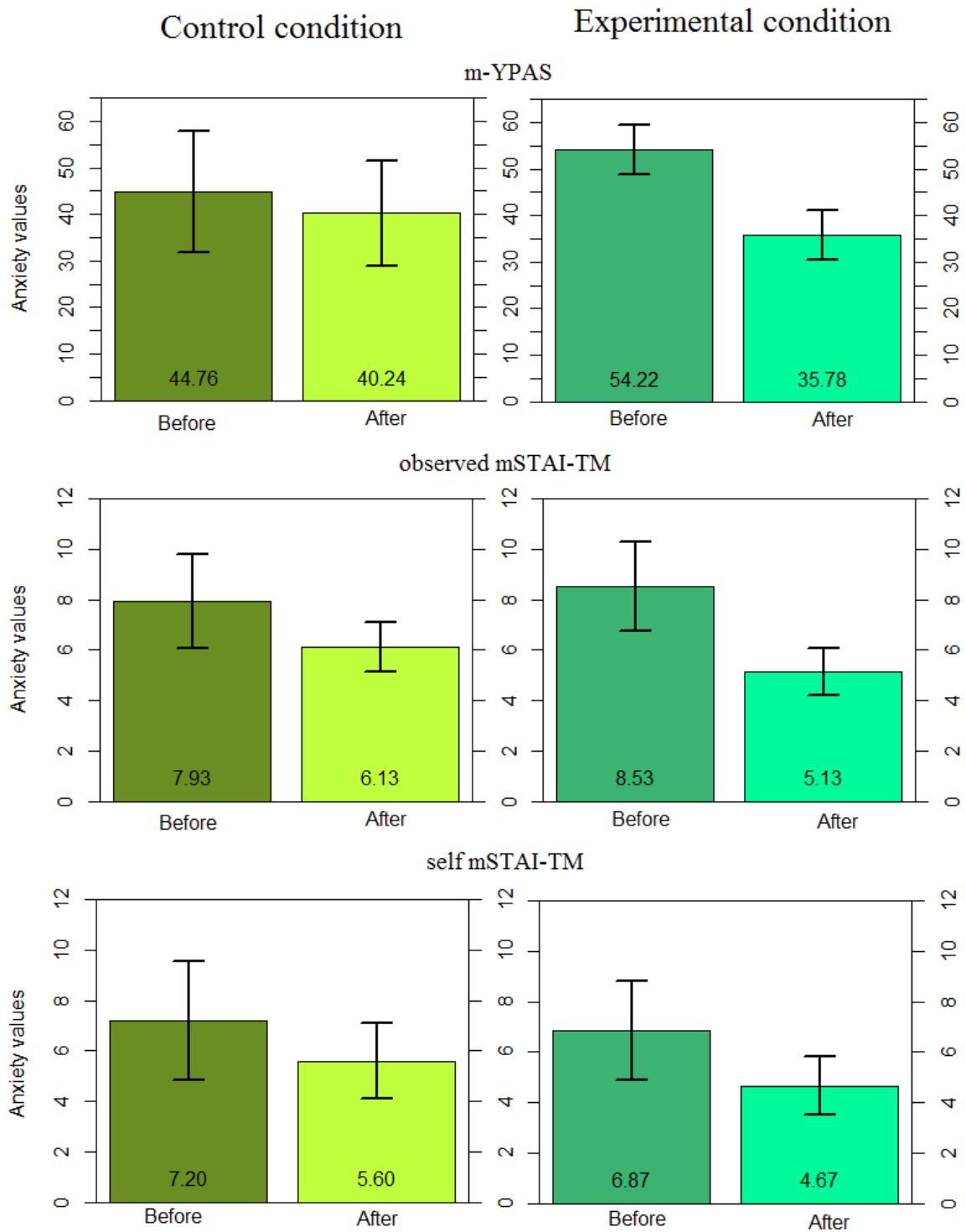


Figure 88 – The average results of the three measures condition of the players

Having the playtests completed in 2 weeks time during the mornings only (the afternoons were too crowded with people) and given previous data received, we thought all risks had been eliminated.

These playtests were used not only to verify our condition but also to see in what points we can improve on our next version, only making at this point one simple alteration.

Alterations

We choose games by three main ways: a friend recommended it, publicity awareness or browsing through a list of games, where the name and logo capture our attention. Curiosity then leads us to touch it to see more detail about it, being that the reason for our logo change. (see Figure 89)

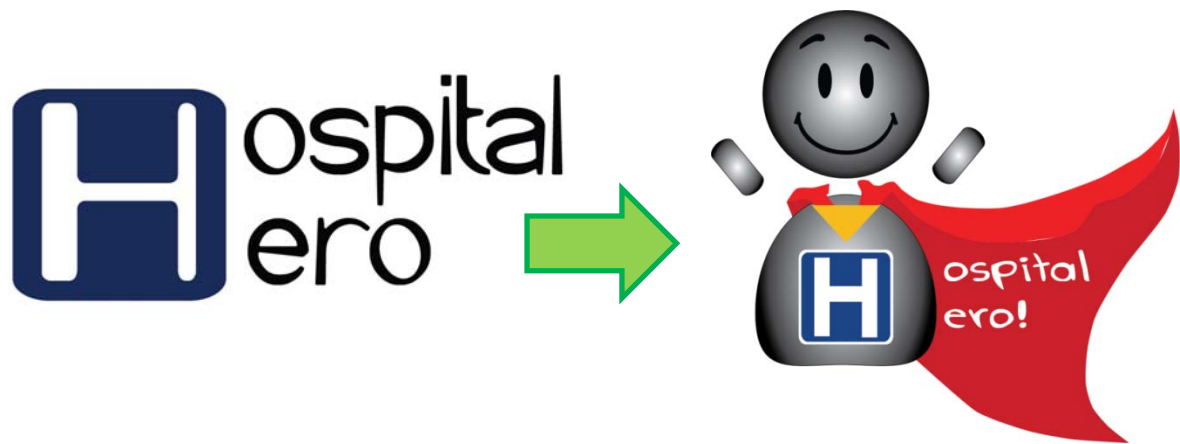


Figure 89 - The improvement of the logo

Despite the alterations made, some problems still persisted, having the first interaction with a positive character take a long time to give a hint back and still not finding a better way to provide a more clear understanding of how to play the game to the child.

6. Conclusion

It is a well-known fact that the levels of stress and anxiety are high in the children's emergency room. With this problem at hand, we went through a variety of solutions where different factors were examined, and one stood out: the Dr. Baldwin study. This study consists of interacting a few minutes a day with positive face through a game. Despite his results, it would not work in this situation having only minutes not days to provide significant results. The necessary adjustments were made by uniting different resources that proved to lead to a decrease of stress and anxiety levels.

Hospital Hero was created, tested and has confirmed that the child's levels of stress and anxiety can decrease.

6.1. What we had

We know that everything we do today, will affect our future in some way. Our future lies with the children. So as they grow, every moment they experience will affect how they view their surrounding and how they interact with other people.

When a child falls or is in some sort of pain, the parents first thought is to take him or her to the emergency room. If it's their first time there, everything they see, smell and feel is new to them as it is a completely unfamiliar place, causing often stress and anxiety. We must keep in mind that the way they feel is not always perceptible, so we need to decipher through their expressions and body language all due to the new place. As they are being treated for the pain it does not mean the other feelings go away. This gives us our problem Stress and Anxiety.

6.2. What was done

A variety of previous works with the purpose of reducing or eliminating stress and anxiety were used. The study of Dr. Baldwin was the main application to the creation of our game. He was interested in cognitive mechanism of attention to rejection that could be the cause of social stress and individual self-esteem. So he created a game that consisted on finding the smiling face as quickly as possible on a grid of 4 to 4, every day for a few minutes.

Hospital Hero is the Hospital Hero is a 3D game that enables the child to wade freely through the maze with the help of arrows, while interacting with different characters. Each providing a different response.

Created due the combination of three elements, the positive expressions, and the main application to reduce stress and anxiety levels; the maze effect, giving the freedom to explore and the search for treasure, giving the feeling of success when finding treasure.

6.3. What was achieved

Two usability tests were made, the first with purpose of testing the understanding of the story and the second the time priority.

With the purpose of testing if the interaction with the positive characters would improve the children levels of stress and anxiety, a new version of the game was created. This gave us two versions, controlled condition (without expressions) and the experimental condition (with expression).

Three measures of stress and anxiety levels occurred in the playtest, two from the observer and one from the child itself. Each occurring before and after playing one of the versions provided.

All three measures of the two conditions showed reduction of the stress and anxiety levels. Having the experimental condition a more significantly reduction then the controlled one.

“Ambrose, I desire something...” a slogan from a Portuguese publicity that tell us that sometimes we do not know what we want or need and then something appears that we do not even expect - like a chocolate – and it can fulfill that desire. That is what this game is all about; to fulfill that need by helping. While in a frightful situation, the only thought that runs through our minds is to get away, but at the moment that this game appears, it provides knowledge, distraction and relaxation without the illusion of being somewhere else.

6.4. Future Work

Nobody knows exactly what the future holds, we just hope that what we wish will happen.

A project is never done, it's only considered over if we give up. For any project to survive, it needs maintenance, meaning that the game is revised in all aspect and improved if possible. [116]

From the point that the games appears finished, the desire to implemented it, in the children emergency room of the Hospital where we performed the play tests, will require the necessary adjustments to run it in the kiosk available there.

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8. Appendix

I –Inspiration and descriptions of ideas



#1 Carnival Shoting

- The player will shoot moving objects to win prizes like on a carnival fair, the objects are bad characters of fairy tales. Example Carnival: Shooting Gallery By Consulence [Ref.117]



#2 Shooting while moving through the story

- The player will move automatically through a story known to the child only by controlling the weapon aim and shooting objects that don't make sense in the story. Example Rayma Raving Rabbids By Ubisoft [Ref.118]



#3 Playing Piano

- The player can choose to play an existing song or play freely; the music provided will be children's music. Example Perfect Piano by REVONTULET [Ref.119]



#4 Playing Guitar

- The player can choose to play an existing song or play freely; the music provided will be children's music. Example Guitar hero 5 by Activision [Ref.120]



#5 Simon Says

- The player has to repeat the sequence in the correct order of colors indicated. Example Simon Says By Studio 54 [Ref.121]



#6 Insert arrows to exit

- The player has to selected arrows and position them in the correct manner enabling the character to leave the room. Example Chu Chu Rocket By Sega [Ref.122]



#7 Super Mario

- The player has to control every moment of the character using each of the four elements (air, fire, earth and water) Example Super Mario by Nintendo [Ref.123]



#8 Angry Birds

- The player has to reach the end by pulling back the character to jump, like a slingshot. Example Angry Birds by Rovio Entertainment [Ref.124]



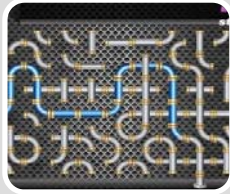
#9 Bejeweled

- The player has to match as many similar objects as possible in a time limit. Example Bejeweled 2 by PopCap [Ref.125]



#10 Bubble

- The player has to shot and burst the bubbles on top. Example Puzzle Bobble by Taito Corporation [Ref.126]



#11 Rotate Pipes

- The player has to rotate the correct portions of the straw to enable the juice to reach the end without spilling. Example Plumber 3 by billiongamee [Ref.127]



#12 Destroy Objects

- The player will be provided with a screen full of objects in different color; the player has to destroy everything but it is only possible to destroy 3 or more pieces at a time. Example Pet Rescue Saga by King [Ref.128]



#13 Balancing Objects

- The player will receive objects of different sizes and try to build a tower. Perfect Balance 2 by tturasas [Ref.129]



#14 Hammer Objects

- The player has to click as fast as possible the objects that will appear for a few seconds. Example Hit Mouse by Magic Air [Ref.130]



#15 Puzzle Grid Math

- The player has to cross the square that matches the number on each row and column and discover pattern in the end. Example Riddlee Stones Saga by Luciano Larrossa [Ref.131]



#16 Unblock Me

- The player is trapped in a room full of boxes and has to move the pieces out of the way in order to exit the room. Example Unblock Me by iragames Co., Ltd [Ref.132]



#17 Powers to Move

- The player has to reach the end of each level just by using the powers that he/she will encounter on each level. Each power is represented by animals' icons. Example C-Bot by Tiago B Tavares [Ref.133]



#18 Maze

- The player has to reach the middle of the maze which holds a prize. Example Labyrinth | Maze by Marat [Ref.134]



#19 Treasure Map

- The player will receive a map where he/she has to solve riddles to find the treasure. Example Treasure map by unknown [Ref.135]



#20 Mind Habits

- The player will be in a room or outside surrounded by people walking around. The aim is to click as much happy faces as possible. Example MindHabits by Dr. Mark Baldwin at McGill University [Ref.136]

II – Representing the instruments

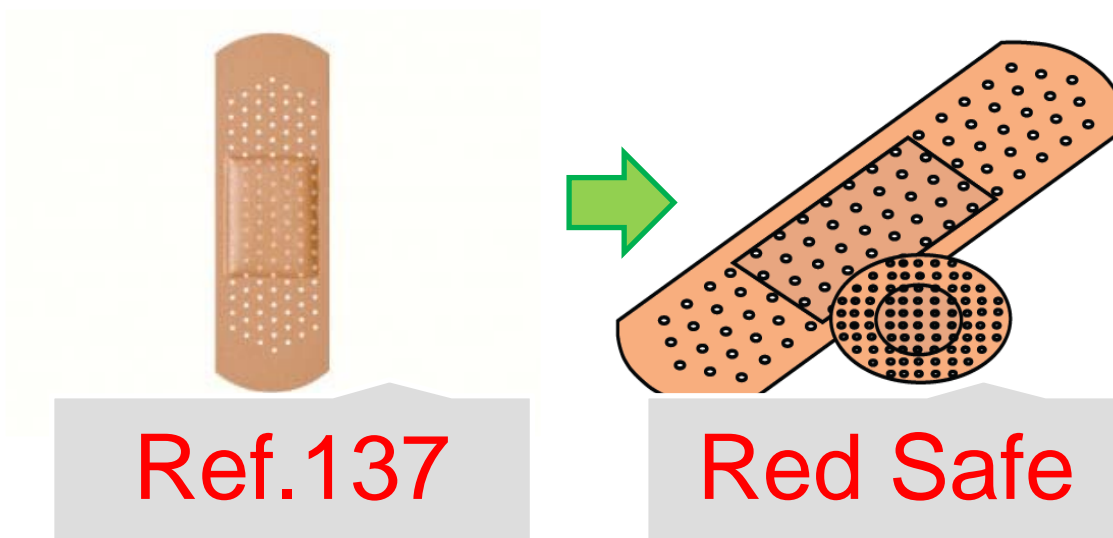


Figure 90 – The first instrument, a band aid, located in the red safe.

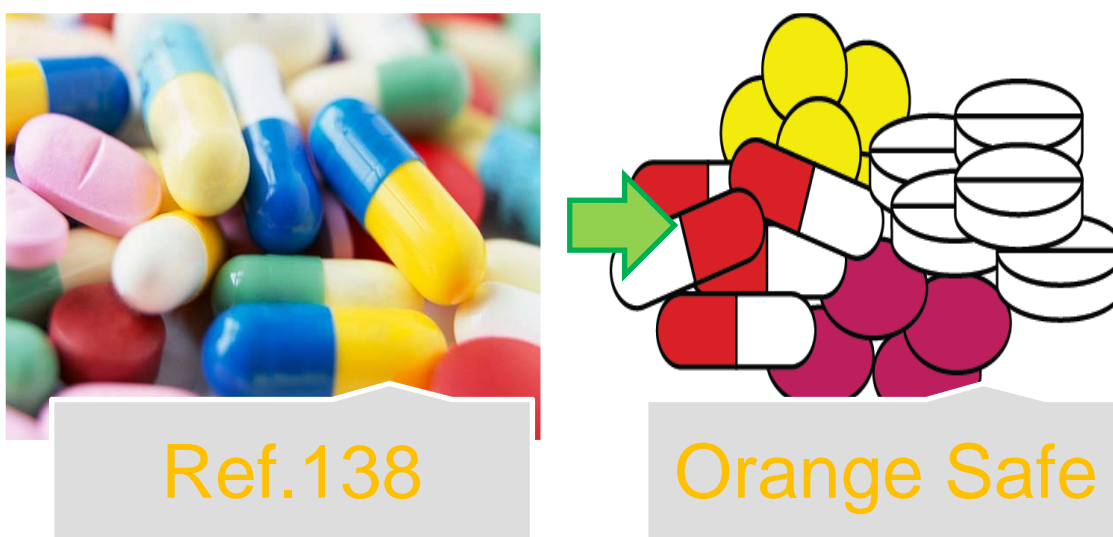


Figure 91 – The second instruments, pills, located in the orange safe

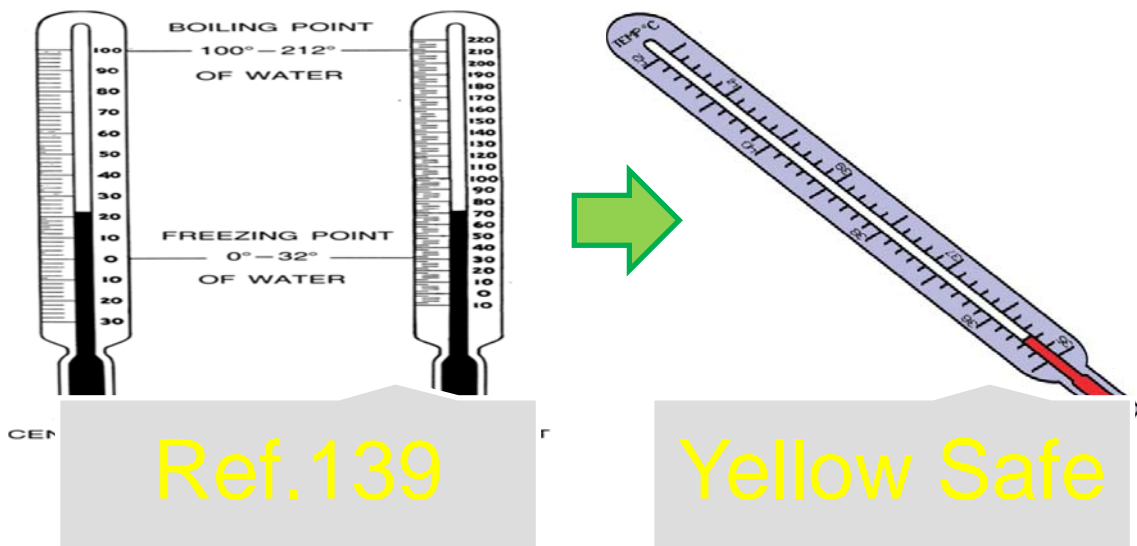


Figure 92 – The third instruments, thermometer, located in the yellow safe

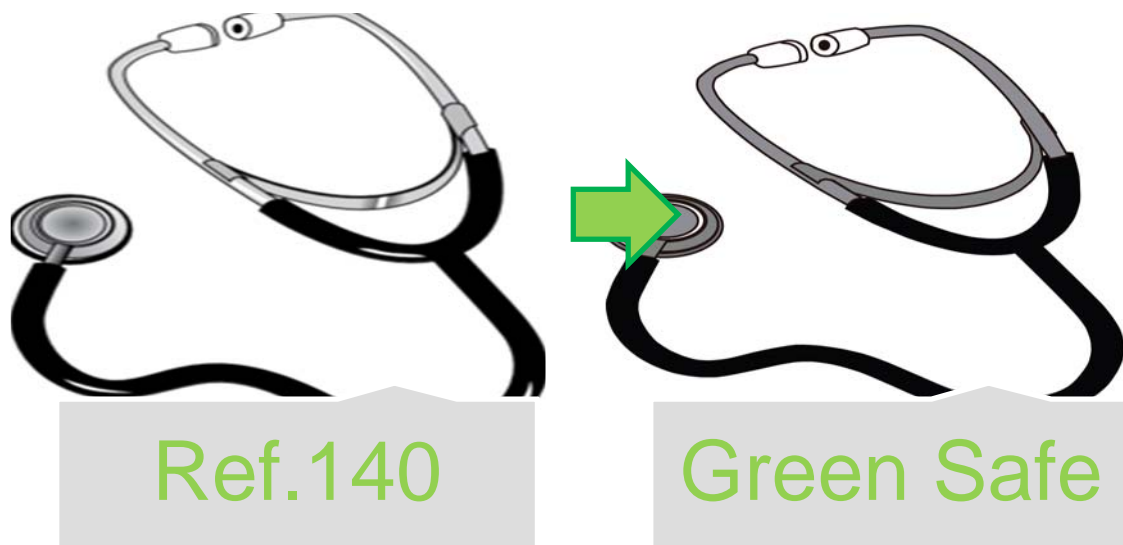


Figure 93 - The fourth instruments, stethoscope, located in the green safe

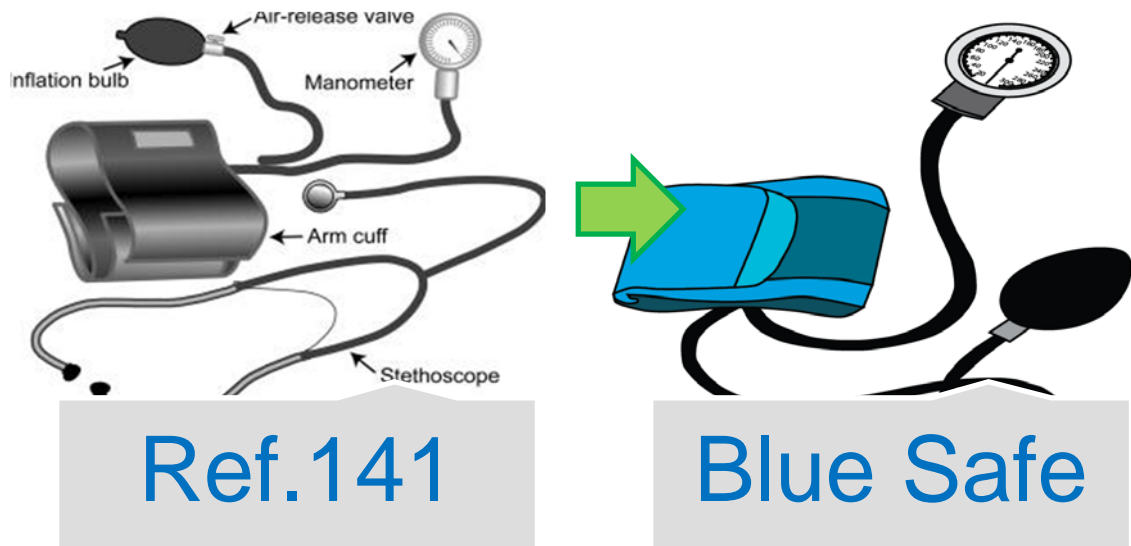


Figure 94 - The fifth instruments, blood pressure meter, located in the blue safe

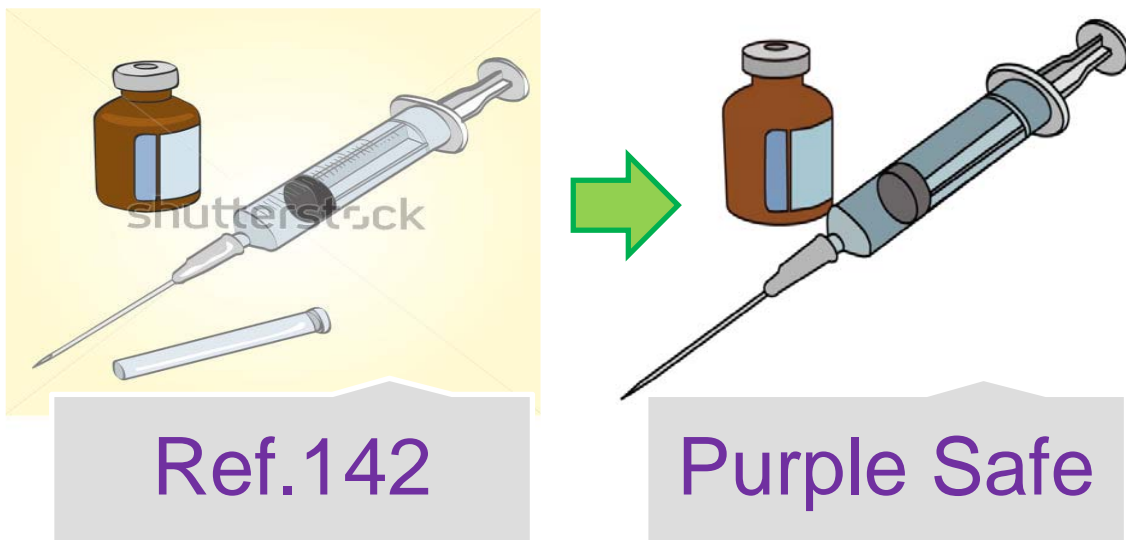


Figure 95 - The sixth instruments, syringe, located in the purple safe

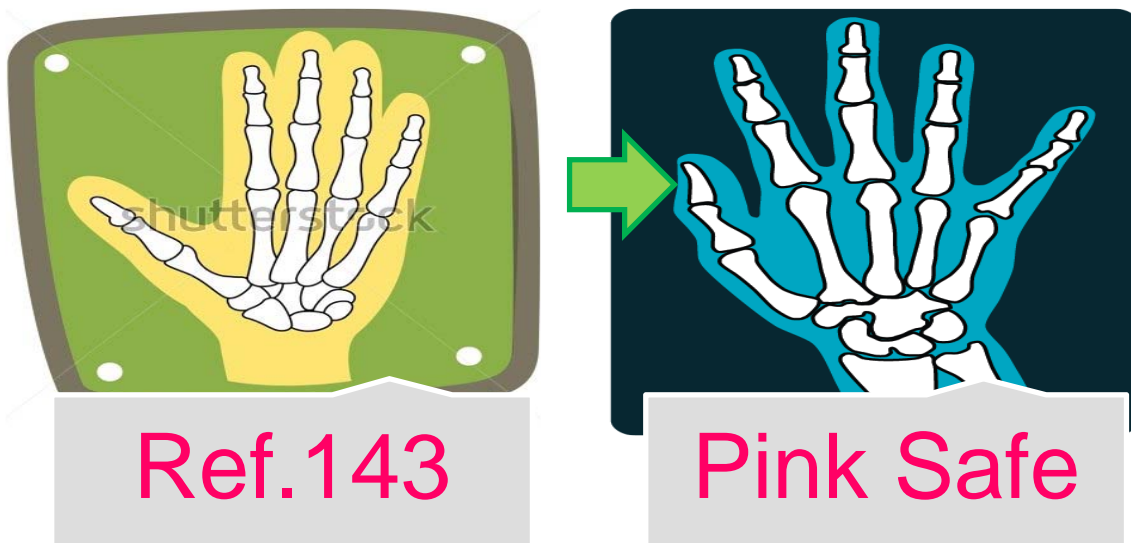


Figure 96 - The seventh and last instruments, x-ray, located in the pink safe

III – The route of the menu

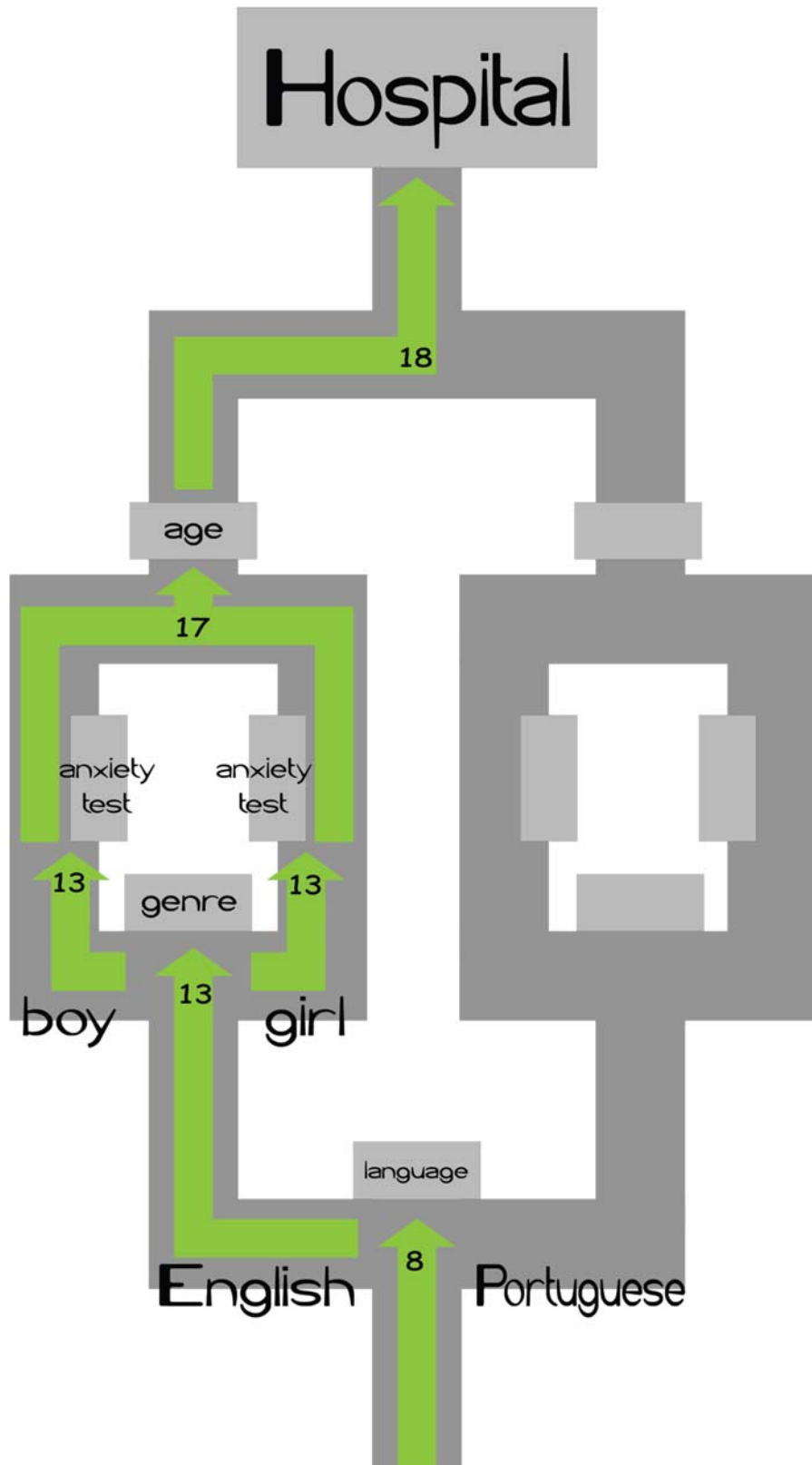


Figure 97 - The path from the tunnel to the entrance of the Hospital

IV – Example of a log file created in end of the game

VERSION H FACE

TIME=1227_20_June_2014

LANGUAGE=PT

GENRE=M

FIRST TEST=8

AGE=11

LAST TEST=4

Red key=2_N_L

Orange key=6_O_R

Yellow key=7_O_R

Green key=9_N_R

Blue key=13_S_R

Purple key=14_N_L

Pink key=19_E_L

Red Safe=1_O

Orange Safe=5_S

Yellow Safe=7_O

Green Safe=10_O

Blue Safe=13_N

Purple Safe=14_O

Pink Safe=19_N

TIME Red key=12:30:02

TIME Orange key=12:31:20

TIME Yellow key=12:32:03

TIME Green key=12:32:32

TIME Blue key=12:33:23

TIME Purple key=12:34:29

TIME Pink key=12:35:10

TIME Red inst=12:30:22

TIME Orange inst=12:31:44

TIME Yellow inst=12:32:13

TIME Green inst=12:32:50

TIME Blue inst=12:33:48

TIME Purple inst=12:34:51

TIME Pink inst=12:35:23

Total=136

startBeg=12:27:09
12:27:19 => place=language click=path tag=Untagged x=787.3078 y=54.90454 click=PT
12:27:32 => place=genero click=path tag=Untagged x=550.1782 y=66.81573 click=M
12:27:52 => place=testeM click=path tag=Untagged x=638.2817 y=37.33069 click =maybe
12:27:53 => place=testeM click=path tag=Untagged x=637.6569 y=65.83936 click =maybe
12:27:54 => place=testeM click=path tag=Untagged x=636.7195 y=63.49622 click =maybe
12:27:54 => place=testeM click=path tag=Untagged x=635.7823 y=54.12347 click =maybe
12:28:08 => place=idadeMF click=path tag=Untagged x=742.3188 y=41.62653 click =Plus
12:28:08 => place=idadeMF click=path tag=Untagged x=756.6903 y=42.79816 click =Plus
12:28:08 => place=idadeMF click=path tag=Untagged x=759.1897 y=48.07031 click =Plus
12:28:08 => place=idadeMF click=path tag=Untagged x=766.6879 y=58.41931 click =Plus
12:28:09 => place=idadeMF click=path tag=Untagged x=771.0618 y=66.22992 click =Plus
12:28:09 => place=idadeMF click=path tag=Untagged x=780.4345 y=74.04053 click =Plus
12:28:09 => place=idadeMF click=path tag=Untagged x=784.8084 y=71.50208 click =Plus
12:28:09 => place=idadeMF click=path tag=Untagged x=782.6215 y=69.74469 click =Plus
12:28:09 => place=idadeMF click=path tag=Untagged x=782.6215 y=72.47839 click =Plus
12:28:10 => place=idadeMF click=path tag=Untagged x=782.6215 y=61.73883 click =Plus
12:28:10 => place=idadeMF click=path tag=Untagged x=785.4333 y=59.20038 click =Plus
12:28:11 => place=idadeMF click=path tag=Untagged x=630.4711 y=168.1581 HospitalPT
EndBeg=12:28:18
StoryStart=12:28:20
StoryEnd=12:28:51
StartLevel=12:29:22
12:29:47 => place=0_N click=0_N_R tag=happy x=1021.313 y=458.7122
12:29:53 => place=0_N click=floor1 tag=Untagged x=758.2524 y=65.44885 rotate_right
12:29:55 => place=0_E click=0_E_R tag=happy x=1004.442 y=439.381
12:29:57 => place=0_E click=floor1 tag=Untagged x=656.7147 y=170.5013 front
12:29:59 => place=2_E click=2_E_L tag=happy x=261.4987 y=479.4103
12:30:00 => place=2_E click=floor1 tag=Untagged x=531.7452 y=42.60284 rotate_left
12:30:02 => place=2_N click=2_N_L tag=happy x=307.425 y=475.7003
12:30:04 => place=2_N click=2_N_L tag=happy x=289.9292 y=457.9312
12:30:05 => place=2_N click=floor1 tag=Untagged x=552.3652 y=44.16498 rotate_left
12:30:07 => place=2_O click=2_O_L tag=happy x=253.0632 y=480.3866
12:30:08 => place=2_O click=floor1 tag=Untagged x=644.8426 y=167.1818 front
12:30:09 => place=0_O click=0_O_R tag=happy x=1025.375 y=492.1025
12:30:13 => place=0_O click=floor1 tag=Untagged x=654.8401 y=161.9097 front
12:30:14 => place=1_O click=Redsafe(Clone) tag=red x=692.9559 y=393.8843
ERedVideo=12:30:14
SRedVideo=12:30:22
12:30:24 => place=1_O click=1_O_R tag=happy x=1011.316 y=498.5463
12:30:24 => place=1_O click=floor1 tag=Untagged x=758.8773 y=4.916748
12:30:26 => place=1_O click=floor1 tag=Untagged x=765.7505 y=53.92822 rotate_right
12:30:27 => place=1_N click=1_N_L tag=happy x=286.4926 y=457.3454
12:30:29 => place=1_N click=floor1 tag=Untagged x=760.127 y=54.31879 rotate_right
12:30:31 => place=1_E click=1_E_L tag=happy x=292.1162 y=472.7713
12:30:33 => place=1_E click=floor1 tag=Untagged x=660.4638 y=170.1108 front
12:30:42 => place=0_E click=0_E_R tag=happy x=1030.061 y=517.6822
12:30:44 => place=0_E click=floor1 tag=Untagged x=544.867 y=26.59113 rotate_left
12:30:46 => place=0_N click=0_N_R tag=happy x=1050.369 y=458.1264
12:30:49 => place=0_N click=floor1 tag=Untagged x=657.3395 y=183.3888 front

12:30:53 => place=3_N click=3_N_L tag=happy x=282.7435 y=483.5109
12:30:55 => place=3_N click=floor1 tag=Untagged x=754.1909 y=33.42542 rotate_right
12:30:58 => place=3_E click=3_E_R tag=happy x=1041.621 y=501.6705
12:31:00 => place=3_E click=floor1 tag=Untagged x=647.9669 y=176.5546 front
12:31:06 => place=6_N click=6_N_R tag=happy x=1001.318 y=486.2446
12:31:09 => place=6_N click=floor1 tag=Untagged x=534.2446 y=63.88672 rotate_left
12:31:20 => place=6_O click=6_O_R tag=happy x=1013.581 y=453.6198
12:31:22 => place=6_O click=6_O_R tag=happy x=1037.872 y=456.1738
12:31:24 => place=6_O click=floor1 tag=Untagged x=628.5966 y=178.1166 front
12:31:27 => place=5_O click=5_O_R tag=happy x=986.0093 y=465.5465
12:31:28 => place=5_O click=floor1 tag=Untagged x=525.8091 y=66.81573 rotate_left
12:31:29 => place=5_S click=Orangesafe(Clone) tag=orange x=698.267 y=396.8133
SOrangeVideo=12:31:29
EOrangeVideo=12:31:44
12:31:46 => place=5_S click=5_S_R tag=happy x=1009.754 y=472.576
12:31:47 => place=5_S click=floor1 tag=Untagged x=736.3828 y=65.44885 rotate_right
12:31:48 => place=5_O click=5_O_R tag=happy x=1005.692 y=463.9844
12:31:50 => place=5_O click=floor1 tag=Untagged x=632.9705 y=175.7735 front
12:31:53 => place=4_O click=4_O_L tag=happy x=305.238 y=469.4518
12:31:54 => place=4_O click=floor1 tag=Untagged x=762.9388 y=38.30707 rotate_right
12:31:56 => place=4_N click=4_N_R tag=happy x=1025.062 y=480.1913
12:31:58 => place=4_N click=floor1 tag=Untagged x=641.7184 y=165.0339 front
12:32:00 => place=7_N click=7_N_L tag=happy x=275.8701 y=474.9192
12:32:01 => place=7_N click=floor1 tag=Untagged x=504.8768 y=49.43713 rotate_left
12:32:03 => place=7_O click=7_O_R tag=happy x=991.6329 y=461.4459
12:32:05 => place=7_O click=Yellowsafe(Clone) tag=yellow x=627.3469 y=345.8492
SYellowVideo=12:32:05
EYellowVideo=12:32:13
12:32:21 => place=7_O click=7_O_R tag=happy x=1006.629 y=493.8599
12:32:23 => place=7_O click=floor1 tag=Untagged x=761.0642 y=73.25946 rotate_right
12:32:26 => place=7_N click=7_N_L tag=happy x=258.062 y=478.2387
12:32:29 => place=7_N click=floor1 tag=Untagged x=632.9705 y=142.3832 front
12:32:32 => place=9_N click=9_N_R tag=happy x=1029.749 y=470.4281
12:32:35 => place=9_N click=9_N_R tag=happy x=1036.31 y=486.6351
12:32:36 => place=9_N click=floor1 tag=Untagged x=627.6593 y=149.4127 front
12:32:38 => place=10_N click=10_N_R tag=happy x=1013.503 y=483.3156
12:32:41 => place=10_N click=floor1 tag=Untagged x=546.1167 y=48.07031 rotate_left
12:32:43 => place=10_O click=Greensafe(Clone) tag=green x=644.8426 y=354.2455
SgreenVideo=12:32:43
EgreenVideo=12:32:50
12:32:52 => place=10_O click=10_O_L tag=happy x=240.2539 y=527.2502
12:32:54 => place=10_O click=floor1 tag=Untagged x=755.4406 y=46.70343 rotate_right
12:32:57 => place=10_N click=10_N_R tag=happy x=1028.811 y=456.5643
12:32:59 => place=10_N click=floor1 tag=Untagged x=743.5685 y=66.81573 rotate_right
12:33:02 => place=10_E click=10_E_L tag=happy x=318.9846 y=465.5465
12:33:03 => place=10_E click=floor1 tag=Untagged x=627.0344 y=156.4423 front
12:33:06 => place=11_E click=11_E_L tag=happy x=255.875 y=489.9546
12:33:08 => place=11_E click=floor1 tag=Untagged x=517.6862 y=49.63239 rotate_left
12:33:11 => place=11_N click=11_N_L tag=happy x=267.7471 y=481.1677
12:33:13 => place=11_N click=floor1 tag=Untagged x=640.7811 y=155.0754 front

12:33:16 => place=13_N click=13_N_R tag=happy x=990.0708 y=430.2036
12:33:18 => place=13_N click=floor1 tag=Untagged x=742.0063 y=52.36609 rotate_right
12:33:19 => place=13_E click=13_E_L tag=happy x=279.6192 y=470.2328
12:33:21 => place=13_E click=floor1 tag=Untagged x=765.4382 y=56.07617 rotate_right
12:33:23 => place=13_S click=13_S_R tag=happy x=1004.755 y=474.3334
12:33:25 => place=13_S click=13_S_R tag=happy x=992.5702 y=462.6175
12:33:27 => place=13_S click=floor1 tag=Untagged x=763.876 y=70.33044 rotate_right
12:33:29 => place=13_O click=13_O_L tag=happy x=275.5577 y=476.2861
12:33:31 => place=13_O click=floor1 tag=Untagged x=737.32 y=55.68561 rotate_right
12:33:33 => place=13_N click=Bluesafe(Clone) tag=blue x=659.8389 y=368.6951
SBlueVideo=12:33:33
EBlueVideo=12:33:48
12:33:50 => place=13_N click=13_N_R tag=happy x=978.8235 y=521.0017
12:33:53 => place=13_N click=floor1 tag=Untagged x=749.1921 y=38.11176 rotate_right
12:33:54 => place=13_E click=13_E_L tag=happy x=267.4347 y=466.7181
12:33:57 => place=13_E click=floor1 tag=Untagged x=750.4418 y=58.80988 rotate_right
12:33:59 => place=13_S click=13_S_R tag=happy x=1035.372 y=432.742
12:34:02 => place=13_S click=floor1 tag=Untagged x=628.2841 y=159.176 front
12:34:04 => place=11_S click=11_S_R tag=happy x=1014.44 y=461.6412
12:34:07 => place=11_S click=floor1 tag=Untagged x=756.6903 y=57.8335 rotate_right
12:34:09 => place=11_O click=11_O_R tag=happy x=988.8211 y=463.9844
12:34:12 => place=11_O click=floor1 tag=Untagged x=647.342 y=163.0813 front
12:34:15 => place=10_O click=10_O_L tag=happy x=263.0608 y=489.3688
12:34:18 => place=10_O click=floor1 tag=Untagged x=751.6915 y=64.47253 rotate_right
12:34:20 => place=10_N click=10_N_R tag=happy x=987.5714 y=462.8128
12:34:22 => place=10_N click=floor1 tag=Untagged x=637.6569 y=156.247 front
12:34:29 => place=14_N click=14_N_L tag=happy x=252.4384 y=482.3393
12:34:34 => place=14_N click=14_N_L tag=happy x=276.1826 y=467.3039
12:34:41 => place=14_N click=floor1 tag=Untagged x=521.7476 y=57.44299 rotate_left
12:34:43 => place=14_O click=Purplesafe(Clone) tag=purple x=688.8943 y=361.4703
SPurpleVideo=12:34:43
EPurpleVideo=12:34:51
12:34:56 => place=14_O click=14_O_R tag=happy x=1018.189 y=524.907
12:34:58 => place=14_O click=floor1 tag=Untagged x=761.3766 y=70.52576 rotate_right
12:35:00 => place=14_N click=14_N_L tag=happy x=282.4311 y=500.6942
12:35:02 => place=14_N click=floor1 tag=Untagged x=629.8463 y=154.8801 front
12:35:04 => place=16_N click=16_N_L tag=happy x=284.618 y=493.2741
12:35:06 => place=16_N click=floor1 tag=Untagged x=633.5953 y=189.2468 front
12:35:10 => place=19_E click=19_E_L tag=happy x=268.372 y=469.2565
12:35:12 => place=19_E click=19_E_L tag=happy x=285.5553 y=445.6295
12:35:13 => place=19_E click=floor1 tag=Untagged x=522.0601 y=56.85718 rotate_left
12:35:14 => place=19_N click=Pinksafe(Clone) tag=pink x=628.5966 y=374.9436
SPinkVideo=12:35:14
EPinkVideo=12:35:23
12:35:31 => place=19_N click=19_N_L tag=happy x=222.1333 y=475.1145
12:35:33 => place=19_N click=floor1 tag=Untagged x=757.94 y=79.70319 rotate_right
12:35:35 => place=19_E click=19_E_L tag=happy x=242.7533 y=469.6471
12:35:36 => place=19_E click=floor1 tag=Untagged x=646.0923 y=157.4186 front
12:35:41 => place=20_N click=20_N_L tag=happy x=230.2563 y=477.8482
12:35:42 => place=20_N click=floor1 tag=Untagged x=634.845 y=152.3417 front

EndLevel=12:35:43

startEnd=12:35:51

12:35:55 => place=end click=path tag=Untagged x=551.7403 y=61.15302click=no

12:35:56 => place=end click=path tag=Untagged x=751.6915 y=33.03491 click =yes

12:35:57 => place=end click=path tag=Untagged x=540.1807 y=45.92236 click =no

12:35:58 => place=end click=path tag=Untagged x=746.0679 y=49.82764 click =yes

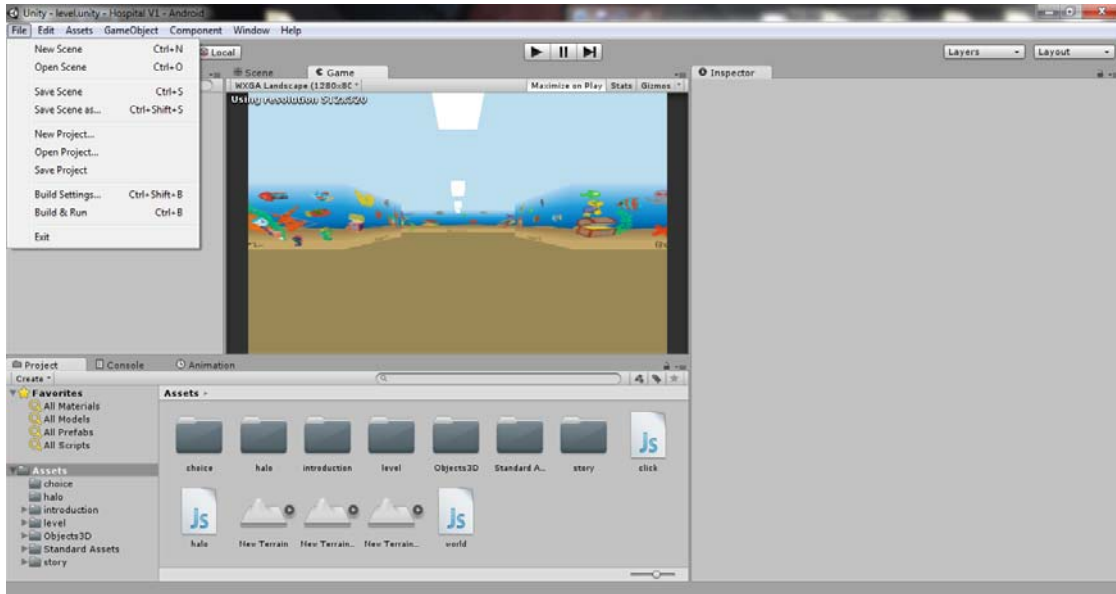
EndEnd=12:35:59

V – Installation Process

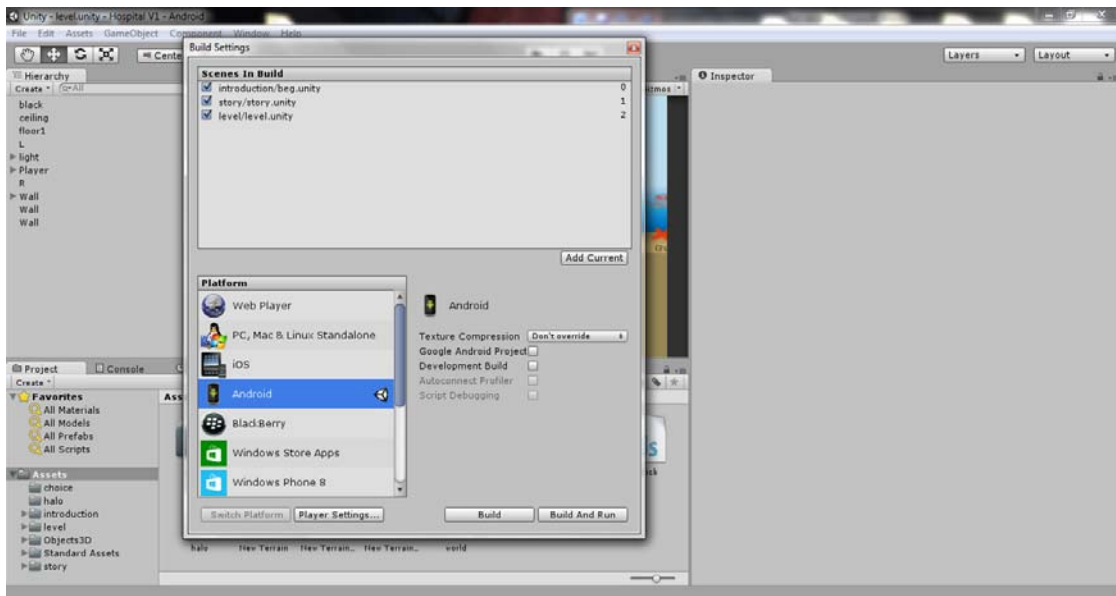
The build of the .apk is showed as a way to view the possibility of creating programs for other platforms

In Unity:

1. In “File” select “Build Settings...”



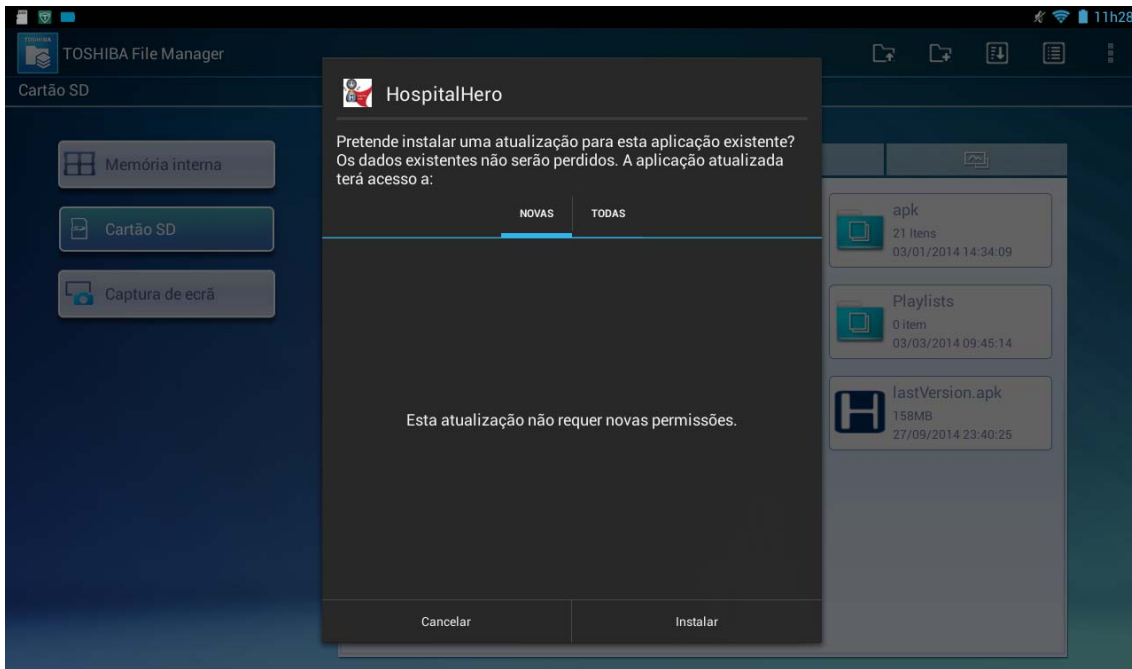
2. In the Build Settings, check all scenes and select the Android in the Platform section and then click “Build” as the image bellow indicates



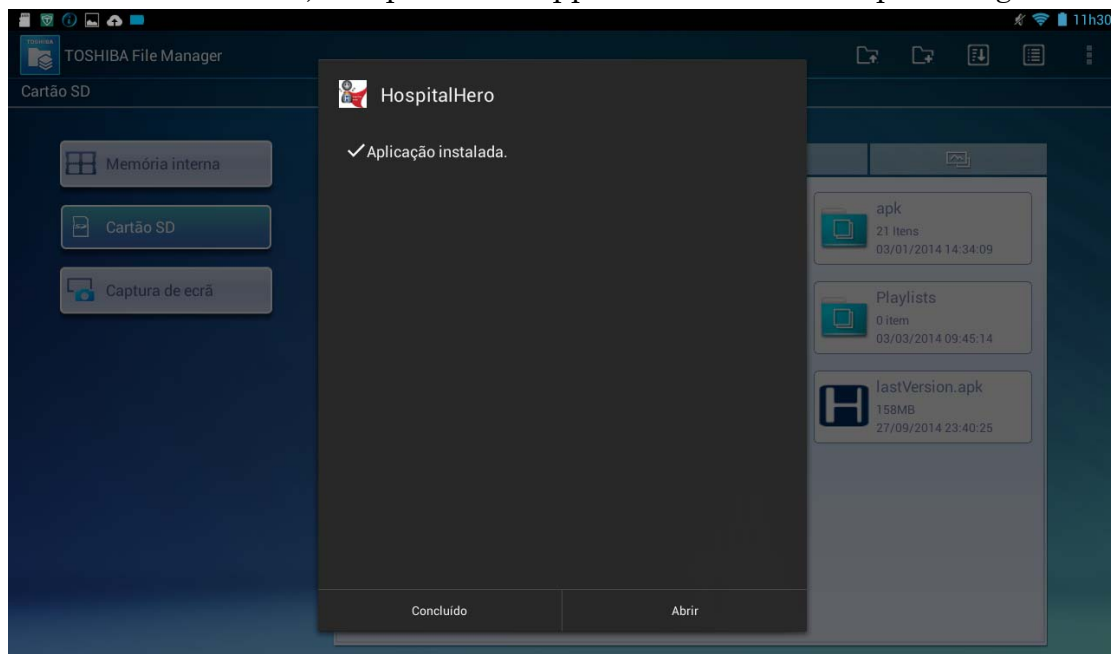
3. If you haven't directed the sdk folder to the unity, the program will ask⁶ for it. With the .apk file what remains is to pass to the android tablet

In Tablet (supports Android):

1. In the location of the .apk file, touch it and a screen will appear, touch it and install



2. When finished, an option will appear to conclude or open the game



⁶ For the creating of android .apk, the SDK MANAGER needs to be installed

VI – 1st Usability questionnaire



Gender: _____

Age: _____

Before playing:

How are feeling right now: (one choice)

I feel Sad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	No		Maybe		Yes
I feel Happy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	No		Maybe		Yes
I feel Scared	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	No		Maybe		Yes
I feel Calm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	No		Maybe		Yes

After playing:

1. What was your first impression? (multi choice)

- | | |
|--------------------------------|---------------------------------------|
| <input type="checkbox"/> Cute | <input type="checkbox"/> Interesting |
| <input type="checkbox"/> Weird | <input type="checkbox"/> Confusing |
| <input type="checkbox"/> Fun | <input type="checkbox"/> Other: _____ |

2. Did that first impression change as you played? (one choice)

- Yes. To what: _____
- No

3. What was the primary goal of the game? (one choice)

- | | |
|--|---|
| <input type="checkbox"/> Finding the safes | <input type="checkbox"/> Finding the keys |
| <input type="checkbox"/> Finding the instruments | <input type="checkbox"/> Finding the exit |

4. Which characters exist in the game? (multi choice)

- | | |
|------------------------------------|---|
| <input type="checkbox"/> Doctor | <input type="checkbox"/> Patient |
| <input type="checkbox"/> Nurse | <input type="checkbox"/> Mailman |
| <input type="checkbox"/> Paramedic | <input type="checkbox"/> Police Officer |

5. Which expressions you came across in the game? (multi choice)

- | | |
|---------------------------------|----------------------------------|
| <input type="checkbox"/> Sad | <input type="checkbox"/> Crying |
| <input type="checkbox"/> Scared | <input type="checkbox"/> Nervous |
| <input type="checkbox"/> Happy | <input type="checkbox"/> Angry |
| <input type="checkbox"/> Calm | <input type="checkbox"/> Sleepy |

6. What does this balloon mean? (one choice)

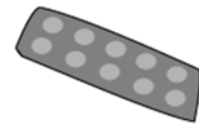
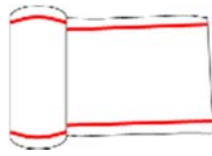
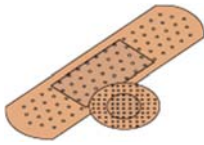
- A key is on the left
- A instrument in on the left
- The exit in on the left



7. What was your strategy to win? (one choice)

- Find the keys first then the safes
- Find the key and the corresponding safe
- Other: _____

8. Which instruments did you find? Circle the answer (multi choice)



9. What did this number mean? (one choice)

- Number of keys you have
- Number of instruments you have
- Number of instruments missing
- Number of keys missing



11. What did you find confusing? (multi choice)

- How to play the game
- The balloons
- The characters
- Nothing
- The instruments
- Other: _____

12. What could be improved? (multi choice)
- | | |
|--------------------------------------|---------------------------------------|
| <input type="checkbox"/> Characters | <input type="checkbox"/> Nothing |
| <input type="checkbox"/> Story | <input type="checkbox"/> Other: _____ |
| <input type="checkbox"/> Instruments | |

12.1. How _____

13. How long did you think you were playing? (one choice)
- | | |
|---|---|
| <input type="checkbox"/> More than 5 minutes | <input type="checkbox"/> More than 30 minutes |
| <input type="checkbox"/> More than 15 minutes | <input type="checkbox"/> More than 45 minutes |

How are felling right now: (one choice)

- | | | | | | |
|---------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| I feel Sad | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | No | | Maybe | | Yes |
| I feel Happy | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | No | | Maybe | | Yes |
| I feel Scared | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | No | | Maybe | | Yes |
| I feel Calm | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | No | | Maybe | | Yes |

Thank you!

VII – 2st Usability questionnaire



The kids will not read anything; I will ask them, they only see the image

Age: _____ Genre: **F** **M**

Place: _____ Noise: _____

Headphones: **Yes** **NO**

How long did you think you were playing?

FAST

NORMAL

SLOW

Do you want to play again? **YES** **NO**

What did you like about the game?

What didn't you like about the game?

Thank you!

VIII – Playtest questionnaire

Consentimento, Informado, Livre e Esclarecido

Título do estudo: “Hospital Hero: Um jogo para reduzir stress e ansiedade nas crianças enquanto esperam no serviço de urgências”

A sua criança está a ser convidada a participar num estudo. Antes de decidir se quer que a sua criança participe, é importante para si que compreenda o motivo da realização deste estudo, o modo como a sua informação será utilizada e o que é que o estudo envolve. Por favor demore o tempo necessário para ler atentamente a informação que se segue e, se assim desejar, a discutir comigo.

Objectivo do Estudo: Este estudo tem como objectivo reduzir o stress e ansiedade da criança fornecendo informação sobre alguns instrumentos que o hospital disponibiliza enquanto se diverte a jogar um jogo no tablet. Os dados fornecidos serão utilizados para artigos científicos.

Participação voluntária de consentimento: Se decidir participar, é sempre livre de desistir do estudo em qualquer altura, ou quando for chamado, sem necessidade de se justificar.

A criança vai fazer: Caso decida que a sua criança pode participar no estudo, a criança antes de jogar tem de responder a umas perguntas sobre como se sente e tentar colocar os instrumentos na ordem certa, depois disso começa a jogar o jogo, o jogo demora no mínimo 10 min, depois de acabar o jogo a criança tem de responder as mesmas perguntas que teve no início.

Consentimento informado: Recebi informação verbal sobre este estudo, li e compreendi toda a informação escrita neste documento. Tive oportunidade de discutir o estudo e de colocar questões. Aceito deixar a minha criança participar no estudo e estou ciente que a participação é inteiramente voluntária. Compreendo que posso desistir do estudo em qualquer altura. Estou a consentir que os dados fornecidos pela minha criança possam ser utilizados como descrito neste formulário de consentimento informado. Compreendo que receberei uma cópia deste formulário de consentimento informado.

Assinatura do Encarregado de Educação

Data

Autorização pelo uso da imagem: Durante a realização do jogo, autorizo a filmagem da cara da minha criança para o âmbito de analisar as expressões que a minha criança faz durante o jogo.

Assinatura do Encarregado de Educação

Data

Activities

- 1. The child looks around, is curious, plays with toys, reads; moves around the room to get toys or seeking family members; might move towards the equipment in the room
- 2. The child does not explore or play, may look down, plays with own hands or sucks its thumb (blanket); may sit close to family members while it is playing, or may show a manic quality while playing
- 3. The child moves without concentration from the toy to family members, movements are not connected to the activity; movements or play is agitated; twisting, moving on the table; grab family members
- 4. Tries to escape, pushes with feet and arms, may move its entire body; in the waiting-room, runs around without purpose, does not look at the toys, does not want to be apart from family members, stick on desperately

Vocalization

- 1. Reads, asks questions, makes comments, stutters, laughs, answers questions promptly, but is usually quiet; child is too young to speak in social situations or too absorbed in the play to answer;
- 2. Answers to adults but whispers, “baby talk”, only shake its head;
- 3. Quiet, no sound or does not answer to adults
- 4. Weeping, moaning, grunting, silent cry
- 5. Child is crying, or might yell “no”
- 6. Crying, high pitched and sustained cry

Expressing emotions

- 1. Happy, smiling, or concentrated on the play;
- 2. Neutral, no discernible face expression;
- 3. From worried (sad) to frightened, sad, worried, or teary eyes
- 4. Distressed, crying, uncontrolled, eyes might be wide opened

State of arousal

- 1. Alert, looks around occasionally, notices or follows anesthesiologist’s actions (might be relaxed)
- 2. Withdraw, calm and silent, might suck its thumb, or its face might be like an adult’s face
- 3. Attentive, looks around quickly, might be startled by noises, eyes wide opened, body is tense
- 4. Whine in panic, might cry or shun others, turns body around

Interaction with family members

- 1. It is concentrated while playing, is sitting down inactive or shows behavior appropriate to age and does not need family members, might interact with family members if they initiate the interaction
- 2. Seeks interaction with family members (gets close to them and talks to family members that were silent until then), seeks and accepts support, might lean against family members
- 3. Looks silently to family members, apparently observes their actions, does not seek contact or consolation but accepts it if it is offered, clings on to family members
- 4. Keeps family members at a distance or might leave the area when parents are present, might push family members away or stick desperately to them, not letting them go away.

=

$$\left(\frac{1}{4} + \frac{1}{6} + \frac{1}{4} + \frac{1}{4} + \frac{1}{4}\right) * 20 =$$

23.3 → 30 No anxiety
 30 → 100 Anxiety

=

mSSTAI

I feel Sad	NO(1)	MAYBE(2)	YES(3)	<input type="checkbox"/>	<input type="checkbox"/>
				+	+
I feel Happy	NO(3)	MAYBE(2)	YES(1)	<input type="checkbox"/>	<input type="checkbox"/>
				+	+
I feel Scared	NO(1)	MAYBE(2)	YES(3)	<input type="checkbox"/>	<input type="checkbox"/>
				+	+
I feel Calm	NO(3)	MAYBE(2)	YES(1)	<input type="checkbox"/>	<input type="checkbox"/>
				=	=

4 → 8 No anxiety

8 → 12 Anxiety

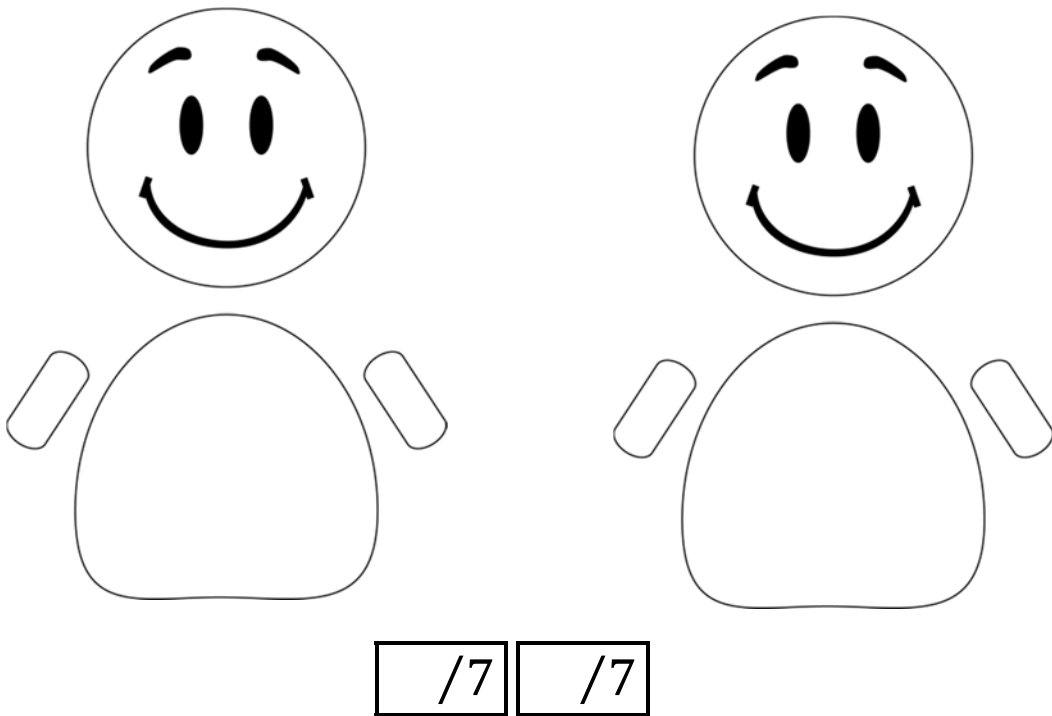
Affair of:

- Hospital
- Doctor
- Nurses
- Equipment: _____
- Other: _____

Affair of:

- Hospital
- Doctor
- Nurses
- Equipment: _____
- Other: _____

Instruments



Version: ____ Age: ____ Genre: ____

Playing with: _____

Bracelet color _____ condition _____

To children

What did you think about the game?

Terrible Pretty bad So-So Good Excellent

Do you want to play again? **YES** **NO**

Why _____

3 things you like about the game?

3 things you didn't like about the game?

Have you never played in a tablet before? **YES** **NO**

To the parent

Is this the first time he/she comes to the ER? **YES** **NO**

If **NO**

How many times have you visited the ER with your kid(s)? _____

What are the major concerns you have while waiting in the room?

What kind of methods, tools have you used to calm your kid(s) down while waiting?

3 things you like about the game?

3 things you didn't like about the game?

Thank you

IX – All playtest data

SUBJECT	GENDER	AGE	COLOR	VERSION	TIME	CLICKS	FACES	HAPPY	SAD	NO EXP	SAFE	ARROWS	BOX	HELP	INSIG	B MYPAS	B OBS MSSTAI-TM	B SELF MSSTAI-TM	A MYPAS	A OBS MSSTAI-TM	A SELF MSSTAI-TM	Subject
1	F	6	Y	F	698	207	75	72	3	0	11	69	10	0	42	43,33	6	6	23,33	4	4	1
2	F	9	Y	F	591	188	64	63	1	0	9	89	0	0	26	56,67	6	5	33,33	4	4	2
3	F	9	Y	F	468	147	45	45	0	0	7	81	0	0	14	55,00	6	4	28,33	4	4	3
4	F	6	Y	F	399	186	75	75	0	0	8	97	0	0	6	55,00	10	7	36,67	5	4	4
5	F	6	Y	F	856	246	105	96	9	0	9	113	0	0	19	58,33	10	5	33,33	5	4	5
6	M	7	Y	F	433	136	62	62	0	0	7	63	0	0	4	61,67	10	7	38,33	6	7	6
7	F	10	Y	N	586	129	56	0	0	56	7	57	0	0	9	55,00	10	10	46,67	6	6	7
8	F	14	Y	N	514	196	68	0	0	68	9	71	0	0	48	60,00	11	4	50,00	6	4	8
9	F	14	Y	N	545	143	42	0	0	42	9	83	0	0	9	50,00	10	5	45,00	7	4	9
10	F	17	Y	N	598	196	60	0	0	60	13	85	0	0	38	50,00	10	6	45,00	8	4	10
11	F	7	Y	N	595	165	62	0	0	62	8	55	0	0	40	45,00	6	7	41,67	6	7	11
12	F	13	G	N	571	146	49	0	0	49	7	73	0	0	17	53,33	8	4	46,67	6	4	12
13	M	13	G	N	1547	232	80	0	0	80	10	81	0	0	61	41,67	6	9	36,67	6	7	13
14	M	10	Y	F	546	216	49	48	1	0	10	131	0	0	26	51,67	10	4	36,67	6	4	14
15	F	9	Y	F	609	157	63	62	1	0	7	79	0	0	8	53,33	10	8	36,67	6	4	15
16	M	13	G	N	842	253	84	0	0	84	9	113	0	0	47	45,00	8	5	41,67	8	4	16
17	F	9	Y	F	822	263	77	76	1	0	8	131	0	0	47	50,00	8	6	41,67	5	4	17
18	F	9	G	N	774	194	68	0	0	68	7	73	0	2	44	41,67	6	4	36,67	4	4	18
19	F	5	G	F	1212	285	89	88	1	0	7	143	0	0	46	55,00	6	6	36,67	4	4	19
20	M	5	G	F	722	349	58	57	1	0	7	135	0	0	149	46,67	8	8	33,33	4	4	20
21	M	7	G	N	459	198	46	0	0	46	10	101	0	0	41	50,00	8	8	41,67	6	6	21
22	M	10	G	N	611	156	66	0	0	66	9	71	0	0	10	46,67	10	10	41,67	6	6	22
23	M	13	Y	N	443	172	40	0	0	40	14	101	0	0	17	51,67	6	10	46,67	5	8	23
24	M	11	Y	N	562	230	68	0	0	68	9	146	0	0	7	46,67	8	8	45,00	6	6	24
25	M	9	Y	F	355	159	74	73	1	0	7	67	0	0	11	58,33	10	9	41,67	6	6	25
26	M	9	Y	N	576	122	60	0	0	60	9	51	0	0	2	36,67	6	10	36,67	6	8	26
27	M	14	Y	F	323	146	47	47	0	0	9	83	0	0	7	50,00	10	10	33,33	6	6	27
28	M	13	G	N	459	153	50	0	0	50	7	95	0	0	1	41,67	6	8	41,67	6	6	28
29	M	10	Y	F	406	159	59	58	1	0	7	79	0	0	14	63,33	10	10	41,67	6	7	29
30	M	11	G	F	380	113	56	56	0	0	7	49	0	0	1	55,00	8	8	41,67	6	4	30

NO EXP - NoExpressions

INSIG –Insignificant

B MYPAS – Before the game MYPAS

A MYPAS – After the game MYPAS

X – Example of a .csv file

TimeStamp	TypeClicks	ContentsClicks	Location	Direction	ItemCollected	GoalAchived	MYPAS	MSSTAI-TM	SMSSTAI-TM
25	F	HAPPY	0	N	NONE	0	55	8	8
31	A	RIGHT	0	N	NONE	0	0	0	0
33	F	HAPPY	0	E	NONE	0	0	0	0
35	A	FRONT	0	E	NONE	0	0	0	0
37	F	HAPPY	2	E	NONE	0	0	0	0
38	A	LEFT	2	E	NONE	0	0	0	0
40	F	HAPPY	2	N	K_RED	1	0	0	0
42	F	HAPPY	2	N	NONE	1	0	0	0
43	A	LEFT	2	N	NONE	1	0	0	0
45	F	HAPPY	2	O	NONE	1	0	0	0
46	A	FRONT	2	O	NONE	1	0	0	0
47	F	HAPPY	0	O	NONE	1	0	0	0
51	A	FRONT	0	O	NONE	1	0	0	0
52	O	SAFE	1	O	RED	2	0	0	0
62	F	HAPPY	1	O	NONE	2	0	0	0
62	O	FLOOR	1	O	NONE	2	0	0	0
64	A	RIGHT	1	O	NONE	2	0	0	0
65	F	HAPPY	1	N	NONE	2	0	0	0
67	A	RIGHT	1	N	NONE	2	0	0	0
69	F	HAPPY	1	E	NONE	2	0	0	0
71	A	FRONT	1	E	NONE	2	0	0	0
80	F	HAPPY	0	E	NONE	2	0	0	0
82	A	LEFT	0	E	NONE	2	0	0	0
84	F	HAPPY	0	N	NONE	2	0	0	0
87	A	FRONT	0	N	NONE	2	0	0	0
91	F	HAPPY	3	N	NONE	2	0	0	0
93	A	RIGHT	3	N	NONE	2	0	0	0
96	F	HAPPY	3	E	NONE	2	0	0	0
98	A	FRONT	3	E	NONE	2	0	0	0
104	F	HAPPY	6	N	NONE	2	0	0	0
107	A	LEFT	6	N	NONE	2	0	0	0
118	F	HAPPY	6	O	K_ORANGE	3	0	0	0
120	F	HAPPY	6	O	NONE	3	0	0	0
122	A	FRONT	6	O	NONE	3	0	0	0
125	F	HAPPY	5	O	NONE	3	0	0	0
126	A	LEFT	5	O	NONE	3	0	0	0
127	O	SAFE	5	S	ORANGE	4	0	0	0
144	F	HAPPY	5	S	NONE	4	0	0	0
145	A	RIGHT	5	S	NONE	4	0	0	0
146	F	HAPPY	5	O	NONE	4	0	0	0
148	A	FRONT	5	O	NONE	4	0	0	0
151	F	HAPPY	4	O	NONE	4	0	0	0
152	A	RIGHT	4	O	NONE	4	0	0	0
154	F	HAPPY	4	N	NONE	4	0	0	0
156	A	FRONT	4	N	NONE	4	0	0	0
158	F	HAPPY	7	N	NONE	4	0	0	0
159	A	LEFT	7	N	NONE	4	0	0	0
161	F	HAPPY	7	O	K_YELLOW	5	0	0	0
163	O	SAFE	7	O	YELLOW	6	0	0	0
179	F	HAPPY	7	O	NONE	6	0	0	0

181	A	RIGHT	7	O	NONE	6	0	0	0
184	F	HAPPY	7	N	NONE	6	0	0	0
187	A	FRONT	7	N	NONE	6	0	0	0
190	F	HAPPY	9	N	K_GREEN	7	0	0	0
193	F	HAPPY	9	N	NONE	7	0	0	0
194	A	FRONT	9	N	NONE	7	0	0	0
196	F	HAPPY	10	N	NONE	7	0	0	0
199	A	LEFT	10	N	NONE	7	0	0	0
201	O	SAFE	10	O	GREEN	8	0	0	0
210	F	HAPPY	10	O	NONE	8	0	0	0
212	A	RIGHT	10	O	NONE	8	0	0	0
215	F	HAPPY	10	N	NONE	8	0	0	0
217	A	RIGHT	10	N	NONE	8	0	0	0
220	F	HAPPY	10	E	NONE	8	0	0	0
221	A	FRONT	10	E	NONE	8	0	0	0
224	F	HAPPY	11	E	NONE	8	0	0	0
226	A	LEFT	11	E	NONE	8	0	0	0
229	F	HAPPY	11	N	NONE	8	0	0	0
231	A	FRONT	11	N	NONE	8	0	0	0
234	F	HAPPY	13	N	NONE	8	0	0	0
236	A	RIGHT	13	N	NONE	8	0	0	0
237	F	HAPPY	13	E	NONE	8	0	0	0
239	A	RIGHT	13	E	NONE	8	0	0	0
241	F	HAPPY	13	S	K_BLUE	9	0	0	0
243	F	HAPPY	13	S	NONE	9	0	0	0
245	A	RIGHT	13	S	NONE	9	0	0	0
247	F	HAPPY	13	O	NONE	9	0	0	0
249	A	RIGHT	13	O	NONE	9	0	0	0
251	O	SAFE	13	N	BLUE	10	0	0	0
268	F	HAPPY	13	N	NONE	10	0	0	0
271	A	RIGHT	13	N	NONE	10	0	0	0
272	F	HAPPY	13	E	NONE	10	0	0	0
275	A	RIGHT	13	E	NONE	10	0	0	0
277	F	HAPPY	13	S	NONE	10	0	0	0
280	A	FRONT	13	S	NONE	10	0	0	0
282	F	HAPPY	11	S	NONE	10	0	0	0
285	A	RIGHT	11	S	NONE	10	0	0	0
287	F	HAPPY	11	O	NONE	10	0	0	0
290	A	FRONT	11	O	NONE	10	0	0	0
293	F	HAPPY	10	O	NONE	10	0	0	0
296	A	RIGHT	10	O	NONE	10	0	0	0
298	F	HAPPY	10	N	NONE	10	0	0	0
300	A	FRONT	10	N	NONE	10	0	0	0
307	F	HAPPY	14	N	K_PURPLE	11	0	0	0
312	F	HAPPY	14	N	NONE	11	0	0	0
319	A	LEFT	14	N	NONE	11	0	0	0
321	O	SAFE	14	O	PURPLE	12	0	0	0
334	F	HAPPY	14	O	NONE	12	0	0	0
336	A	RIGHT	14	O	NONE	12	0	0	0
338	F	HAPPY	14	N	NONE	12	0	0	0
340	A	FRONT	14	N	NONE	12	0	0	0
342	F	HAPPY	16	N	NONE	12	0	0	0
344	A	FRONT	16	N	NONE	12	0	0	0
348	F	HAPPY	19	E	K_PINK	13	0	0	0
350	F	HAPPY	19	E	NONE	13	0	0	0
351	A	LEFT	19	E	NONE	13	0	0	0
352	O	SAFE	19	N	PINK	14	0	0	0
369	F	HAPPY	19	N	NONE	14	0	0	0
371	A	RIGHT	19	N	NONE	14	0	0	0
373	F	HAPPY	19	E	NONE	14	0	0	0
374	A	FRONT	19	E	NONE	14	0	0	0
379	F	HAPPY	20	N	NONE	14	0	0	0
380	A	FRONT	20	N	EXIT	15	41,67	6	4