MY GARDEN OF EMOTIONS: GAME FOR UNDERSTANDING FACIAL EXPRESSIONS FOR AUTISTIC CHILDREN AND ADOLESCENTS

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Abstract

This work presents a game entirely in Portuguese for teaching emotional skills to children/adolescents with autism. The game, My Garden of Emotions [Meu Jardim de Emoções, in Portuguese] is made up of everyday child and adolescent situations, where the player must select the best emotion portrayed in the animation, through the name of the emotion and its respective facial representation. Many of the problems with autistics in detecting emotions are due to their lack of understanding of other views and the realization of the fact that people have different perspectives. In My Garden of Emotions the player is introduced to everyday situations to understand different aspects of emotions and thus improve their quality of life and social interactions.

Keywords: Autistic spectrum; understanding of facial expressions; ASD; educational games.

Resumo

Neste trabalho, é apresentado um jogo totalmente em Português para o ensino de habilidades emocionais para crianças e/ou adolescentes com autismo. O jogo “Meu Jardim de Emoções” é formado por situações do cotidiano infantojuvenil, e nele o jogador deve selecionar a melhor emoção retratada na animação, através do nome do

sentimento e de sua respectiva representação facial. Muitos dos problemas com autistas na detecção de emoções são devido à sua pouca compreensão de outras visões e da não percepção de que as pessoas têm perspectivas diferentes sobre os afetos. Dessa forma, em “Meu Jardim de Emoções”, o jogador é apresentado a situações do cotidiano para compreender os diferentes aspectos das emoções e, assim, melhorar sua qualidade de vida e suas interações sociais.

Palavras-chave: Espectro autista; compreensão de expressões faciais; TEA; jogos educacionais.

Introduction

Autism spectrum disorder (ASD), or autism, refers to a huge range of conditions characterized by challenges with social skills, repetitive behaviors, speech and non-verbal communication. According to the World Health Organization, ASD affects about 70 million people worldwide, with approximately 2 million cases in Brazil (Gomes et al., 2015).

There is not just one type of autism, but subtypes, most influenced by a combination of genetic and environmental factors. As autism is a spectrum disorder, each person with autism has a distinct set of strengths and challenges. The ways in which people with autism learn, think and solve problems can range from highly skilled to severely challenged. Some people with ASD may need significant support in their daily lives, while others may need less support and, in some cases, they live completely independently (Sharma et al., 2018).

Autism was first described in 1943 by the Austrian physician Leo Kanner, working at Johns Hopkins Hospital (Kanner, 1943). However, it was not until 1993 that the syndrome was included in the International Classification of Diseases of the World Health Organization. In Brazil, in December 2012, some of the rights of autistic people were guaranteed by law 12,764 (Lei n. 12764, 2012), named the “National Policy for the Protection of the Rights of Persons with Autism Spectrum Disorder”. In summary, the law recognizes that people with autism have the same rights as all other patients with special needs in Brazil.

Even the latest research shows that early intervention leads to positive outcomes later in life for people with autism (Vivanti et al., 2020) (Paynter et al., 2020), the reality

remains quite different. We still have many difficulties in Brazil to access treatment and therapies for individuals with ASD. Thus, it is important to think about approaches to improve the quality of life since childhood, but also think about today's adolescents and adults who have not had access to early treatment.

An interesting point that we see is that the advance in the use of technologies to improve the quality of life of patients with ASD has gained a lot of space. The child/adolescent with the disorder has difficulty interacting with others and understanding feelings. The best way to teach it is through activities that encourage observing facial expressions, and thus acting accordingly (Grossard et al., 2019). They also have a certain predilection for using tablets, smartphones, computers, among other electronic devices. Board games, chips, pieces and figures are less attractive, even so, they are the most suitable for the younger ones (Boucenna et al., 2014).

Currently, the digital game options available to this audience are aimed at the development of personal autonomy in order to assist in the learning of everyday tasks (for example: cleaning the room, dressing, eating, etc.), and there are also those focused on the cognitive areas (generally speaking, reading or writing). Furthermore, in the current market, there is a clear lack of games in Portuguese, which makes it difficult to use them within Brazilian reality (Barbosa et al., 2020). Finally, we see that most of the scenarios presented are aimed only at children, making it necessary to also think about the teenager who has not had access to treatment since childhood.

In this way, this work proposes a game entirely in Portuguese for teaching emotional skills to children/adolescents with autism. Through the combination of playfulness and memorization, it is possible to make the learning process less tiring and adequate to the Brazilian situation.The game My Garden of Emotions is made up of everyday situations for children and teenagers, where the player must select the best emotion portrayed in the animation, through the name of the emotion and its respective facial representation.

The article sections are organized as follows: Section 2 presents the theoretical referential, giving notes on teaching approaches that must be taken into account when developing a game for autistic people and how are the works currently found in the literature; Section 3 presents the game proposed in this article, showing some of its scenes, gameplay, mechanics and technologies used; Section 4 presents a discussion of the differences of this game in relation to literature; and finally, in Section 5 the

conclusions are pointed out.

Related Works

Several psychologists and pedagogues, such as Piaget et al. (2006), Vygotsky (1994) and Mora (2019) have highlighted the important role of motivation and affectivity in learning. For Piaget et al. (2006), without affection, the subject would not be interested in unraveling problems or making discoveries. The lack of questions, due to lack of interest or motivation, can represent an obstacle to the development of intelligence.

For children with ASD, however, learning is different. Social interaction occurs in an atypical way, there is little response to the other, especially with eye contact, and the approach, often, in an attempt to interact, occurs in an inappropriate way. In certain social situations, such as in school recess or in the cafeteria, it is a challenge to maintain reciprocity and there is a difficulty in understanding social rules and interpreting them (Swaiman, 2018).

The hallmark of ASD is the deficit in non-verbal communication, which ranges from the total lack of facial expression to the lack of integration of gestural communication (eye contact, smile, point, nod, send a kiss, shrug) with verbal communication. Receptive language is generally less compromised than expressive language in highly verbal children with ASD (Christensen et al., 2016). Even with failures in social skills, children and adolescents with ASD can become socially competent with appropriate stimulation and education (Sharma et al., 2018).

In this work we focus on understanding emotions and facial expressions. Many of the problems with autism in detecting emotions are due to their lack of understanding of other points of views and the realization of the fact that people have different perspectives. So paying attention to this disorder and trying to improve it in children with autism is very important.

Information and Communication Technologies (ICTs) have been playing a significant role in teaching facial expressions and understanding emotions to children with autism (Navan & Khalegi, 2019). This is mainly because: 1) children/adolescents with ASD generally like to play electronic games and are interested in ICTs (Boucenna et al., 2014); 2) their predictability makes them reassuring (Mitchell et al., 2007); 3) ICT tools allow creating environments close to real life, but keeping the child in a protected

area (Josman et al., 2008).

Currently, digital game options for children with ASD focus on developing personal autonomy, teaching everyday tasks such as tidying the room, dressing, eating, among others. There are also those focused on the cognitive areas, usually in relation to speaking, reading and/or writing. It is important to highlight that there is a clear lack of games in Portuguese on the market, which makes their use in the Brazilian reality difficult (Barbosa et al., 2020). It is also noticed that most of the scenarios presented in the games are aimed only at children, making it necessary to also think about the teenager or adult who did not have access to early treatment.

Barbosa et al. (2020) wrote a compilation about educational games for autistic people, mainly those that approach alternative communication or literacy. Fifteen games were analyzed for this audience, only 1 of which also presented the theme of understanding facial expression: Robbie the Robot. This game features 3D animations and a real person's face to communicate the emotion the character is feeling. The main focus is to link the words related to feelings to your facial expression. Unfortunately, the game also doesn't associate some everyday situation with an emotion. Also, the game is all in English. It is interesting to note that the authors of (Barbosa et al., 2020) pointed out the difficulty of finding games in Portuguese for autistic people.

A more extensive compilation of games is presented by Grossard et al. (2017). The authors found a total of 31 serious games that were designed to improve the social skills of autistic individuals. Sixteen of these games specifically aimed at recognizing or producing facial emotions, and 15 were aimed at training more general social skills, such as interaction, collaboration, and adaptation to specific social contexts. The authors pointed out that many games are aimed at highly functional people, while many individuals with ASD have intellectual disabilities, as stated by Amiet et al. (2013).

Some of the games featured in Grossard et al. (2017) require good reading skills and are therefore not accessible to a large proportion of people on the spectrum. A small number of games attempt to circumvent this challenge with oral explanations. However, for most autistic people, listening is difficult and they may find it difficult to play them. The focus of training with these individuals tends to emphasize basic communication needs, such as attention to faces and eye contact (Amiet et al., 2013). Unfortunately, only a few serious games have addressed such basic non-verbal skills that are nevertheless relevant to the growth of the autistic person. Within this compilation, there was no game

in Portuguese.

My Garden of Emotions

In this work, a digital game was designed in which the child/adolescent who is on the autistic spectrum will be able to deal with everyday situations through characters, to train and improve their emotional skills. The goal is for the player to understand himself and others, and also learn to relate to the world around him.

As it is a disorder with different cases, it would not be possible to specifically cover the needs of each player. Therefore, the objective is for the game to have a certain linearity. A study by Assumpção-JR et al. (1999) shows that the recognition of these expressions must occur in a progressive way in relation to the child's development and the greater complexity of the expression presented. Based on the results of this study, the implementation of the difficulty level in the game My Garden of Emotions spontaneously adapts to the complexity of each particular everyday situation.

Below, we present the technologies used, the main related concepts and how the game mechanics are like.

A. Technologies used

Unity[1]: Game engine created by Unity Technologies for creating games in two or three dimensions. Its choice is due to the possibility of free development in it and for being a cross-platform tool. Initially, My Garden of Emotions is a game for mobile devices. However, with the use of Unity we can open the possibility of distribution on different platforms.

C#: Strongly typed, multi-paradigm programming language developed by Microsoft as part of the .NET platform. It is the language used for game development in Unity.

Canva[2]: Graphic design platform available online that allows users to create social media graphics, presentations, infographics, posters and other visual content. It was used throughout the creation of the art, such as the characters, animation scenarios, menu

[1] https://unity.com/
[2] https://www.canva.com/

elements and selection sheets.

Adobe Spark[3]: is an integrated suite of web and mobile media creation applications developed by Adobe Systems3. It comprises three separate design applications: Spark Page, Spark Post and Spark Video. Used in the montage of animation scenes.

B. Related concepts

Autistic spectrum disorder (ASD) is characterized by specific aspects, the main difficulties being observed in the areas of social skills, speech and communication, repetitive behaviors, and some peculiarities. Symptoms, as well as their intensity, vary from person to person, thus configuring levels that facilitate the study and development of treatment methods. Most cases are diagnosed late, however, the signs can be observed even in childhood, especially during schooling. The child with the disorder has difficulty interacting with others and understanding feelings.

The purpose of the proposed game is to help understand human emotions from facial expressions. We can define Human Emotions as a set of physical-emotional sensations that are manifested by the human being through some stimulus. They are the ones that make us react to events in different ways, and they also actively participate in the set of characteristics that shape our personality.

Although there are different ways of expressing emotions, most research focuses on facial expression. Ekman (2007) and Plutchik (2005) consider that this situation can be explained by the fact that the face is the human body region with the greatest resources for expression, since its main muscles are concentrated in the oral region, being also responsible for mastication, which results in the possibility of movement in different directions. Muscles that are also involved in facial expression are the muscles of the eyebrows, forehead, eyelids, and neck, although these have less freedom of direction.

There is no consensus on which are the main emotions, but researchers from the Social Interaction Laboratory at the University of Berkeley (Cowen & Keltner, 2017) after studies pointed to the existence of 27 emotions: admiration, adoration, relief, yearning, anxiety, aesthetic appreciation, rapture, calm , confusion, sexual desire, pain,

[3] https://spark.adobe.com/

astonishment, estrangement, excitement, horror, envy, interest, joy, fear, disgust, nostalgia, anger, romance, satisfaction, surprise, boredom, sadness. In the literature, it is common to find the nomenclature “basic emotions” to distinguish different classes of emotions. Most authors usually cite the following or some variation of them: joy (or happiness), fear, surprise, sadness, disgust, contempt and anger (Paxiuba & Lima, 2020).

For this work, we selected six of the basic emotions as shown in Figure 1: Happiness, Fear, Disgust, Anger, Surprise and Sadness. These emotions were initially chosen for their very distinct characteristics in relation to facial expressions.

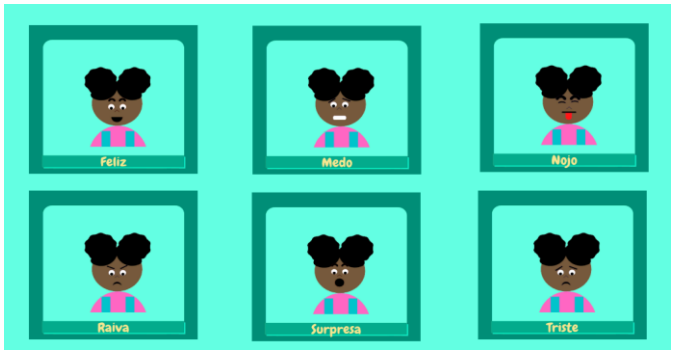

Figure 1 – The six emotions represented in the game: happiness, fear, disgust, anger, surprise and sadness.

Through understanding the situation and related emotion, the player will be able to acquire emotional skills. Emotional skills, or even socioemotional skills, are a set of skills developed from the Emotional Intelligence of each person. In summary, they point to two types of behavior: your relationship with yourself (intrapersonal) and also your relationship with other people (interpersonal).

The methodology for teaching facial expressions adopted is based on the principles of the ABA (Applied Behavior Analysis) approach. In this approach, frustrations with errors are avoided and one always tries to teach through positive reinforcement (Fernandes & de la Higuera Amato, 2013). Other important points of ABA therapy (Vismara & Rogers, 2010) that we took into account when creating the game are:

- Adaptation of the program to the needs of each person.
- It can be done individually or in a group.
- It can be done at home, at school, in clinics and even in shared spaces.
- Teaches useful skills for everyday life.

C. Game dynamics

The game My Garden of Emotions is formed by eighteen stories with situations of children's daily life distributed in six levels featuring 3 main characters: Camila, Diogo and Marcelo. To also help the player understand everyday life in society, the main characters have different ethnicities and disabilities. In this way, it is also possible to work on the inclusion of different minority groups in society. So we have: Diogo is a white blond boy who needs a wheelchair, Marcelo is a brown boy and Camila is a black girl. These are represented in Figure 2.

The game has 3 main stages: animation/situation, selection and hit/miss which leads to the score screen. The game begins by presenting a situation of the daily life of the 3 characters. After the situation is displayed (Step animation in Figure 3), six cards are presented to the player who, in turn, must select the one that best represents the emotion portrayed in the animation (Step selection in Figure 3). If there is an error, the cards reappear for the child to try again until successful. In the case of a hit (Step hit in Fig. 3), a flowerpot with one more flower is shown. The game continues until all flowers are present in the garden. The dynamics of the flowers was chosen to facilitate the assimilation of all the proposed teaching.

Figure 2 – Example of a level showing the characters Diogo, Marcelo and Camila. Diogo is a white blond boy who needs wheelchairs, Marcelo is a brown boy and Camila is a black girl. The text says: "Marcelo was the first. He jumped very high!".

Figure 3 – Flow of stages of the game My Garden of Emotions: Animation, Selection, Hit (or Miss) and Next Phase.

Figure 4 – In this example situation, Camila packs her bag to go out to play. The text says: "She was so excited that she decided to go for a walk. She put her favorite toys inside and left.".

Figure 5 – In this example situation, Marcelo is apprehensive because a ball may hit his toy castle. The text says: "It looks like it is going to hit Marcelo's castle.".

The Animation Stage (Situation) tells a small story that happens with the characters and that generates a specific emotion. For example, in the situation presented in Figure 2 we have the three main characters playing jump rope. The situation is explained through a simple drawing and easy-to-read text, as indicated to be the best

approach by Grossard et al. (2017).

The everyday situation can be experienced both by the group of friends, as shown in Figure 2, and individually (Figure 4 and Figure 5). A complete story example is shown in Figure 6. The animation starts with Diogo and Camila fighting over a ball. The ball ends up escaping the children's hands and flies until it falls into Marcelo's toy castle. According to Marcelo's facial expression, the player must respond how the character felt.

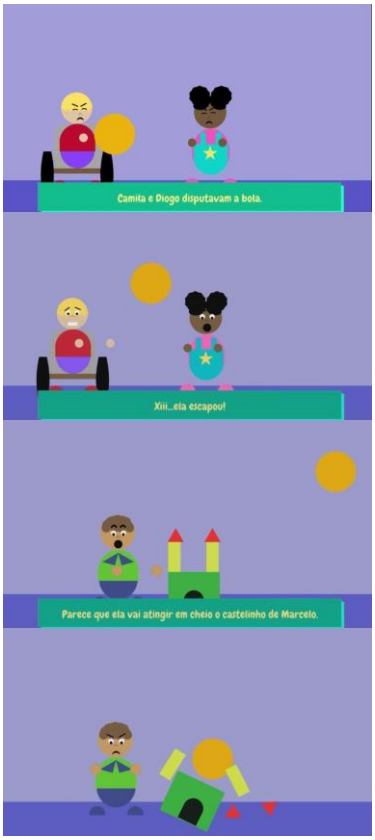

Figure 6- The animation starts with Diogo and Camila fighting over a ball. The ball ends up escaping the children's hands and flies until it falls into Marcelo's toy castle. According to Marcelo's facial expression, the player must respond how the character felt.

The Selection Step occurs as soon as the animation ends. A question is placed on the screen (Figure 7) clearly showing which character we want the player to indicate the emotion expressed: How did [character name] feel?. Soon after, the screen of emotions and their respective facial expressions is displayed (Figure 8). The six emotions represented in the game are: Happiness, Fear, Disgust, Anger, Surprise and

Sadness. Each character is represented according to the situation presented.

Figure 7 – Example of a situation-related question showing which character we want the player to indicate the emotion expressed: "How did Marcelo feel?".

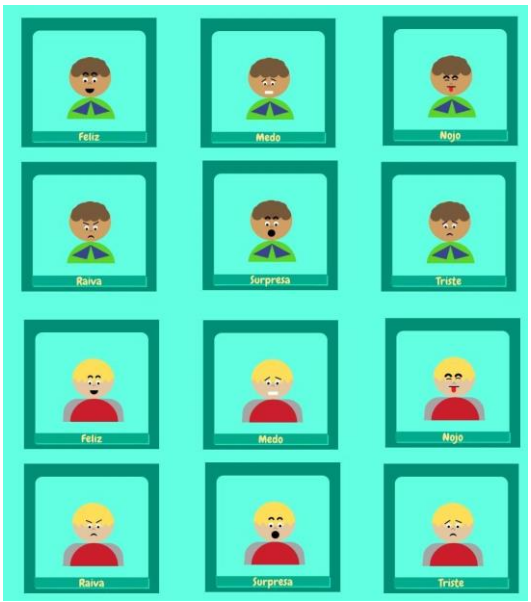

Figure 8 – The six emotions represented in the game: Happiness, Fear, Disgust, Anger, Surprise and Sadness. These emotions were initially chosen for their very distinct characteristics in relation to facial expressions. Each character is represented according to the situation presented.

Finally, the Hit and Miss Step. When the player doesn't get it right, the "Try Again" screen is displayed with happy expressions to encourage the player to keep trying (Figure 9). When the player gets it right, the "You've got it" screen is displayed, also with expressions of happiness to encourage the player to proceed to the next phase (Figure 10). According to Barbosa et al. (2020), the most interesting thing in both communication and literacy games was when both simulated the ideal behavior of a tutor who praised the success of these autistics without punishing their mistake, making them repeat the

process several times until they hit. Here, we simulate the same situation.

Figure 9 - When the player doesn't get it right, the "Try Again" screen is displayed with happy expressions to encourage the player to keep trying.

Figure 10 – When the player gets it right, the screen “You've got it right” is presented with expressions of happiness to encourage the player to proceed to the next phase.

Figure 11 – Scoring is done by creating a flower garden. Each vase in the garden represents three hits in the game.

The scoring mechanism is done by creating a flower garden (Figure 11). Each vase in the garden represents three hits in the game.

My Garden of Emotions ends when the player manages to hit the emotions of all the situations presented and the shelf is complete with all the flowers. This points system

allows the user to quickly visualize their growth in the game, the more points, the more flowers. In addition, the points can serve as a stimulus for the player to continue in the game. This scoring strategy is highly related to the ABA therapy approach.

Discussion

My Garden of Emotions is a digital game entirely in Portuguese for understanding facial expressions for autistic children and adolescents. Following the ABA approach, we are concerned with following four basic principles already mentioned:

- Adaptation of the program to the needs of each person: For each situation presented in the animations, we can associate the behaviors that we want to increase or reduce, opening the later discussion of why the character may have felt that emotion.
- It can be done individually or in a group: the game is made for a mobile platform, but it can be used together with therapy to promote conversation and arrive at which expression and name of the emotion is associated with that animation.
- It can be done at home, at school, in clinics and even in shared spaces: as the game is made in Unity, it is possible to democratize its distribution for any mobile platform, as well as for consoles and the web.
- Teaches useful skills for everyday life: the purpose of each situation is to show the daily life of the main characters in situations that generate one of the emotions represented in the game (Happiness, Fear, Disgust, Anger, Surprise and Sadness).

Also, the scoring system does not punish the child in case of mistake, they are always encouraged to keep trying to complete their flower garden.

The game mechanics associates an everyday situation with an emotion, this facilitates the adaptation for different ages, which adapts well to the Brazilian reality, due to the late support to individuals with ASD. One of these adaptations is some histories for adolescents. We add for them daily situations not just related with child's play, but with interactions with other teenagers (Serbai & Priotto, 2021). The mechanics of the

game are the same, only the situation is changed. Figure 12 shows one example of it.

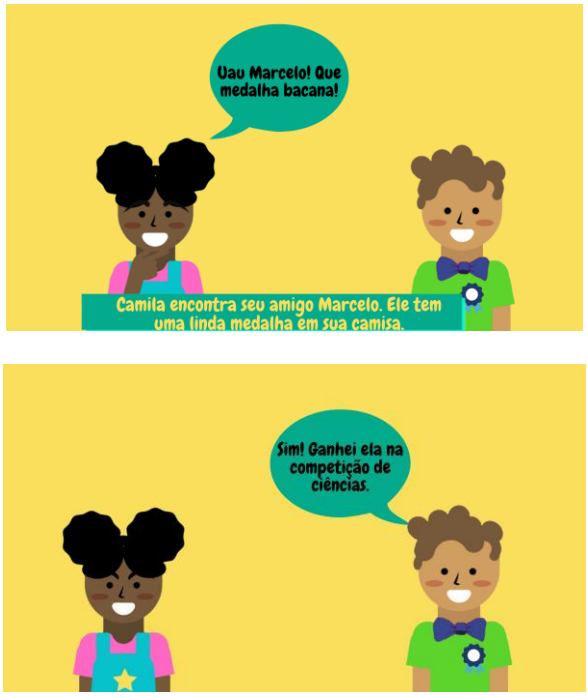

Figure 12 - Camila and Marcelo are talking about a medal that Marcelo has won in a Science Competition. Camila says "Wow, Marcelo! That is an awesome medal". Marcelo responds "Yes, I won it in a Science Competition".

Each animation is made in a simple way, with simple texts and audio description to facilitate understanding for people with ASD. Here it is necessary to indicate a limitation of the game. For autistic people with low literacy and difficulty reading and understanding, the game created can be quite challenging. We intend to study other forms of association between emotion and facial expression for individuals with more severe difficulties.

One point that we took great care to include in My Garden of Emotions was the diversity of the characters. This helps the autistic child also perceive the diversity of the environment that surrounds him.

As children and adolescents with ASD may have attention problems and a strange response to the environment and attentional stimuli such as sensitivity to noise and touch (Sharma et al., 2018), we chose to avoid unnecessary stimuli. Throughout the game there is only the sound of the narration of the story and images only related to the situation being described.

It is important to emphasize that the game must be used in conjunction with

professional monitoring, and can even be of assistance during the attendance.

Conclusion

In this work, the game My Garden of Emotions is presented entirely in Portuguese for teaching emotional skills to children/adolescents with autism. The game is made up of everyday child and adolescent situations, where the player must select the best emotion portrayed in the animation, through the name of the emotion and its respective facial representation. The six emotions represented in the game are: Happiness, Fear, Disgust, Anger, Surprise and Sadness.

The game follows the principles of ABA therapy, making learning facial expressions playful and always with positive reinforcement.

An important point of My Garden of Emotions was to have diversity in the characters. This helps the autistic child also perceive the diversity of the environment that surrounds him. So we have three main characters: Diogo is a white blond boy who needs a wheelchair, Marcelo is a brown boy and Camila is a black girl.

One of the game's limitations is that it focuses on narrated and written situations, which can be a problem for low-functioning autistics. We intend to study other forms of association between emotion and facial expression for individuals with more severe difficulties.

For future work, we will analyze the application of the game within the therapy for children/adolescents with ASD.

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