Emotional Intelligence vs. Artificial Intelligence: The interaction of human intelligence in evolutionary robotics

Inteligência Emocional vs. Inteligência Artificial: A interação da inteligência humana na robótica evolutiva

Inteligencia Emocional vs. Inteligencia Artificial: La interacción de la inteligencia humana en la robótica evolutive

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Abstract
In recent years, the notions of artificial intelligence and emotional intelligence have grown in popularity in the relevant literature. The development of technology, particularly in the area of artificial intelligence, has made it possible to examine the numerous facets of human emotional behaviour in new and powerful ways. This article constitutes a narrative review in which we try to investigate the causal connection between emotional intelligence and artificial intelligence by using the most recently studies as well as studies from the last decade. It aims to determine whether AI systems possess several intelligence types similar to those seen in humans and whether these types can elicit various emotions in individuals. For this purpose we abstract the denotation of Emotional and Artificial intelligence at first and display the main human intelligence types such as the artificial types as well, according to the scientists. Thus, we exhibit the disciplines and the ways that these two intelligence areas are affected and how AI could be more useful for individual's lifelong progress.
Keywords: Artificial intelligence; Emotional intelligence; Emotional artificial intelligence; Human intelligence types; Artificial types; Robotics.

Resumen
Nos últimos anos, as noções de inteligência artificial e inteligência emocional têm crescido em popularidade na literatura relevante. O desenvolvimento da tecnologia, particularmente na área de inteligência artificial, tornou possível examinar as inúmeras facetas do comportamento emocional humano de maneiras novas e poderosas. Este artigo constitui uma revisão narrative na qual procuramos investigar a relação causal entre inteligência emocional e inteligência artificial inteligência usando os estudos mais recentes, bem como estudos da última década. O objetivo é determinar se os sistemas de IA possuem vários tipos de inteligência semelhantes aos vistos em humanos e se esses tipos podem provocar várias emoções nos indivíduos. Para isso, abstraímos inicialmente a denotação de Inteligência Emocional e Artificial e apresentamos os principais tipos de inteligência humana, como também os tipos artificiais, segundo os cientistas. Assim, exibimos as disciplinas e as maneiras pelas quais essas duas áreas de inteligência são afetadas e como a IA pode ser mais útil para o progresso ao longo da vida do indivíduo.
Palavras-chave: Inteligência artificial; Inteligência emocional; Inteligência artificial emocional; Tipos de inteligência humana; Tipos artificiais; Robótica.

Resumo
En los últimos años, las sociones de inteligencia artificial e inteligencia emocional han ganado popularidad en la literatura relevante. El desarrollo de la tecnología, particularmente en el área de la inteligencia artificial, ha hecho posible examinar las numerosas facetas del comportamiento emocional humano de maneras nuevas y poderosas. Este artículo constituye una revision narrativa en la que intentamos indagar en la conexión causal entre la inteligencia emocional y la inteligencia artificial inteligencia mediante el uso de los estudios más recientes, así como estudios de la

última década. Su objetivo es determinar si los sistemas de IA poseen varios tipos de inteligencia similares a los que se ven en los humanos y si estos tipos pueden provocar diversas emociones en las personas. Para este propósito, primero abstraemos la denotación de inteligencia emocional y artificial y mostramos los principales tipos de inteligencia humana, como también los tipos artificiales, según los científicos. Por lo tanto, exhibimos las disciplinas y las formas en que estas dos áreas de inteligencia se ven afectadas y cómo la IA podría ser más útil para el progreso de la vida del individuo.

Palabras clave: Inteligencia artificial; Inteligencia emocional; Inteligencia artificial emocional; Tipos de inteligencia humana; Tipos artificiales; Robótica.

1. Introduction

Artificial intelligence (AI) is now discussed frequently and forms a component of our everyday lives. It is regarded as the new type of energy that is reshaping the globe. Both industry and academia have significant investments in AI.

Nowadays there has been a lot of discussion about AI and if this could be a threat or a positive development in humans' life. Some people (including famous scientist Stephen Hawkin) liken this transition to a sci-fi film-style doomsday scenario in which technology destroys us and artificial intelligence surpasses human strength in an effort to seize control of humanity (Pietikäinen, & Silven, 2022).

Others, however, contend that this is simply another significant industrial revolution that has the ability to boost society's productivity and provide workers the chance to fully realize their potential and engage in more stimulating, innovative, and fulfilling work (Pietikäinen, & Silven, 2022; Miles, 2016).

In the other hand, according to the experts it's obvious that this might be the beginning of emotional intelligence and artificial intelligence functioning together. The two together could have devastatingly powerful effects that will be to everyone's advantage and add excitement to regular working or personal life. Moreover, scientists believe that by assisting humans in developing their emotional intelligence, soft skills, and interpersonal communication abilities, AI will enable individuals to perform better human tasks. (Pietikäinen & Silven, 2022; Miles, 2016; Limon & Plaster, 2022; Kambur).

However, only logic and algorithms are ever considered when discussing artificial intelligence. Therefore, when we discuss emotional intelligence, we attempt to link feelings to a cause (5 Soni, 2022).

Below, we will present the main characteristics of Emotional and Artificial Intelligence and examine where they converge. In addition we will see how AI can prove to be beneficial in human life.

2. The Emotional Intelligence Rates

The early 20th century saw developments in psychology that led to a greater focus on people's emotional reactions. People began to express their emotions more openly in the 1960s. The capacity of people and the ability to openly express their feelings marks the beginning of the growth of EI (Kambur, E.)

In recent years, both on a personal and institutional level, emotional intelligence (EI) has become increasingly widespread. Life satisfaction, professional advancement, social relationships, work engagement, and friendships are all significantly impacted by EI. Moreover, recent studies refer that EI improves employees' commitment to the organization, performance, and job satisfaction from an institutional standpoint. These findings have an effect on the workers' productivity and commitment to their jobs. A growing number of studies prove that employees and organizations in communication jobs can definitely benefit greatly from EI (Kambur, et al., 2020).

Emotional Intelligence (EI), sometimes known as emotional quotient (EQ), according to Mayer and Salovey, is the capacity to comprehend, identify, and control one's own emotions as well as those of others and of groups to get to the point where the information is useful for directing thought and behavior. According to their article, the field of emotional

intelligence (EI) is broad and includes both verbal and nonverbal emotional appraisal and expression, as well as emotion control, and the role of emotional content in problem-solving.

Thus, EI includes two facets of intelligence: i) being aware of objectives, intents, reactions, and conduct and ii) recognizing others' emotions, thoughts, desires, and actions. Inferentially, the Emotional Intelligence framework organizes individual variations in terms of the capacity to process and modify one's personality in response to emotional information. Bakola, & Drigas, 2020; Drigas, & Papoutsi, 2019; Papoutsi, et al., 2019, Mayer, & Salovey, 1993).

Without a doubt, everything we do, including every action, decision, and assessment, is influenced by our emotions. Some people frequently lack self-control, have flimsy structural relationships, and give in to their rage despite having scored highly on general intelligence tests. However, one must comprehend and employ feelings. EI has a good impact on employee and social engagement since it makes communication easier. People with high EI are better at adjusting to work and personal environments. On the other side, those who are unable to regulate their emotions engage in an internal conflict that makes it difficult for them to think clearly, interact and pay attention to their task (Kambur, 2018).
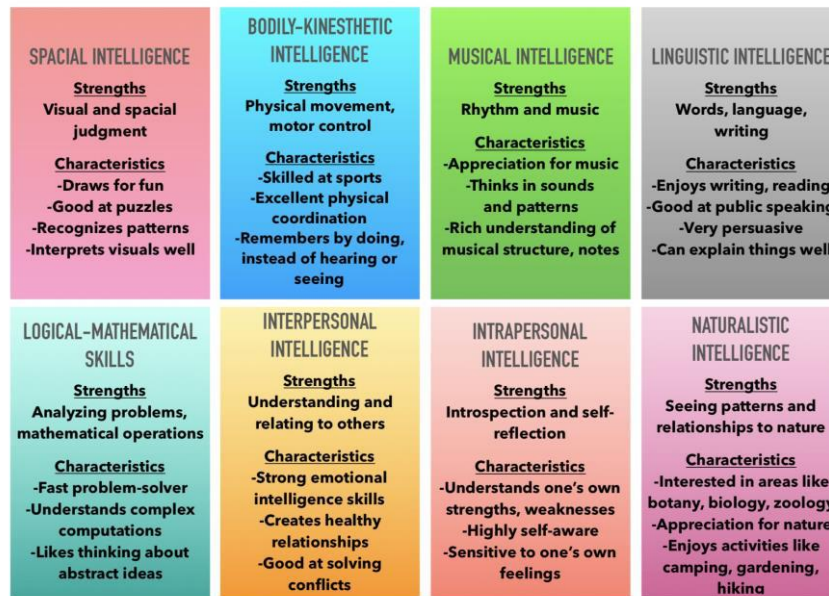
Pantano, and Scarpi, (2022), in their resent research refer that studies on intelligence have initially concentrated on the capacity for abstract thought and environmental adaptation. Even if there is disagreement over the exact definition of intelligence, the way it is conceptualized has changed from the idea of a single, unchanging intellect to a collection of diverse skills that can grow with age (time) and experience. This method acknowledges the different elements that go into the concept of intelligence as a whole.

But despite above the experts mention that there is significant disagreement among theories of human intelligence (HI) regarding the precise categories of intelligence that define human cognitive capacities and their relationship. For instance, they refer that Eysenck does not regard Gardner's mathematical intelligence as a sort of intelligence. In addition, Gardner treats various forms of intelligence separately, but Geake views them as being connected via the cognitive and neurological mechanisms of the human brain. In line with this, the researchers indicate that the Cattel-Horn-Carroll (CHC) model of human cognitive skills also takes memory and processing-speed into account. Additionally, according to Drigas, and Bakola, (2021), the impact of transmission on knowledge and information in general is a significant and hotly contested issue that differs based on the means (philosophy) or media (technology) and the epoch of transmission (Kambur, 2018; Pantano, & Scarpi, 2022; Gardner, Howard., 1983; Eysenck, Hans Jürgen, 1998; Geake & John., 2008; Drigas, & Bakola, 2021; Meta, 2021).

Below, summarizing, we present the different types of intelligence, initially as they are identified by Gardner (Figure 1) but also as they are presented jointly by Pantano, & Scarpi (Table 1).

Figure 1 -

Howard Gardner's Theory of Multiple Intelligences
Credit: Kumar Mehta, CNBC Make It
https://www.cnbc.com/2021/03/10/harvard-psychologist-types-of-intelligence-where-do-you-score-highest-in.html

Table 1 -

| Human Intelligences	Brief description
Physical or bodily-kinesthetic	The ability to deftly handle objects physically and develop suitable physiological reactions
Interpersonal or social	The ability to perceive others' feelings and moods and to interact with them effectively.
Verbal-linguistic (or comprehension-knowledge in CHC theory)	The ability for storytelling, reading, and writing
Musical-rhythmic (or auditory processing in CHC theory)	The ability for musical composition and awareness of rhythm, pitch, and melody
Logic-Mathematical (or analytical)	Understanding of causal systems, logic, and abstractions
Visual-spatial (or visual processing in CHC theory)	The ability for mental object visualization and spatial manipulation
Intrapersonal	Understanding oneself, including one's shortcomings and strengths
Emotional	The ability to recognize, evaluate, produce, comprehend, and control emotions
Creative	Ability to generate or act an innovative thought
Moral and ethical	Understanding how to apply human principles to one's own ideals, deeds, and aims
Fluid reasoning	Control of attention to solve new problems that cannot be solved by depending simply on learned scripts and schema
Short-term memory	Being able to maintain, manipulate, and encode information in one's immediate consciousness
Long-term storage and retrieval	The ability to accumulate, access, and retrieve data over time
Processing-Speed	The efficiency with which simple, repetitive operations can be carried out

Source: Authors.

3. From Human Intelligence to Artificial Intelligence-The Borderlines and the Skills witch Make the Difference

A technology that imbues machines with intelligence is known as Artificial Intelligence (AI). More specifically, Artificial intelligence (AI) is a broad field of computer science concerned with the development of intelligent machines capable of performing human tasks without the use of human intelligence or intervention. Artificial intelligence is used in a variety of fields, including information technology, customer service, advertising, and operations management. It is a simulation of natural intelligence in machines that have been programmed to learn and mimic human behavior (Markotic, K. ,2021).

According to the experts, Artificial intelligence can mainly be divided into the following three groups (Figure 2.) based on its mechanism and uses:

- Artificial Narrow Intelligence (ANI)
- Artificial General Intelligence AGI) and
- Artificial Super Intelligence (ASI)
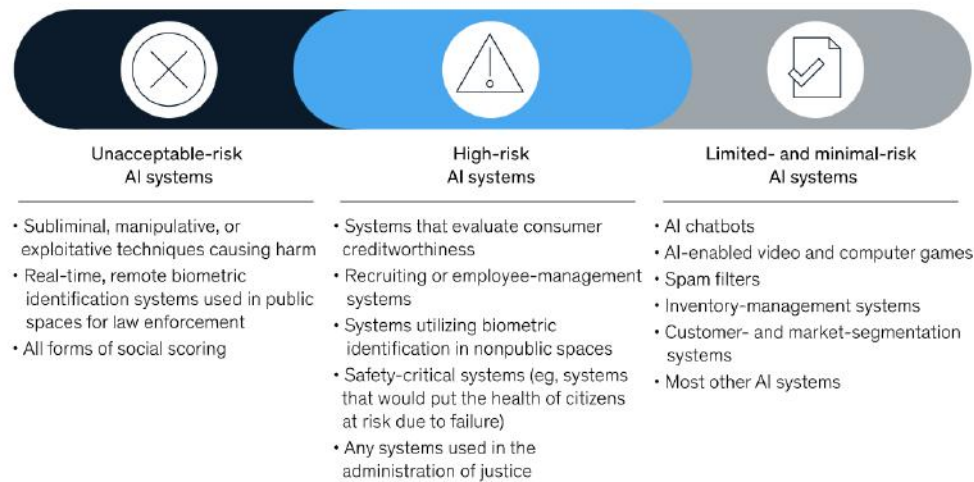
Figure 2 -
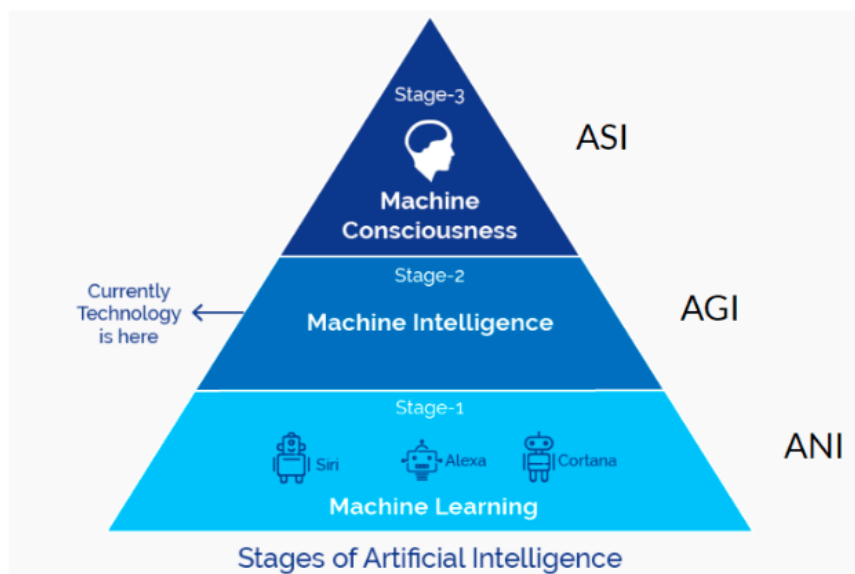
Understanding the Different Types of Artificial Intelligence
https://www.bbntimes.com/science/what-is-the-path-towards-artificial-general-intelligence

ANI is the simplest type of AI. It has limited features and is created to address a single issue. On the other hand, AGI is still hypothetical and does not yet exist. General intelligence is characterized as AI with cognitive abilities comparable to those of humans. It is defined as AI that has a human-level cognitive function in a variety of domains such as language processing, image processing, and computer functioning and reasoning, and so on. AGI editing is a difficult process since it closely resembles how human neural activity operates. Currently, no legislation exists to govern the use of artificial general intelligence. Other existing regulations govern current AI systems. Data protection, consumer protection, and market competition laws are examples of these. Bills to regulate specific AI systems have also been passed. Moreover, McKinsey divides AI system regulation into three categories (Figure 3): i) unacceptable-risk AI systems, ii) high-risk AI systems, iii) and limited- and minimal-risk AI systems.

Figure 3 -

The European Union's draft AI regulations classify AI systems into risk categories.
https://www.bbntimes.com/science/what-is-the-path-towards-artificial-general-intelligence

Finally, ASI is science fiction territory, also known as future intelligence. ASI, or super intelligence, will outperform all human abilities. In case scientists can create an ASI system, it will aid machines in making rational decisions. It would also assist robots and machines in developing emotional relationships in the same way that humans do (Soni, 2022, Markotic, 2021, Abdoullaev, 2022)

In addition, the authors Saridis and Valavanis (1988),a s well as Muhlhoff (2020) claimed that AI tries to imitate human cognitive capacities by recreating human traits. However, the discussion is complicated by the fact that several writers use various terminologies to refer to the same forms of AI. Pantano, et. Scarpi, provide a more comprehensive overview of the potential new AI types (Table 2) emerging from the human (Table 1)-AI contrast. (Pantano, & Scarpi, D 2022, Abdoullaev, 2022, Saridis, & Valavanis 1988).
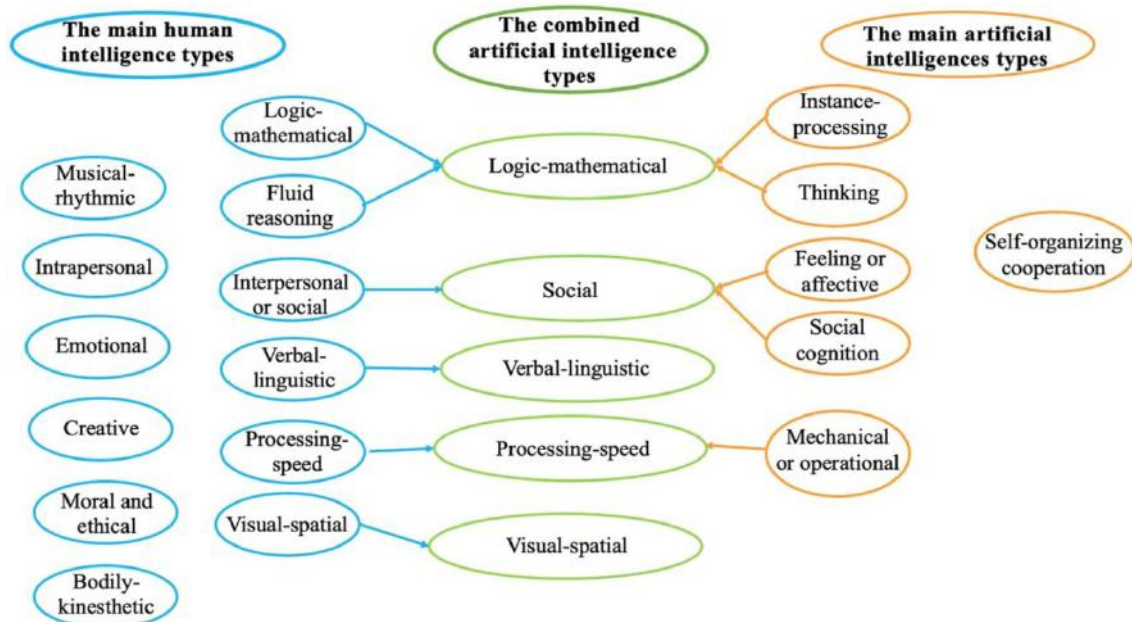
The same researchers developed a combined and more comprehensive overview of possible AI types as they emerge from comparing human intelligence types (Table 1.) from previous studies in psychology and evolutionary robotics (Table 2). Moreover, they identify five major types of AI that show a correspondence between human intelligences emerging from previous psychological studies and AI developed from previous AI studies, with an emphasis on the application of AI in marketing and service contexts (Figure 4.).

Table 2 - The AI Intelligences.

AI Intelligences	Description
Mechanical or operational	The ability to learn and execute simple and repetitive tasks
Thinking	Analytical and intuitive abilities (it is reasoning-based)
Emotional or feeling or affective	The ability to recognize and adapt to human emotions
Self-organizing cooperation	The ability to collaborate with other AI to form a self-managed, autonomous, and collaborative network (distributed intelligence)
Social cognition	The ability to process, store, and apply information about others in order to act appropriately.
Instance processing	Capability to select, categorize, and condense large-scale instances (risks, images, any other entity)

Source: Authors.

Figure 4 -

The combination of the two sets of intelligence in the new AI types.
https://journals.sagepub.com/doi/full/10.1177/10946705221103538#bibr37-10946705221103538

4. The use of Emotional Artificial Intelligence-Extended Intelligence and Humans reactions

According to Kaplan, A. and Haenlein, M. (2019), Humanized AI is expected to have cognitive, emotional, and social intelligence, as well as be aware of their interactions with others but this AI system, however, has not yet been realized. Human-inspired AI possesses both cognitive and behavioral abilities as well as emotional intelligence (EI). This AI system is capable of comprehending human language implementing emotions into decision making. Furthermore, AI is intertwined with a wide range of disciplines, including philosophy, mathematics, economics, neuroscience, psychology, computer engineering, and linguistics (Kambur, 2018, Kaplan, & Haenlein, 2019).

Generally, AI technologies use various programs to perform simple and limited tasks, making life and work easier. However, it is now capable of detecting emotions. AI can recognize emotions based on voice and face and imitate them as well. Some AI technologies may require voices to understand user emotions and can also reveal emotions by analyzing small changes in the face. Using optical sensors or webcams, emotional AI examines unfiltered facial expressions comprehend and forecast humans'(behavior Bakola, & Drigas, 2020, Kambur, 2018).

Moreover, in recent decades, significant social changes have been observed, which are related to the role of A.I. and technology in people's daily lives. The most important of them concern communication, diffusion and management information's and in the ability to assimilate and utilize the produced new knowledge. We have to underline that the role of Digital Technologies in education domain as well as in all the aspects of everyday life, are very productive and successful, facilitate and improve the assessment, the intervention, decision making, the educational procedures and all the scientific and productive procedures via Mobiles (Stathopoulou, et al., 2018, 2020, 2022, Kokkalia, 2016, Drigas, & Pappanastasiou, 2014,), various ICTs applications (Drigas et. al, 2004, 2005, 2015, 2016, Drigas, & Kokkalia, 2017, Pappas, et al., 2018, 2019, Drigas, & Leliopoulos2013, Papanastasiou, et al., 2018, 2020, Alexopoulouet al., 2019, Kontostavlou, & Drigas, 2019) AI and STEM (Vrettaros, et al., 2009, Anastasopoulou, et al., 2020, Lytra, & Drigas, 2021), and games (Chaidi, & Drigas, 2022, Kokkalia, et al., 2017, Drigas, & Mitsea, 2021). The New Technologies (NT) and more specifically Digital Technologies provide the tools for access, the analysis and transfer of information and for its management and utilization new knowledge. Information and Communication Technologies (ICT), unprecedented technological capabilities of man, have a catalytic effect, create the new social reality and shape the Information Society (Pappas, et Drigas, 2015, 2016, Drigas, et Koukiannakis, 2004, 2006, 2009, Drigas, & Kontopoulou, 2016, Theodorou, & Digas, 2017, Drigas, & Kostas, 2014, Bakola, et al., 2019, 2022, Drigas, & Politi-Georgousi, 2019, Karyotaki, et al., 2022).

On the other hand, it is thought that Artificial Intelligence will enable machines to think like humans. Extended intelligence refers to the advancement of machine capabilities with the goal of extending human capabilities. This includes using creativity to make better decisions and communicate more effectively, as well as deploying sophisticated tools to aid in decision-making. In other words, the use of artificial intelligence (AI) to augment human intelligence is called extended intelligence (EI). EI combines the advantages and disadvantages of the two types of intelligence. Human intelligence is used to direct AI's computational strength through improved free association and comprehension. Human intelligence also excels at sensory data processing, comprehension, abstract thought, and free association. AI is particularly good at remembering, processing, prediction, and analysis. Despite their differences, human intelligence and artificial intelligence are good at balancing each other's weaknesses and complementing each other's strengths. Whereas humans struggle with scale, computers can perform trillions of operations per second (Tech Target Contributor, 2019).

Thus, as human-robot interactions become more common, there is a greater need to understand how humans perceive artificial intelligence and what emotional responses such intelligence elicits (Huang, Ming-Hui. 2001).

According to the American Psychological Association (APA), emotion is defined as "a complex reaction pattern, involving experiential, behavioral and physiological elements." Emotions are how individuals deal with matters or situations they find personally significant" (UWA, 2019). The emotions that scientists have paid the most attention to are: anger, disgust, fear, happiness, and sadness. While these five emotions are critical, recent research indicates that we also experience a wide range of other emotions in our daily lives (Izard, C. E. ,2009, Cowen A ,2018). Furthermore, Huang focuses on and suggests two main categories of emotions: positive and negative ones (Huang, Ming-Hui. 2001).

On the subject of emotional development, one of our recent studies has shown that AI and particularly social robots can function as social mediators or facilitators between a child and a teacher or a therapist by creating controlled environments that are primarily aimed at reducing negative emotions like stress that can be caused by typical social interactions, especially in children with ASD and ADHD (Bakola, & Drigas, 2020). Playing with social robots, on the other hand, improve the positive feelings and encourages children to interact freely, without fear, in a safe environment, and reduces the tendency to social isolation, promoting their sociality. In addition, interacting with technology eliminates the complexity and unpredictable nature of verbal or nonverbal communication that children with developmental disorders typically encounter when interacting with

others. Given that playing games is one of the most important aspects of a child's cognitive and social development, the significance of technological tools is also recognized (Vélez, & Ferreiro, 2014, Cho, & Ahn, 2016, Fridin, & Yaakobi, (2011).

Moreover, Pantano, et. Scarpi, in their recent study came to the conclusion that humans react differently to AI intelligences by displaying different emotions (positive: happiness, excitement, enthusiasm, pride, and inspiration; negative: sadness, fear, anger, shame, and anxiety) with varying intensities, as well as varying levels of emotional attachment, satisfaction, and technology continuation intention.

Similarly, according to Lm and Kirby (2002), psychologists discovered that social intelligence reduced, or even protected against, negative emotions, improving people's ability to cope with and repair negative emotions.

5. Conclusion

Summarizing the above, we could say that Emotional intelligence shares many common elements with Artificial Intelligence. However, several main differences distinguish them. Initially, AI is related to machines, whereas emotional intelligence is related to humans and hearts. Thus, Emotional intelligence seeks to improve an individual's key personal emotional competencies, as well as emotional intelligence relationship skills, in order to achieve personal and professional success. While AI can gather, analyze, and interpret data, emotional intelligence can perceive, understand, and manage emotions.

It is safe to say that AI does not replace humans, but rather augments human capabilities. AI technologies are now being used to sense, think, learn, and make autonomous decisions for the benefit of human society by providing them with skill sets. In any case, it is necessary to follow the progress of the research in order to be able to reach even more certain conclusions in the future.

Concluding, it's necessary to refer that the combination of ICTs with theories and models of metacognition, mindfulness, meditation and emotional intelligence cultivation accelerates and improves more over the educational, productive, and decision- making practices and results and we recommend further research in these areas in relation to emotional and artificial intelligence. (Drigas, & Papoutsi, 2020, Drigas, & Mitsea, 2020, 2021, 2022, Kokkalia, et al., 2019, Pappas, & Drigas, 2019, Pappoutsi, & Drigas, 2016, Karyotaki, & Drigas, 2015, 2016, Papoutsi, et al., 2019, 2021, Chaidi, & Drigas, 2020, Drigas, & Karyotaki, 2019, Mitsea, et al., 2020, 2021, Angelopoulou, & Drigas, 2021, Tairimpampa, et al., 2018, Kapsi, et al., 2020, Drigas, et al., 2021, 2022, Galitskaya, & Drigas, 2021). .

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