

CAN WE PAINT THE EMOTIONS? AN EXPLORATORY STUDY WITH PORTUGUESE UNIVERSITY STUDENTS

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Abstract

From the twentieth century, Emotion started to be an important subject of study, being even equated to Reason. Although Emotion is a construct that is constantly present in interpersonal relationships, in communication and in the interaction with everything that surrounds us, in today's society there seems to exist a difficulty in recognising and expressing emotions, called alexithymia. Colour, a basic element of Art and Design, is an area that has also interested several authors, some of whom are dedicated, to understand its relationship with Emotion, trying to realise which emotional states it can evoke. Thus, the research presented here has as general aim the analysis and understanding of a possible relation between colours and emotions. Based on this goal, a convenience sample of UBI's student population was selected, composed of 248 participants over the age of 18, of Portuguese nationality. A sociodemographic questionnaire was used to do so, as well as the TAS-20, and the CEQu was created. From the results obtained we can refer that about 43.1% of the participants present scores at the extremes of the TAS-20. Spearman's correlations between the emotion felt and the emotion associated with target colours are positive and significant ($.50 \leq r_s \leq .78$, $p < .01$) for all target colours. During this research, there was no relation between colours and emotions like Anticipation, Anger and Sadness. Thus, we consider it possible to state that in this study, the relationship established between Colour and may be related to learning factors and socio-cultural characteristics underlying this theme.

Keywords: colour, emotion, alexithymia, students

1. INTRODUCTION

1.1. Emotion

The human species is social and, therefore, in everyday life, communication is constant. This communication is not limited to dialogue, it also integrates facial expressions and body gestures that help us transmit or veil our emotions (Ferreira and Teixeira, 2016). The truth is that nonverbal communication has a significant weight in information sharing (Gomes, Teixeira and Ferreira, 2015; Ferreira and Teixeira, 2016).

The concern to learn more about emotion and how it affects us reminds us of ancient philosophers (Solomon, 2008). As opposed to what we can see today, the study of emotions was always in the background, since they were accused of being irrational, dysfunctional and disruptive, slaves of reason (Dias, Cruz and Fonseca, 2008). However, from the 20th century onwards and particularly in the last decade of it, emotion began to be considered an important object of study (Mendes and Seidl-de-Moura, 2009; Claxton, 2015). The neuroscientist António Damásio presents a new theory, based on a line of continuity of emotions, feelings and reason, where emotions are not intrusive, but mechanisms of biological regulation (Santos, 2015). This turn of thoughts has transformed emotions into a fundamental part for understanding the behavior and functioning of the human being (Damásio, 2000; Dias, Cruz and Fonseca, 2008; Mendes and Seidl-de-Moura, 2009).

Although, in everyday life, the term emotion is commonly used, its definition is not as simple as it appears to be (Dias, Cruz and Fonseca, 2008; Zagalo, 2009; Miguel, 2015). For several authors, the notion of emotion can be related to movement and here it refers to the reactions of our body in relation to an event or surrounding environment, each having its specific function and, therefore, a different type of response (Damásio, 2000; Goleman, 2005). These responses can be both proximity and avoidance, depending on the type of emotion to which we are being exposed (Belzung, 2010; Claxton,

2015). Therefore, an emotion seems to require the interaction of the mind and body in an undeniable way, involving both sensations and perceptions, desires and beliefs (Solomon, 2008). However, we still do not have a consensus definition for this concept (Dias, Cruz and Fonseca, 2008; James, 2008).

In Ancient times, Aristotle considered that emotions were essential for a good life; in the Modern Age, Espinosa looked at emotions as thoughts, which were most often erroneous, making us unhappy and frustrated (Dias, Cruz and Fonseca, 2008; Solomon, 2008). In Ancient Greece, they regarded the judgments, emotions from our perspective in the world, as that of lawless beasts (Dias, Cruz and Fonseca, 2008; Claxton, 2015). Plato looked at emotions as an attack on truth, a persuasive, disturbing and pathological element, thus believing that communication should be free of emotion (Zagalo, 2009; Belzung, 2010). In its turn, in the Middle Ages, an era dominated by the Christianity, it was believed that emotion was linked to desires and, therefore, related it to sin (greed, gluttony, lust, anger, envy and pride), because love, hope and faith were chaste virtues destined to reason and not emotion (Solomon, 2008). For Descartes emotions were classified as passions, designating them in six primitive passions: wonder (or admiration), love, hatred, desire, joy and sadness; these may be influenced by reason (Solomon, 2008). As we can see, over time, the term emotion has had several definitions, as Solomon (2008) states "just when it seems that an adequate definition is in place, some new theory rears its unwelcome head and challenges our understanding" (p. 3). William James launched, in 1884, the question "What is an emotion?", and although no consensus has yet been found in the definition of a construct that appears to be so complex, some authors define emotion as a complex and momentary condition, which depends on three elements: 1) psychological and physiological alteration, and each emotion has its own pattern of physiological reactions; 2) tendency to action, such as attack, avoidance, approximation or removal; 3) subjective experience, that is, what people describe when experiencing an emotion, whatever it is (Dias, Cruz and Fonseca, 2008; Miguel, 2015).

1.1.1. Classification

According to Damásio (2000), emotions can be classified as primary and secondary. The primary ones are characterised as being innate, universal, evolutionary, shared by all and associated with specific neurobiological processes, such as anger and sadness; in its turn, secondary ones have a social learning character, as is the case of shame and envy (Belzung, 2010). However, the classification of emotions is as complex as the definition itself (Dias, Cruz and Fonseca, 2008; James, 2008; Miguel, 2015). Some distinguish six primary emotions, such as Paul Ekman (joy, fear, disgust, anger, surprise and sadness) but not all identify the same number of primary emotions (Claxton, 2015; Miguel, 2015). Ekman considers that classification depends on the universality found in facial expressions, having studied them over decades and on the various continents (Zagalo, 2009).

Plutchick's psychoevoluist model consists of eight basic bipolar emotions: joy-sadness, trust-disgust, fear-anger, and surprise-anticipation (Plutchik, 1994, 2001); these are distinguished from the rest by the behavioral and biological aspect. We refer to a circumflex model of three dimensions (polarity, similarity and intensity), which can be represented by the shape of a cone, in which the base circle, analogous to the wheel of colours, represents the similarity between emotions, while the vertical dimension reveals the intensity of emotion (Plutchik, 2001; Martins, 2011; Miguel, 2015).

It is also important to highlight that the models of basic emotions suggest that they are grouped together, forming complex emotions, such as: deceit, a mixture of surprise and sadness; remorse, a mixture of sadness and disgust; and longing, a fusion of joy and sadness (Miguel, 2015). However, the same mixture of basic emotions may not result in the same complex emotion, since these depend on the intensity and individual evaluation of each human being (Miguel, 2015).

1.1.2. Alexithymia

Humanity is composed of a group of individuals, originating from different parts of the planet, with different cultures, traditions and experiences, each with its own characteristics. The expression of emotion depends, in part, on culture and experiences. However, there are human beings who present greater difficulty in the expression of emotions than others, resembling human robots, when they present signs of a certain emotional illiteracy (Freire, 2010). The difficulty of recognizing and

expressing emotions can be called alexithymia (Taylor, 1984; Haviland, Warren and Riggs, 2000; Carneiro and Yoshida, 2009; Freire, 2010).

Several factors, such as empirical studies with small samples, poorly planned investigations, poor choice of instruments and inaccuracy in construct definition, lead to a lack of consensus in the elaboration of a consistent theory for this concept. However, we can consider that alexithymia depends on several components: 1) difficulty in using appropriate language to express and describe emotions; 2) difficulty in differentiating emotions from bodily sensations; 3) difficulty in imagery and fantasizing; 4) operative thinking (Parker *et al.*, 1993; Parker, Taylor and Bagby, 1993; Prazeres, Parker and Taylor, 2000; Prazeres, 2000; Yoshida, 2007; Yoshida and Silva, 2007; Carneiro and Yoshida, 2009; Freire, 2010).

The first reports of patients without imagination date back to the late 1940s, with a weak ability to verbalize feelings and stuck to the mundane aspects of reality; however, it was only in the 1970s that the Word of Greek origin, alexithymia, which literally meant "no words for emotion or feeling" emerged, coined by Sifneos (Taylor, 1984; Parker *et al.*, 1993; Prazeres, Parker and Taylor, 2000; Prazeres, 2000; Fernandes and Tomé, 2001; Carneiro and Yoshida, 2009; Freire, 2010).

Although the origin of this concept is related to psychosomatic diseases, since the 11th European Conference on Research in Psychosomatics, occurred in 1976, it was found that it is not an exclusive characteristic of psychosomatic patients, being present in other clinical conditions (depression, addition, posttraumatic states, anxiety and eating disorders, for example), as well as in so-called healthy individuals, covering about 10% to 20% of the non-clinical population (Prazeres, 2000; Fernandes and Tomé, 2001; Yoshida, 2007; Yoshida and Silva, 2007; Carneiro and Yoshida, 2009).

This particularity, a failure in the social development of a human being, can interfere with decision-making, especially when they are of a personal and social nature (Prazeres, 2000; Freire, 2010; Miguel *et al.*, 2010). We refer to a failure that interferes with the relationships of the living being with the environment, since the individual with high alexithymia values has a reduced capacity for empathy and human understanding (Prazeres, 2000; Freire, 2010). They are beings with difficulty in identifying emotional states, both in them and in others; with little understanding of emotional bonds, which fail to establish emotional communication, making them a kind of robot, which lives in a "non-human form of existence and of relating to the other" (Prazeres, 2000, p. 118).

In short, an individual is considered to have high levels of alexithymia when: 1) has the experience or awareness of emotions, since these are biological and innate phenomena; 2) it is difficult to distinguish the emotional states, either in themselves, as in others, because they have similar physiological reactions, thus hindering the task; 3) has difficulty in emotional regulation, due to the weak recognition of the associated feeling; 4) is unable to describe what you feel; 5) describes minutely the reality, devoid of any subjective experience; 6) it has weak imaginative capacity; 7) does not exhibit psychotic or neurotic manifestations; 8) seems well socially adapted; 9) has little capacity for empathy; 10) does not have a pathology, because alexithymia is considered a personalistic trait or a symptom; 11) does not realize its condition; 12) can be a healthy individual (Taylor, 1984; Parker, Taylor and Bagby, 1993; Haviland, Warren and Riggs, 2000; Prazeres, 2000; Fernandes and Tomé, 2001; Carneiro and Yoshida, 2009; Freire, 2010; Silva and Vasco, 2010).

1.2. Colour

The phenomenon of vision has been studied for a long time and there are several personalities who have been enthused by the mystery of vision and colour. Aristotle regarded colour as a property of objects, for it was inconceivable to him that true and pure light, the light of the Sun, had colour (Goethe, 1970; Monteiro, Melo and Negrão, 2013). The Greek Euclid, in his theory of vision, argued that rays came out of the eyes that captured the observed object (Silveira, 2015). Leonardo Da Vinci dissected corpse eyes to describe the functions of each component of vision and found that the eyes instead of emitting rays, they received them, and demonstrated the interference of the colour of the air, stating that the colour of the air is blue (Silveira, 2015). In the Middle Ages, there was concern to define how many and what would be the primary and essential colours and, in the Renaissance, Leon Battista Alberti defined four essential colours, justifying them with the theory of the four elements. In

its turn, Da Vinci defined the primary colours as simple colours, those that are not obtained from the mixture of other colours: white, yellow, green, blue, red and black (Silveira, 2015). In the 17th century, Espinosa dedicated a treaty to the rainbow (Sacks, 1996), while Newton discovered the composition of white light; however, his theory was challenged by Goethe in his *Farbenlehre* (Theory of Colour) (Sacks, 1996; Arnheim, 2005). In the 20th century, Kandinsky associated colours with a spiritual dimension and Itten concatenated them to the seasons (Dabner, Stewart and Zempol, 2017).

Isaac Newton is a landmark name in the history of mankind, as a physicist responsible for the discovery of the laws of gravity and for an amazing progress in the study of the phenomenon of light, an event that is reported to the year 1666 (Silveira, 2015). Within the electromagnetic spectrum, which Newton was unaware of being composed of several frequencies of electromagnetic radiation, the physicist discovered that white light, coming from the Sun and an integral part of that spectrum, is not a simple entity as believed since Aristotle (Sena, 2009). Using a triangular prism of glass, Newton realized that white light was refracted into seven colours that make up the spectrum of visible light, that is, the fraction of the wavelengths of the electromagnetic spectrum that our visual system perceives (visible in the rainbow phenomenon): red, orange, yellow, green, blue, indigo blue and violet (Itten, 1970; Arnheim, 2005; Zavaglia, 2006; Sena, 2009; Inácio, 2010; Gonçalves, 2011; Silveira, 2015). The spectrum of visible light, discovered by Newton, presents a continuous chromatic gradation, whose transition from one colour to the next is imperceptible by the human visual system, making it difficult to determine where one colour ends and where the other begins (Gonçalves, 2011) (Gonçalves, 2011).

Newton's studies on light and chromatic phenomenon are based on the concepts of reflection, refraction and perception of light and allow us to understand the chromatic appearance of objects (Sena, 2009; Silveira, 2015). For example, if an object looks green to us, it is because it mainly reflects the green wavelength, absorbing, mostly, the remaining lengths of the visible spectrum (Sena, 2009; Gonçalves, 2011; Silveira, 2015). However, it is important not to forget that colour is a sensation constructed by the visual system and entirely dependent on the action of light, and not an intrinsic property of objects (Arnheim, 2005).

Although Newton's findings were considered a major progress in the study of the phenomenon of light, Goethe saw light as the simplest, indivisible and homogenous being, and therefore could not believe that light could be divided into coloured lights, since coloured light would always be darker than colourless light (Goethe, 1970; Arnheim, 2005; Silveira, 2015; Barsan and Merticariu, 2016). Thus, about two centuries after Newton, Goethe's *Farbenlehre* emerges, a theory that portrays colour in a mystical way, a subjective property that only exists in our perception (Goethe, 1970; Gonçalves, 2008; Silveira, 2015). He distinguishes three types of manifestation of colour: 1) physiological colours, because they belong to the eye, in a healthy state, and depend on the action and reaction of the visual organ, that is, it is the light perceived by the human eye; 2) physical colours, the ones "produced by certain material mediums" (Goethe, 1970, p. 56), are reflected by the coloured objects in the eye and refer to both the perception of colours and optics; 3) chemical colours, those that we produce through substances, pigments (Goethe, 1970; Silveira, 2015; Barsan and Merticariu, 2016). What really interested Goethe was to realize how human beings actually see colours and light, how we create coloured worlds and illusions (Sacks, 1996).

In this perspective, colour is like an elementary phenomenon of nature, a law that acts on the meaning of vision, influencing the feelings of human beings (Goethe, 1970; Arnheim, 2005; Gonçalves, 2008; Sena, 2009; Inácio, 2010). Colours originate from the interaction of light with darkness and any colour will be determined towards one side: on the side of light, the first colour to appear is yellow, on the side of darkness appears blue (Goethe, 1970; Arnheim, 2005; Gonçalves, 2008). Goethe is one of the first to make an emotional reading of colour, as he believes that the chromatic universe is associated with emotions, acting in the mind through the effect it causes on the eyes: "The ox becomes furious if a red cloth is shown to him; but the philosopher, who speaks of colour only in a general way, begins to rave" (Goethe, 1970, p. lv). Colours cause subjective sensations in the living being, however, they can be distinguished by temperature, since man makes associations between colour and thermal experiences, or even by the level of activation they cause in the mind: some are considered warm,

active and stimulating (red and yellow), others cold, passive and depressive (indigo and violet) (Goethe, 1970; Sena, 2009; Inácio, 2010). The colour green, the result of when yellow is mixed up with blue, is the center of these two contrasts (light and darkness); between hot and cold, active and passive and, between stimulant and depressive, it is balance and calm (Sena, 2009; Gonçalves, 2011).

Colour is revealed as a dimension of identification and complex communication, which helps human beings to perceive the universe (Arnheim, 2005; Silveira, 2015). Both in the animal and vegetable kingdom, colour plays a crucial role: some living beings use colour as camouflage, others use it to attract companions, or even to ward off certain creatures, so we can say that colour plays a central role in the survival or extinction of species; in human societies it is no different: through colour man can, for example, distinguish green from mature foods and good foods from dangerous foods to eat or harmful ones (Inácio, 2010). Thus, colour can be seen as a unique and complex language, since it has the ability to convey messages, social and/or cultural codes, information and even sensations (Inácio, 2010; Dabner, Stewart and Zempol, 2017).

1.3. The symbolic dimension of colour

Over time, colours have acquired certain associations, many of them derived from nature. According to Heller (2016), the relationship between colour and feeling does not depend on individual taste, but on common experiences, which have always marked our language and our thinking. However, the perception of colours is not equal from individual to individual; they always depend on the time and cultural context: 1) in the West, black is considered the colour of mourning and death, but in China and India the colour of mourning is white; 2) in most Western peoples, red is associated with caution, but in China, the red colour is associated with good luck; 3) in Japan, yellow is the colour of courage; 4) in the United States, mailboxes are blue, but in Sweden and Britain they are red; 5) in the 19th century, green was associated with poison, while nowadays it is associated with spring and environmental awareness; 6) in finance, red means social problem, danger, while green means money; 7) depending on the part of the world, happiness is associated with a different colour (white, yellow, red, or green) (Inácio, 2010; Gonçalves, 2011; Weinschenk, 2011; Fofonka, 2016; Heller, 2016; Dabner, Stewart and Zempol, 2017). We can, then, say that there is no colour devoid of meaning, because colour has the ability to symbolize certain human feelings or qualities (Schachtel, 1943; Heller, 2016). However, the way it acts can change, depending on the situation, since the symbology of colour is binary, that is, each colour can have positive and negative meanings (Fofonka, 2016; Heller, 2016).

Some people do not have names for all colours, but there are three terms that seem to be present in all languages: white, black and red (Heller, 2016; Pastoureaux, 2019b). This is because, in a civilization, individuals may not feel the need to differentiate certain types of colours, but they always need to distinguish between day and night, the light and the dark. Thus, the denominations that classify light and darkness arise, and they are often used to describe white and black (Heller, 2016; Pastoureaux, 2019b). These two colours pose a dilemma: are they or are they not colours? In Physics, and according to Newton, white is the sum of all colours, it is light, but it is not considered a colour (Gauding, 2011; Silveira, 2015; Heller, 2016). White is “considered as no colour (a theory largely due to the impressionists, who saw no white in nature), is a symbol of a world from which all colour as a definite attribute has disappeared” (Kandinsky, 1914, p. 77). Like white, with the discovery of the spectrum of light, black also lost its colour status, being considered, in the context of physics, as the absence of light (Pastoureaux, 2014; Heller, 2016). However, black is the origin of everything, the first colour to emerge on Earth, the darkness that enveloped the planet still lifeless; only then did white, light, and life come; and if white is light, black is darkness; it is a colour universally known for its negative status, the colour of evil, emptiness, deadly and negative forces (Gauding, 2011; Pastoureaux, 2014; Fofonka, 2016). On the other hand, red, present in the first chromatic experiments, is the first denomination of colour, recurrently used in rock art; this is also universally known as the colour of fire and blood (Heller, 2016; Pastoureaux, 2019b). In addition to being the symbolically strongest colour, its polarity is famous, because it is considered the colour of love and passion and, at the same time, hatred, anger and aggression (Sena, 2009; Fofonka, 2016; Heller, 2016; Pastoureaux, 2019b). Unlike red, blue is a colour very present in nature, appears late in chromatic palettes and, over time undergoes

a great evolution: it begins to be a colour almost ignored, and then becomes the most present colour (Pastoureau, 2016). Perhaps this reversal of values can be justified by the weak symbolic dimension that the colour blue has shown over time.

Although blue is very present in landscapes, green is the predominant colour, it is the colour of vegetation, nature, forests (Heller, 2016; Pastoureau, 2019a). However, it should be noted that, for a long time, it was also not included in the chromatic palettes produced by the human being (Pastoureau, 2019a). Over time, green began to be seen by some as an ideology because it is related to environmental awareness and love of nature (Heller, 2016). However, green has an ambivalent character. On the one hand, it is a symbol of life, luck and hope; on the other hand, it is attributed to disorder and poison (Pastoureau, 2019a). The lightest of colours, yellow, is the most vulnerable, unstable and changeable colour: a little red and yellow turns orange; a drop of blue and turns greenish; a drop of black turns yellow into a dirty colour (Goethe, 1970; Gonçalves, 2011; Heller, 2016). However, and anywhere in the world, yellow is the colour of the Sun, it is cheerful, invigorating, optimistic (Heller, 2016). Goethe (1970) described yellow as the closest colour to light, with a serene, warm and pleasant character, the colour of honor and joy; however, he also described it as the colour of ignominy and aversion, since it was the colour used in the hats of the bankrupts or in the circles of the mantles of the Jews. The human being has the tendency to underestimate the colour orange, because he thinks first of red or yellow (Heller, 2016). In Europe, the name orange did not exist until the fruit became known (Heller, 2016); an example of this is the way in which Goethe referred to this colour: “red-yellow” (Goethe, 1970). There are countless phenomena and objects of the world that are orange, but, it seems that this colour is not perceived and valued by man, like the other colours: the goldfish, in reality, is orange, the roofs of the houses are more orange than reddish, but when a child draws a house, his dominant hand has a tendency to reach for his red colours pencil can. Magenta is the “completely pure red, which does not contain particles of yellow or blue [...] Surprisingly it is a red that seems to have a hint of blue; many call it “pink”, and have it for a kind of violet” (Heller, 2016, p. 73). In a study conducted in Germany with 2,000 people of different ages and professions, the participants stated that they could not distinguish the shades: violet, lilac, purple or purple, pink and magenta (Heller, 2016), nor did the physicist Newton distinguish between violet and purple, using both terms to refer to the same shade (Newton, 1671; Arnheim, 2005).

Based on the principle that the designer's work is embedded in emotions and since colour is a key point in product development, with this work we intend to verify the existence, or not, of the relationship between colour and emotion.

2. MATERIALS AND METHODS

2.1. Sample

The sample of this study was obtained for convenience, consisting of university students from the University of Beira Interior. Exclusion factors were: 1) psychological and/or psychiatric follow-up; 2) foreign nationality. Thus, 248 students participated in this study, all of them Portuguese, of which 70.6% were female (n=175) and the remaining male (n=73), between the ages of 18 and 45 (M=21.3; SS=2.75).

It should be noted that this is a non-probabilistic sample, since the participants were selected for convenience, so the probability of a subject from the study population being part of the sample is not known. The inclusion of participants in the sample had the following criteria: 1) being a UBI student; 2) being 18 years or older; 3) knowing how to read and understand Portuguese; 4) completing the informed consent in which they agreed to participate in the investigation.

2.2. Instruments

2.2.1. Toronto Alexithymia Scale of 20 items (TAS-20)

There are several scales developed with the objective of measuring alexithymia levels, but, the one that demonstrated better psychometric properties to measure this characteristic, was developed in 1985

by Taylor, Ryan and Bagby - Toronto Alexithymia Scale (TAS), a self-assessment scale, consisting of 26 items (Parker *et al.*, 1993; Praceres, Parker and Taylor, 2000; Fernandes and Tomé, 2001; Freire, 2010). Despite having better psychometric properties in relation to other scales, TAS still demonstrated some problems, leading to its improvement: first there is the Toronto Alexithymia Scale Revised (TAS-R) version, consisting of 23 items; later, the latest version of the scale, the Toronto Alexithymia Scale of 20 items (TAS-20) (Parker *et al.*, 1993; Bagby, Parker and Taylor, 1994; Praceres, Parker and Taylor, 2000).

Thus, the TAS-20 is an instrument developed by Bagby, Parker and Taylor of self-completion, consisting of 20 items; the subject is asked to register, for each of the items, his degree of agreement on a five point Likert scale: 1 – I totally disagree; 2 – I disagree in part; 3 – I do not agree or disagree; 4- I agree in part; 5 – I totally agree (Praceres, Parker and Taylor, 2000). In addition to presenting an adequate consistency and accuracy to the evaluation of alexithymia levels, this scale also demonstrates a structure of three factors congruent with the alexithymia construct: 1) difficulty in identifying feelings; 2) difficulty in describing feelings to others; 3) exterior-oriented thinking style (Parker *et al.*, 1993; Bagby, Parker and Taylor, 1994; Praceres, Parker and Taylor, 2000).

The TAS-20 has already been translated into 18 different languages (Praceres, Parker and Taylor, 2000; Taylor, Bagby and Parker, 2003) and evaluated in 19 distinct cultural populations, and the results demonstrate a strong generalization of the structure of three factors of the scale between languages and cultures (Taylor, Bagby and Parker, 2003). In regard to the Portuguese language, a study was conducted by Praceres, Parker and Taylor, in 2000, which allowed the validation and adaptation of the scale to the Portuguese population, thus proving the good psychometric abilities, as well as the tri-factorial structure of the English version of the scale (the original); this supports its use as an alexithymia screening tool in Portugal (Praceres, Parker and Taylor, 2000). For the present investigation, the authors did not need authorization, as TAS is available for free use.

2.2.2. CEQu

The questionnaire on the association of colour with emotion arose from the need to study the relationships that human beings make between colour and emotion, Colour Emotion Quiz (CEQu), developed by the research team of this study. This consists of four different questions, placed in relation to eight colours (Yellow, Blue, White, Orange, Magenta, Black, Green and Red), randomly: 1) What colour do you see? (open answer); 2) What emotion does this colour relate to? (forced choice between: "Joy", "Anticipation", "Trust", "Fear", "Disgust", "Anger", "Surprise" and "Sadness"); 3) What does this colour make you feel from an emotional point of view? (forced choice between: "Joy", "Anticipation", "Trust", "Fear", "Disgust", "Anger", "Surprise" and "Sadness"); 4) What did they teach you that this colour represents? (open answer).

The layout of the experiment was developed in E-Prime version 2.0.10.356 and consisted of: 1) a rectangle always with the same dimensions with a solid fill of one of the colours listed above; 2) by eight rectangles, each with one of the eight selected emotions (in forced answers) (**figure 1A**); 3) by a writing area, in the open answer questions (**figure 1B**). Throughout the experience the background is presented in a grey tone (128,128,128), for two reasons: the first is that grey is not a colour used as a target colour; the second is related to the coherence between stimuli and the grey colour was selected because there is theoretical foundation that in an environment rich in stimuli, the mechanisms of attention are directed as a rule to the stimulus that the subject considers to be more relevant. This prioritization of stimuli is related to, for example, as the luminance, contrast or spatial frequency of the same, as well as, by factors such as experience, knowledge and expectations (Marino and Munoz, 2009). Due to the influence exerted by all these factors, it is necessary to wisely and carefully select the stimuli to be presented during investigations in several areas (Knebel *et al.*, 2008). In the case of neuroscientific studies of discrimination and categorization, it is particularly important to ensure that stimuli in different experimental conditions are homogenized to ensure that the potentially tested effects actually come from the stimulus and not from surrounding parasitic variables (Knebel *et al.*, 2008; Willenbockel *et al.*, 2010; Lakens *et al.*, 2013). The grey used is still the most neutral grey in the face of the stimuli being presented. Between each question, the screen turns black for 150ms, to facilitate the understanding, by the participants, that the program accepted the mouse click.



Fig. 1. CEQu's Layout

Figure 1A (forced response) on the left; Figure 1B (open answer) on the right.

2.2.3. Statistical analysis

With the results in a Microsoft Office Excel spreadsheet, we analyze each subject's answers to open answer questions. This data processing allowed a reduction of the answers, presented by the participants the open questions. When analyzing the answers to the open questions, we chose to select only the first word written by the participant. This choice follows the norms of free association, used by Deese (*in* Bourscheid, 2017), in which he states that when a stimulus is provided to the participant, he must respond with the first word that comes to mind, related to the stimulus presented. When using this standard, the values to be analyzed are those of counting the frequency with which a given response appears (Bourscheid, 2017). After the transformation of the raw data, a quantitative database was created, and it was transferred and worked through IBM's Statistical Package for Social Sciences (SPSS) computer software, version 20, in order to carry out statistical analysis.

3. RESULTS

The TAS-20 values for the different subjects, as seen in **table 1** and **figure 2**, do not follow a normal distribution $K-S(248)=0.07$, $p=.009$, although the asymmetry (-.06) and kurtosis (-.56) values are within the range of -1 to 1.

	Kolmogorov-Smirnov			Shapiro-Wilk		
	statistics	Df	Sig.	statistics	Df	Sig.
TAS-20	.067	248	.009	.989	248	.052

Table 1. Kolmogorov-Smirnov Normality Test

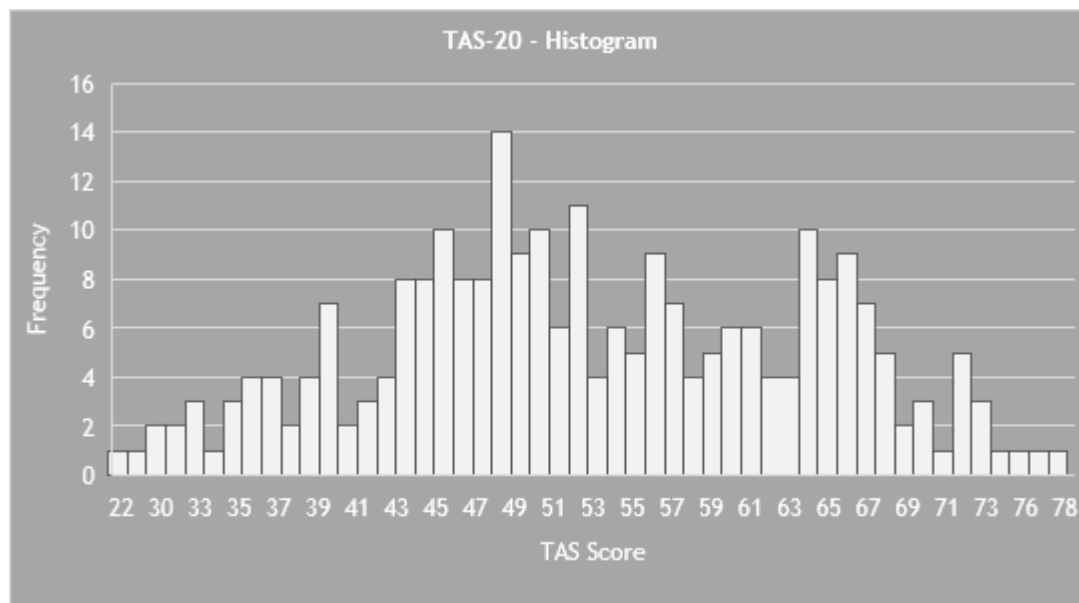


Fig. 2. Histogram of the frequency distribution of TAS-20 scores

In general, the TAS-20 presents for $N=248$, an average of 53.26 ($SD=10.93$), with a minimum of 22 points and a maximum of 78 points. In order to be able to use the TAS-20 as an aggregating variable in the following questions, we created the following categories: 1) low category ($n=34$), with an average of 35.79 ($SD=4.05$), with a minimum of 22 and a maximum of 40; 2) Mean category ($n=141$), with an average of 50.60 ($SD=5.00$), minimum of 41 and maximum of 60; 3) High category ($n=73$), presents an average of 66.53 ($SD=4.08$), with a minimum of 61 and a maximum of 78.

Participants are distributed according to **table 2**:

	Categories	Intervals	N	%	m	SD
Classification in the TAS	low	20-40	34	13.7	35.79	4.05
	average	41-60	141	56.9	50.60	5.00
	High	61-100	73	29.4	66.53	4.08

Table 2. Distribution of participants by TAS-20 categories

Table 3 shows the associations that participants made between colour and emotion, in relation to what colour triggers from the emotional point of view. It should be noted that there were no associations between colour and emotions Anticipation, Anger and Sadness.

		N	%
green	joy	108	43.5
	fear	2	0.8
	surprise	38	15.3
	trust	69	27.8
	disgust	31	12.5
	anticipation		
	anger		
	sadness		
yellow	joy	171	69.0
	fear	8	3.2
	surprise	42	16.9
	trust	10	4.0
	disgust	17	6.9
	anticipation		
	anger		
	sadness		
red	joy	152	61.3
	fear	21	8.5
	surprise	14	5.6
	trust	58	23.4
	disgust	3	1.2
	anticipation		
	anger		
	sadness		
orange	joy	161	64.9
	fear	4	1.9
	surprise	35	14.1
	trust	33	13.3
	disgust	15	6.0
	anticipation		
	anger		
	sadness		
blue	joy	132	53.4
	fear	10	4.0
	surprise	20	8.1

	trust	83	33.6
	disgust	2	0.8
	anticipation		
	anger		
	sadness		
white	joy	121	49.0
	fear	6	2.4
	surprise	18	7.3
	trust	101	40.9
	disgust	1	0.4
	anticipation		
	anger		
	sadness		
black	joy	119	48.2
	fear	75	30.4
	surprise	4	1.6
	trust	47	19.0
	disgust	2	0.8
	anticipation		
	anger		
	sadness		
magenta	joy	121	48.8
	fear	5	2.0
	surprise	81	32.7
	trust	25	10.1
	disgust	16	6.5
	anticipation		
	anger		
	sadness		

Table 3. Total responses obtained from the question “What does this colour make you feel from an emotional point of view?”

Table 4 shows the differences between participants who presented Low, Medium and High scores in the TAS-20, in relation to the question “What does this colour make you feel from an emotional point of view?”. Regardless of the colour presented and the Low, Medium or High score in the TAS-20, the “Joy” emotion was the one with the highest frequency count.

		Low (%)	Average (%)	High (%)
green	joy	47.1	44.0	41.1
	fear		1.4	
	surprise	17.6	9.2	26.0
	trust	32.4	33.3	15.1
	disgust	2.9	12.1	17.8
yellow	joy	82.4	69.5	61.6
	fear		5.0	1.4
	surprise	11.8	16.3	20.5
	trust		5.0	4.1
	disgust	5.9	4.3	12.3
red	joy	58.8	61.7	61.6
	fear	5.9	9.9	6.8
	surprise	8.8	5.7	4.1
	trust	26.5	20.6	27.4
	disgust		2.1	
orange	joy	55.9	68.1	63.0
	fear		2.1	1.4
	surprise	20.6	13.5	12.3
	trust	14.7	12.1	15.1
	disgust	8.8	4.3	8.2
blue	joy	50.0	51.8	58.3
	fear	2.9	2.8	6.9
	surprise	8.8	9.9	4.2
	trust	38.2	34.0	30.6
	disgust		1.4	
white	joy	41.2	50.4	50.0
	fear	14.7		1.4
	surprise	5.9	9.2	4.2
	trust	35.3	40.4	44.4
	disgust	2.9		
black	joy	55.9	47.5	45.8
	fear	17.6	33.3	30.6
	surprise	2.9	2.1	
	trust	23.5	16.3	22.2
	disgust		0.7	1.4

magenta	joy	61.8	41.8	56.2
	fear	2.9	2.1	1.4
	surprise	26.5	37.6	26.0
	trust	8.8	11.3	8.2
	disgust		7.1	8.2

Table 4. Cross table of the question “What does this colour make you feel from an emotional point of view?” with the TAS-20 categories

Figure 3 represents the associations that participants have made between colour and emotion with regard to cultural aspects. None of the participants associated the emotions “Anticipation, Anger and Sadness” with any colour.

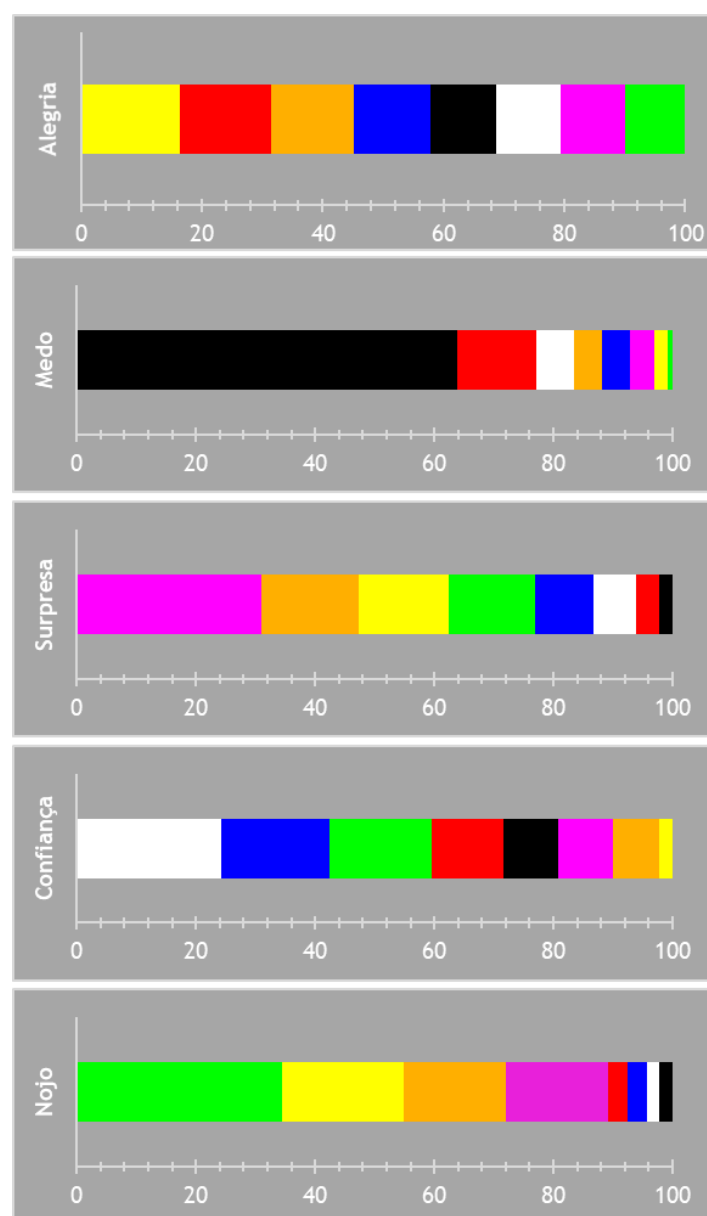


Fig. 3. Panel demonstrating the selection of how colours are distributed by emotions

Regarding the question “What emotion does this colour relate to?”, considering the score of the participants in each of the categories of the TAS-20, “Joy” was the emotion that presented the highest frequency count in any of the colours, except white. In this colour, the emotion with the highest frequency count for the Low category in the TAS-20 was “Trust” (44.1%), while for the High category it was “Joy” (48.6%) (**Table 5**).

		low	average	high
green	joy	44.1	46.1	42.5
	fear		0.7	
	surprise	17.6	9.2	19.2
	trust	32.4	29.1	26.0
	disgust	5.9	14.9	12.3
yellow	joy	76.5	73.8	72.6
	fear		1.4	1.4
	surprise	11.8	15.6	11.0
	trust	2.9	3.5	4.1
	disgust	8.8	5.7	11.0
red	joy	61.8	67.4	71.2
	fear	8.8	6.4	6.8
	surprise	5.9	4.3	1.4
	trust	23.5	19.9	20.5
	disgust		2.1	
orange	joy	50.0	64.5	65.3
	fear	2.9	2.8	1.4
	surprise	23.5	14.9	11.1
	trust	14.7	14.2	11.1
	disgust	8.8	3.5	11.1
blue	joy	50.0	57.4	58.3
	fear	2.9	1.4	4.2
	surprise	2.9	11.3	6.9
	trust	44.1	27.7	30.6
	disgust		2.1	
white	joy	32.4	52.5	48.6
	fear	14.7		4.2
	surprise	5.9	7.8	4.2
	trust	44.1	39.0	43.1
	disgust	2.9	0.7	
black	joy	52.9	50.4	45.2

	fear	29.4	34.0	31.5
	surprise		2.8	1.4
	trust	17.6	12.1	20.5
	disgust		0.7	1.4
magenta	joy	50.0	41.8	58.9
	fear		1.4	4.1
	surprise	32.4	33.3	16.4
	trust	14.7	15.6	15.1
	disgust	2.9	7.8	5.5

Table 5. Cross table of the question “What emotion does this colour relate to?” and the categories of the TAS-20

Table 6 shows Spearman's correlations for the relationship between the questions “What does this colour make you feel emotionally?” and “With which emotion relates this colour?” are moderate to high positives $.50 \leq r_s \leq .78$ (all $p < .01$) for all target colours.

	N/N	r_s	P
green	248	.55	<.01
yellow	248	.58	<.01
red	248	.72	<.01
orange	247	.50	<.01
blue	247	.59	<.01
white	247	.67	<.01
black	247	.78	<.01
magenta	248	.56	<.01

Table 6. Spearman's correlational analysis of the questions “What does this colour make you feel from an emotional point of view?” and “What emotion does this colour relate to?” for each of the target colours

4. DISCUSSION

When we focused on the results of alexithymia levels, we realise that the values of the TAS-20, for the different participants of our study, do not follow a normal distribution. This indicates that there is a set of participants, about 43.1%, at the extremes of the TAS-20 scores (13.7% score between 20 and 40, and 29.4% score equal to or above 61 points). The analysis of these scores led us to include participants in three TAS-20 scoring categories: Low (20-40 points), Medium (41-60 points) and High (61-100 points). Although most participants are included in the mid-range category, our results indicate that 34 participants (belonging to the Low category) can be characterized as individuals with good abilities in the recognition and expression of emotion, in themselves and in others. However, the results indicate that about 29.4% (73 subjects, in the High category) seem to present difficulties in the identification, recognition and expression of emotion, in themselves and in others.

According to the literature, these latter participants, with high scores in the TAS-20, can be considered "emotional illiterate", with characteristics such as: 1) difficulty in using adequate language to express and describe emotions; 2) difficulty in differentiating emotions from bodily sensations; 3) difficulty in imagery and fantasizing; 4) operative thinking (Parker *et al.*, 1993; Parker, Taylor and Bagby, 1993; Praceres, Parker and Taylor, 2000; Prazeres, 2000; Yoshida, 2007; Yoshida and Silva, 2007; Carneiro and Yoshida, 2009; Freire, 2010). Thus, our sample consists of about 1/3 of individuals who may present some or all of the characteristics mentioned above. We can see, therefore, that we can be faced with a group of people without imagination, with a weak capacity to verbalize feelings and stuck to the mundane aspects of reality.

As our sample consists of university students, from various areas of study, this work raises some doubts about the reason for these difficulties, in the recognition and verbalization of emotions, as well as their impact on the future of these young adults. However, it should be noted that we cannot say that these participants present a pathological picture, but rather a phenomenon, where alexithymia is seen as the result of several factors, whether genetic, physiological, psychodynamic, cognitive-behavioral or sociocultural (Fonte, 1993; Fernandes and Tomé, 2001; Maciel and Yoshida, 2006; Carneiro and Yoshida, 2009).

The CEQu questionnaire arose from the curiosity to study the relationships that human beings establish between colour and emotion, which allows the association of colour with emotion. The first question of the CEQu intended to ascertain whether the colours were correctly identified by the participants, so that the answers to the remaining questions could not be compromised by the difficulty in identifying the colour.

Some authors allude to the relationship between colour and emotion, stating that colours can transmit and/or affect our emotions (Volkova, Dolan and Wilson, 2012). Therefore, the study of the link between colours and emotions becomes useful for areas such as design, allowing us to unravel and select colours, so that they can arouse a certain emotional state (Volkova, Dolan and Wilson, 2012; Wilms and Oberfeld, 2018). Based on this purpose, the CEQu incorporates two questions that tried to assess this relationship: a) what does this colour make you feel?, from the emotional point of view, which had at its basis the attempt to activate an emotional alteration of the participants in relation to the observation of a target colour; b) with which emotion relates this colour?, which intended to collect information about learning the emotional relationship of colours with emotions, that is, what they were taught that a colour represents, emotionally.

Many of us grew up hearing expressions like "angry red", "green with envy", among others. These popular expressions are passed down from generation to generation and, therefore, we were curious to know whether the participants, when observing some target colours, would make the relation between emotion and certain colours and whether this relation was cultural. The analysis of these questions was generally performed, with the answers of all participants through cross tabulations and spearman correlations, as well as, through the results obtained from the participants belonging to the various categories of the TAS-20. When we started to analyze the results we realized that the correlations for the relationship between these questions are positive, leading us to conclude that we can analyze the results of the questions simultaneously, since apparently the answers of the participants are similar in both questions, in all target colours. The analysis of the cross-tabulations of the questions to be debated with the categories of the TAS-20, give the same indications.

Most participants responded "joy" to all target colours. "Joy" is considered one of the basic emotions with more positive polarity. This emotion presents a panoply of terms often used as synonyms (happiness, satisfaction, pleasure) (Rodrigues and Nascimento, 2019). Thus, "joy" can be interpreted as the sensation of a state of physical and psychological tranquility, thus inhibiting negative thoughts (Antonio *et al.*, 2008). Some authors who are dedicated to the study of the relationship between colours and emotions consider that warm colours are more associated with joy and these highlight orange and yellow (Freitas, 2007). Orange for reflecting enthusiasm and vivacity and yellow for being associated with positive thoughts, spontaneity, euphoria and resplendence (Plutchik, 2003; Pimenta, 2008). In this study, as already indicated, the emotion "joy" is not only associated with the colours Yellow and Orange, but also with the remaining six colours presented. In the case of Magenta colour,

it can be associated with joy by transmitting juvenility, therefore, a sense of joy. For the remaining five colours, we could not find any explanation for this in all the literature consulted. For this reason, we consider that the relationship between joy and colour can occur simply because the colours, by themselves, trigger joy. As some authors refer, depending on the part of the world we live in, happiness is associated with a different colour (white, yellow, red or green) (Heller, 2016). Perhaps that is why the participants have associated any of the colours with “joy” emotion, since one of the synonyms for this emotion can be happiness.

However, the association between the colour Black and the emotion “Joy”, aroused in us a huge curiosity. We thought that in Portuguese culture the idea that black is pain and sadness would be rooted and for this it was with awe that we found that this is not the association made by our participants, from the emotional point of view. This ambivalence can probably occur because black was and remains the “color of fashion”, we are invaded by numerous advertising in which people dressed in black have more power, more money, a greater social status. Ivone Silva's famous phrase “with a simple black dress, I never commit myself”, may have changed mentalities and a colour that would be associated with sadness, in our country, came to be seen as luxury and even well-being.

Although Joy is the most selected emotion for any of the colours, all other emotions were selected at some point, except for emotions: “Anticipation, Sadness, and Anger”. We hoped that the “Anticipation” emotion would not be associated with any of the target colours, since it is not an emotion, in our opinion, known to the general public, although in the Plutchick model, this is related to the colour Orange. On the other hand, we find no justification for not relating emotions “Sadness and Anger” to any colour. When participants were asked to identify the target colour with some learned concept, emotional concepts emerged, such as anger and sadness, for example, when target colour Red and Black appeared, respectively.

Thus, we think we can say, regardless of the scoring levels in the TAS-20, that emotions can have a colour and for this we can paint emotions. However, from the results obtained, we do not find a universal colour language for all emotions; it seems to be something idiosyncratic and that may depend on cultural factors.

5. CONCLUSIONS

One of the difficulties that we had as a possible variable influencing the relationship between colour and emotion was alexithymia. In this investigation, it is important to highlight the high scoring values of the TAS-20. However, we cannot in any way affirm that the participants present a pathological picture, but rather a set of symptoms and/or personality traits that can hinder communication and understanding of emotion, in themselves and in others. These results seem to be worrying and may in some way be contributing to inter-relational changes, perhaps leading to medium/long-term social changes and transformations. These, in turn, may lead to the relationship between Colour and Emotion not being transversal to the entire population, because the mean values of TAS-20 (N=248, M=53.26) of our sample are higher, given the studies of the validation of the instrument for the Portuguese population with university students (N=298, M=47.17) and in both, the sample was of convenience. In this context, we are asked a few questions: have alexithymia values changed over the years? If so, what is the reason? Can the increasingly close man-machine connection contribute to these results? If so, we believe that it is also the responsibility of the designer, as an agent of change, to create tools that allow the identification and/or recognition of emotions, in order to improve the quality of interpersonal relationships.

The emotions selected for the study were the eight in Plutchik's model: Joy, Trust, Fear, Surprise, Sadness, Disgust, Anger and Anticipation. We thought that the “anticipation” emotion, because it is not known to most participants could not, somehow, be associated with one of the colours. It was with surprise that we identified that besides the emotion Anticipation, Sadness and Anger were also not identified with any colour. However, we believe they are known and experienced by all. We did not find an adequate justification, and therefore we consider that, in future studies, we could change the

way stimuli are presented (target colour and emotion) in order to compel participants to a forced choice between a target colour and an emotion.

In our opinion, in addition to the possible association between colours and emotions, some variables could interfere in this process. We believed that the TAS-20 scores, that is, alexithymia score levels, somehow had positive or negative interference in the way participants associate colour with emotion. It was with astonishment that we realized that the TAS-20 scores had no influence throughout the study. Thus, we consider it possible to state that in this study the relationship established between Colour and Emotion did not depend on the identification and / or recognition of emotion by the participants, which leads us to consider that there may be learning factors and socio-cultural characteristics underlying this theme.

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