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CAN ROBOT TEACH EMOTION RECOGNITION AND REGULATION TO YOUNG GENERATIONS?

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ABSTRACT

The importance that emotions play in education and the impact they have on a person's life is decisive. Emotional intelligence is widely recognized and sought after which, together with many other abilities, make up a person's intelligence. Emotional intelligence is a skill that we develop from an early age and the experiences we have in childhood are fundamental. The relationships we establish are so impactful that they outline what will be the mechanisms with which we will automatically respond to all the other relationships in our lives. This is why we have started workshops aimed at teaching children in nursery schools how to recognize emotions and what strategies can be used to manage them better.

We integrate this important aspect about emotion recognition and regulation together with the innate interest that children have for robots. Our aim was to present in an attractive way something that we believe is truly useful for the personal growth of everyone.

We thus qualitatively analyzed the same through direct observation and informal talks with the teachers.

CHAPTER 1

Emotion regulation and robots

1.1 Emotion regulation and development

"*If your emotional abilities aren't in hand, if you don't have self-awareness, if you are not able to manage your distressing emotions, if you can't have empathy and have effective relationships, then no matter how smart you are, you are not going to get very far.*"

Daniel Goleman

The ability to self-regulate one's emotions, and to know how to recognize, name, and experience them in a conscious and useful way, is the most precious ability that an individual can acquire and develop throughout his life. All the other facets of what we define as intelligence do not in themselves offer total satisfaction to those who possess them, while those who manage to have emotional intelligence live a fulfilling and serene life despite not simultaneously possessing all the other characteristics that are considered components of intelligence. For example, being able to make complex mathematical calculations and having extensive economic knowledge is not enough to guarantee success in the workplace. Together with technical useful skills, it is necessary to have good problem-solving abilities, stress management skills, and the ability to work in a team. This is impossible without good emotional competence: knowing and managing one's own emotions efficiently and being able to recognize and understand the emotions of others by empathizing with them.

Early development of emotional regulation is crucial, particularly in preschool years. Research indicates that preschool children who develop strong emotional regulation skills tend to perform better academically and socially in later years. Effective emotional regulation in preschoolers is associated with better peer relationships, reduced behavioral problems, and

enhanced readiness for school. These early skills are foundational for long-term emotional health and well-being. In contrast, difficulties in emotional regulation during preschool years can lead to a range of issues later in life, including increased risk for mental health problems, academic challenges, and social difficulties.

There are several scientific studies in the literature which state that emotional regulation/emotional dysregulation in children is a predictive indicator of depression in young adolescents (Hollender et al., 2024), a predictive indicator for developmental psychopathology (Cavicchioli, Tobia, and Ogliari, 2023), a risk factor for both substance and behavioral addictions (Estévez, Jáuregui, Sánchez-Marcos, López-Gonzales, and Griffiths, 2017), a predictive indicator for eating disorders (Shiver et al., 2020) and (Trompeter et al., 2023), a moderator factor between self-reported psychological stress and paranoia (Krkovic, Krink, and Lincoln, 2018), a predictive indicator for suicidal ideation among adolescents and young adults (Swee, Shochet, Cockshaw, and Hides, 2020), a predictive indicator for juvenile arrest (Kempt et al., 2017), and a prospective predictor for PTSD after a traumatic event (Bardeen, Kumpula, and Orcutt, 2013).

"*Helping people better manage their upsetting feelings—anger, anxiety, depression, pessimism, and loneliness—is a form of disease prevention. Since the data show that the toxicity of these emotions, when chronic, is on a par with smoking cigarettes, helping people handle them better could potentially have a medical payoff as great as getting heavy smokers to quit*."

Daniel Goleman

Considering all the implications that good emotional regulation ability has on people's lives, it is seen today as an important objective both in family life (Paley and Hajan, 2022) and in academic environments (Sala, Pons, and Molina, 2014), (Herndon, Bailey, Shewark,

Denham, and Bassett, 2013), (Bailey, Denham, Curby, and Bassett, 2016), and (Valiente, Swanson, deLay, Fraser, and Parker, 2020).

It is from the collaboration of these two realities that the individual is able, from his first years of life, to meet caregivers. Caregivers could transmit to the individual the ability to recognize the sensations that make up emotions, distinguish between various emotions, and recognize in oneself and others, how to experience them. If the caregivers teach a healthy emotional response this will be useful for the rest of the individual's life. Unfortunately, not all caregivers we encounter in our lives are skilled in emotional intelligence. Every caregiver passes only what they know: if they don't know how to manage their own emotions, they will also teach this to those around them.

This remains a challenge also for health professionals who have the duty to disseminate the knowledge acquired to make people aware of emotional intelligence and offer them the tools to become active actors towards the search for health that considers all the spheres of which it is composed without focusing more on a single aspect but giving it its due in its entirety: physical health, mental health, and spiritual health.

1.2 The role of technology and robots in development

In our daily lives, we are increasingly in contact with technology: from Alexa's alarm clock to Google Maps directions, our lives are characterized by interactions with complex robots.

We can find research in the literature that helps us understand how people's perception of robots has changed over time. If initially there was a rampant fear that robots could only steal our jobs or be the authors of the destruction of humans, today we are trying to be more aware and understand how to best use these tools. Even if the differences between robots and humans remain clear in our brains during and after interactions with robots, as demonstrated

by a study by Cross et al., 2019, on the impact of socialization with robots on our brain, we consider the robot in the position of a social agent as a true representative figure, endowed with all the characteristics that we recognize in a person (Clark and Fischer, 2022), (Girouard-Hallam and Danovitch, 2023), (Haber and Corriveau, 2023), and (Goldman, Baumann, and Poulin-Dubois, 2023). The same rules that apply to establishing a good relationship between human beings therefore apply to a good relationship with robots (Szondy and Fazekas, 2024), (Schina, Valis-Bautista, Borrull-Riera, Usart, and Estévez-Gonzales, 2021), and (Brink and Wellman, 2020). Thus, a good attachment and a condition of trust are necessary, both conditions that are built with interaction and customization of the robot based on the user's needs and suggestions. If we can appreciate the use of robots is increasingly widespread in the home care of people with disabilities (Pascher et al., 2022) and in situations where safety requires it such as during and after the recent Covid pandemic (Getson and Nejat, 2022), we still have some questions about the interaction between robots and children. We ask ourselves what precautions should be taken and what limits should be applied to these interactions because, if as adults we struggle to relate correctly to robots, how difficult is it for a child?

The child, as such, is not able to distinguish and discern on his own, but he needs and has the right to be guided and helped in gathering all the information and all the tools he will need to develop critical thinking. Here we find research in the literature that considers the ethics to be applied in child-robot interaction (Langer, Marshall, and Levy-Tzedek, 2023), trying to use robots as tools to intervene in the lives of children, for example providing relief during surgical operations (Spinoit, Nguyen, and Subramaniam, 2017) and encouraging hygiene staff (Pasuletti et al., 2023). Robots can therefore provide a valid help in everyday life as well as in complex situations if used consciously and thoughtfully manner for the good of the users. We maintain that it would be foolish not to exploit a tool like robots in areas whereby doing so can bring relief or help to people.

This does not mean that the use of robots is useful or applicable in every situation. We should be able to evaluate and discern well by evaluating both immediate and long-term risks and benefits on a case-by-case basis.

1.3 The role of robots in learning processes

Considering the point at which technology has reached today, we can say that robots are not able to replace a human teacher (Serholt, Ekström, Küster, Ljungblad, and Pareto, 2022) but that students perceive the guidance and support offered by teachers during lessons as important. Students can perceive the topic as clearer and work better when the teacher is present in the classroom together with the robot compared to the exclusive presence of the robot (Serholt et al., 2022). This is certainly not a disadvantage; the purpose of using robots in teaching is certainly not to find an effective substitute for the teacher. What we are trying to achieve with the introduction of robots in the educational field is support for the teaching staff and a way to excite students, thus helping them to find fascinating and captivating topics. There are therefore valid possibilities for the development of this type of use for robots as proposed by Pareto, Erkström, and Serholt (2023) who, in their research, compare two different types of learning: learning from peers and learning from robots. In peer learning we have two individuals learning from each other. This is useful because skills belonging to different people combined enrich both subjects. The advantage we can obtain by introducing the robot into this process is being able to teach without having competent individuals in the field. When we are faced with people who are immature on a topic and cannot effectively train new generations in that field, we can pass on this knowledge by robots. When we talk about robots in the educational field, a very important limit is brought by the robot itself; the type of robot used, and its technical characteristics make a great difference in achieving the objective (Westlund et al., 2017). Much progress can be made by trying to create robots able

to respond to the educational needs of the various age groups and personal differences that students bring to schools. Therefore, if we do not dwell on the difficulties and look for a useful way to integrate and support the teacher's work with the tools that the robot can provide, we arrive at a more captivating and complete educational method, capable of involving and exciting the students, guaranteeing them the security and reliability that the figure of the teacher represents (Kori-Westlund and Breazeal, 2019).

Here are some successes obtained by teachers through collaboration with robots: it is possible to work towards linguistic success for students (Rohlfing et al., 2022), it is possible to achieve the desired objectives in the field of disabilities (Warren et al., 2015), it is possible to help children improve their relationship with emotions (Littler, Alassa, Dimitri, Smith, and de Witte, 2021), and also the gap in accessibility and study of STEM subjects can be reduced (Li et al., 2022).

CHAPTER 2

Methods

2.1 Aim of the project

With this project we asked ourselves two questions. The first was to understand to what extent kindergarten children can grasp topics such as sensations, emotions, and emotional regulation strategies. The second objective was to understand whether using robots to transmit this knowledge is a good means or whether this was not suitable in this educational field. The laboratory was part of PNRR projects (National Recovery and Resilience Project) subsidized by the Italian State. By subsidizing this type of project, the Italian state aims to provide schools with the economic means to lay the foundations for a long-lasting and sustainable development of the economy. Equipping future generations with the elements that make up emotional intelligence means giving the Italian population a boost.

2.2 Participants

The offer was open to all schools in the city and province of Padua (Veneto, Italy). Given that the project was subsidized by the Italian state, there were no financial constraints for the schools. Each school was able to choose freely and free of charge whether to join the project or not.

Two nursery schools in Montemerlo di Cervarese Santa Croce (PD) and a nursery school in Silea (TV) decided to join our project. All schools participated with two classes each for a total of six classes of pre-school children aged 5 to 6 years. In total, 80 children were registered to participate.

Due to flu, we did not have all the children present every day. But every time, the first part of the content that had been presented the previous meeting was reviewed to be sure that all the children were equally aware of what was going on.

2.3 Procedure and measures

2.3.1 The emotion regulation robot laboratory

Our intervention in the school was structured as a workshop lasting 10 hours per class divided into two hours a day for five days. This organization was designed to allow us to establish a relationship of trust with the children and an ongoing relationship to avoid loss of information between one meeting and another. At this stage children have a very limited attention span and a concept of personal time so they can quickly forget the information received. A workshop in which they receive information clearly and continuously for five days was the solution we thought of to maximize our intervention.

The robot used was the Mtiny to which we gave the name "ROB" which is easy to

associate with the word "robot" for children.

Having already had experience of how useful storytelling could be in approaching nursery school children, we gave our robot the role of protagonist in a story about the discovery of emotions.

on the first day we dedicated a space to presentations: we explained to the children that we would embark on a journey to discover emotions and, as in all journeys, you don't leave without knowing those you go away with. After the presentations we proposed a game to deepen mutual understanding: everyone rolled the dice and, based on the number that came out, they could share their favorite thing with everyone. The final moment of the presentations was dedicated to the introduction of the robot. We then told the children Rob's story: Rob is a robot who, having large eyes, was designed to supervise the production of toothbrushes, but after a motherboard failure he was taken to the repair room. from that room it was possible to see the garden of a school and Rob, once repaired, instead of returning to the factory, went out into the garden. He began to perceive completely new sensations in the garden, such as the tickling of the wind, the cold of the stones and the dampness of the grass, the heat of the sun, its heart beating strongly and the muscles tense while running away scared of a dog, the panting when you stop after a scare.

On the first day, we allowed the children to experience, through the example of the robot, the sensations that we perceive several times during the day, most of the time, without paying attention.

On the second and third day we dedicated space to the association of these sensations with emotions, having the robot meet animals that perceived several sensations which together made them feel an emotion. We chose to present the emotions that, in our opinion, are experienced more frequently at their age: happiness, fear, anger and sadness. The limited time did not allow us to deal with other emotions that we consider equally important.

On the fourth day we tried to convey to the children that emotions become a problem when they are so intense that they do not allow us to be ourselves: the animals that the robot encountered had been flooded by the emotion that was so great that it overwhelmed them like a wave and they could no longer control themselves, their decisions were dictated by the

emotion that ran through them and no longer by themselves. Here, from the window of good functioning (for us the green zone of a volcano), the animals ended up either in the red zone (thus exploding with happiness, fear, anger) or in the blue zone (blocked by sadness). Rob, who had never felt these emotions, was trying to understand what they were and how to help his new friends feel good again and return to the green area of the volcano.

The fifth day was dedicated to teaching the various emotional regulation strategies. To adapt the teaching and make it stimulating for the children, we created the figure of a superhero of emotions, explaining to the children that each of them had already been a superhero of emotions within themselves every time they had managed to master and manage an emotion well. We saw how this superhero of emotions had a suitcase with some tricks and helped the robot and his friends return to the green zone of the volcano, where emotions are present but manageable. We explained in this way which strategies each of us can use to manage our emotions so that they become an ally and not a limit in our lives.

For each day, we also combined some handcrafts, trying to make the concepts settle through the manipulation of materials and the creation of drawings which, hung in the school, would be a good reminder of the activity carried out together. We also played different games and sang some simple songs about sensations and emotions to help them to remember some important terms that could remind them of the topic discussed together.

2.3.2 Data collection and analyses

During our project two people entered the classroom to carry out the workshop. The person called "expert" had the task of presenting the topic and directing the activity while the person called "tutor" had the task of having an overview and helping with class management. This allowed us to have the situation under control from two different points of view. Furthermore, while one of the two people managed the class, the other could focus on

someone or something. The presence of a second person allowed to collect observational data, that is why on researcher was conducting the activities, the other was taking notes. In addition to this, to understand the effectiveness of our project was collected information through interviews with the teachers. Such interviews took place at the beginning and at the end of the entire intervention but also before and after each meeting. During all the five lessons we discussed with teacher and asked for feedback and clarify doubts and perplexities. how important such an approach was for families. Having worked in the same school two weeks in a row, with different classes, we had time to collect feedback from the teachers also in the following days to form a more complete idea of our work.

CHAPTER 3

Results and discussion

3.1 Results

For the purpose of the present thesis, we focused just on qualitative observation data and feedback from the teachers. Here we shortly summarize our main findings.

During the hours spent with the children we were able to see that the robot was the favorite part of the laboratory: after the presentation of the robot at the end of the first meeting, in subsequent meetings the children asked, "Can we play with the robot now?" as soon as we entered the classroom. The robot was like a human to the children who greeted him, hugged him, and smiled at him just as they did to us at the beginning and end of every meeting. For the children, comparing themselves to the robots who lived the adventures they were told was very simple, they all imitated the robot and had facial expressions that made it clear how much they sympathized with what the robot was encountering. It was therefore clear that children can perceive a robot as their peer, a playmate, and a model to imitate.

It was interesting to note that despite the robot did not have the typical characteristics of warmth of a human, for the very beginning children related to it using words, behavior and facial expression that were related to emotional and social states of connection and comprehension. Thus, showing the important of emotion also in non-human interaction.

Presenting the theme of emotions to children through story telling was certainly a success: they managed to identify perfectly with the characters and thanks to the adaptation of the story with games and activities typical of their age we managed to have a story representative of their reality. This allowed us to make them feel like protagonists and actors in this journey to discover emotions.

The robot had technical characteristics that allowed children to use it easily: it could be controlled via a joystick and move around the room without limitations, or it could carry out precise commands by touching tiles that made it move with just one command at a time. The design also favored children's sympathy: a rounded shape and two enormous eyes that could express various emotions on command were elements that contributed to creating a positive impact on the robot. This robot model is also capable of reproducing sounds; therefore, it was able to associate different aspects of emotions: it moved, expressed through the eyes, and reproduced sound. In this way, the children were able to clearly understand the sensations associated with the emotion.

The choice to accompany each activity with a manual job was also useful: during the various days, we created a poster with drawings of what made the children happy, a poster with what scared them, a poster in which they represented their anger with clay, a poster on which we glued the representation of what made them sad. These activities thus produced crafts that the teachers hung in the classroom and that the children could see all day, recalling the journey they took together. It was a work appreciated by both teachers and parents as each drawing had the child's name and a description of what had been represented and this also allowed the parents to understand the path taken, to get to know their child better, and to resume and deal with the things taught during the workshop at home.

3.2 Limitations

The introduction of a robot into the laboratory was designed to make the laboratory itself more current and attractive for children, but we encountered several limitations.

First, the presence of the robot alarmed some parents who considered their children's participation in the laboratory inappropriate, and therefore some children were excluded from the activity only due to the presence of the robot in the program. We aimed to help children and families, and this choice did not allow us to have 100% participation.

Another difficulty created by the fact that the protagonist was the robot is that the children were disoriented by our having explained to them that robots cannot think, cannot perceive sensations, or experience emotions, on the other, but the story made constant references to the robot as the protagonist of these new experiences, and some of the children were unable to switch from one side to the other. They froze, interrupting the story and underlining the unfeasibility of the emotions of the robot. The story telling with animal protagonists did not create any difficulty for children in believing that they could talk, dream, play soccer... the story telling in which the robot who could not feel emotions, did feel them, was an elusive contradiction.

Another limitation that we encountered was that of the spaces in which we carried out the workshop. Using the school environments, the children had games and books around them that they loved and that they could not use at any time, and we noticed that these games and books were as captivating as our robot and in some moments even more so.

The schools that joined our laboratory were from different areas of the province of Padua and the economic condition of the neighborhood and of the families who had access to the school service could be clearly perceived. In well-equipped schools with attentive and caring teachers, the children were interested in the laboratory but at times preferred their environment, which already satisfied them perfectly, to playing with the robot. In schools

where teachers were less affectionate and present for the children, the children sought comfort and care in our laboratory and in playing with the robot. In these cases, the impression was that of filling the need in the children with the robot what they should receive through school caregiver. Instead, it would be appropriate for relationships with caregivers to be strong and secure enough to allow children to develop solid foundations for their future relationships, their character, and their emotional regulation.

This cannot and should not be delegated to a robot.

3.3 Discussion

We can consider the robot a useful tool in the education of children growing up in the digital age. This tool can be used to develop computational thinking, problem solving skills, and creativity. It is possible to work on waiting times and respecting your turn.

We were able to see how easy it is for children to take a robot as an example, how natural it is for them to imitate its words and movements. We can therefore use robots in teaching language and reactions by transmitting to the child the exact pronunciation and desired movement.

The validity of storytelling as a tool to capture attention and convey very important concepts such as, in our case, emotional intelligence through the story is also confirmed.

But from what emerged in our laboratories, introducing the robot in the emotional field creates confusion in children who cannot distinguish the parts of fantasy from those of reality and this could set precedents in the perception of robots leading to future problems. The field of educational robotics is vast and complex. We can try to clarify how to use these robotic resources we have, but we should always do so with the awareness that every decision we make has consequences for the end users, in this case children. We cannot therefore make decisions lightly, and we must not let ourselves be guided by fear, but we must be able to

evaluate the risks and benefits of this tool while always remaining attentive to the developments and feedback that fieldwork gives us to fix any errors and always improve more what our contribution is in the part of the path that we are given to travel together with these new generations. We should work in the educational field with the thought of "Be who you needed when you were younger", keeping in mind that by working with children we do not have someone to shape as we like but we have the possibility of creating a good environment for them to blossom and grow, like plants, providing them with solid roots such as a good ability to manage emotions, which can give them the courage to make the best use of their abilities.

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