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CONTENTS

Research

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Autism spectrum disorder and cognitive flexibility: A cognitive neuropsychological study

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ABSTRACT. La presente ricerca si propone di valutare la flessibilità cognitiva (CF), cioè la capacità di passare da un compito a un altro quando il nuovo compito non è familiare, tra i bambini con ASD rispetto a quelli con sviluppo tipico (TD). Il campione di ciascun gruppo era composto da 54 bambini di età compresa tra i 6 e i 12 anni. I risultati dello studio hanno indicato che i soggetti con ASD soffrono di problemi nella FC rispetto a quelli con TD, in quanto i bambini con ASD impiegano più tempo (risposta lenta) e commettono più errori (numero totale di errori) e tendono a commettere più errori di perseverazione (risposta ripetuta) rispetto a quelli con TD.

SUMMARY. Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by persistent difficulties in social communication and social interaction, along with restricted and repetitive patterns of behaviours, activities and/or interests. These symptoms generally appear before early childhood. Cognitive flexibility (CF) is the ability to shift from one task to another, where the new task is unfamiliar and novel. CF was assessed in this study among children with ASD compared to typical development (TD). The sample for both groups consisted of children aged between 6-12 years, with each group comprising 54 children. This study employed three tests to evaluate CF, including the Trail Making Test (TMT), the Playing Cards Test (PCT), and the New Card Sorting Test (NCST). Results indicated that individuals with ASD suffer from impairments in CF compared to TD, as children with ASD take longer (slow response) and make more errors (the total number of errors) and tended to make more perseveration errors (repeat response) compared to TD. Our findings may explain many of the problems that these children suffer from, especially with regard to interaction, social communication, and stereotypical behavior, which deserves further research.

Keywords: *Autism spectrum disorder, Executive functions, Cognitive flexibility, Typical development, Neurodevelopmental disorder*

INTRODUCTION

Autism spectrum disorder (ASD) is characterized by deficits in social interaction and communication, in addition to stereotypical behaviors and restricted, repetitive interests. These symptoms typically appear in the early years of childhood (APA, 2013; Gerlach, 2003; WHO, 2019). ASD is considered one of the most important disorders studied by researchers, affecting males more than females. It is a neurodevelopmental disorder diagnosed through behavioral symptoms, such as communicative and interactive impairments, as well as restricted and repetitive interests (APA, 2013). Behavioral difficulties reported in autism spectrum disorder, such as resistance to change, inflexible thinking, repetitive language, and problems switching from activity to activity, and body movements, may appear to be indicators of impairment of cognitive flexibility (Smithson et al., 2013).

Cognitive flexibility (CF) is the ability to change behavioral and cognitive patterns to adapt to changes in the environment (Dennis & Vander Wal, 2010). This ability is often required in school environments especially in academic skills (Censabella, 2007). It is related to reading comprehension (Colé, Duncan, & Blaye, 2014), and mathematics skills (Purpura, Schmitt, & Ganley, 2017).

A study using functional magnetic resonance imaging revealed a set of brain regions responsible for CF, confirming that there is no single region responsible for CF, but rather it is distributed across several regions, such as the prefrontal cortex, anterior cingulate cortex, posterior parietal cortex and basal ganglia (Turk-Browne & Chun, 2008). Another study focusing on brain injuries investigating the neural basis of CF competencies found that the essential elements of CF are distributed across a network of brain regions that support specific abilities of human intelligence (Barbey, Colom, & Grafman, 2013). CF is associated with an extensive network of brain regions, primarily within the left hemisphere, including many brain regions such as the prefrontal cortex, left superior temporal lobe, left inferior and superior parietal cortex, and superior parietal cortex (Barbey, Colom & Grafman, 2013).

Among individuals with autism spectrum disorder, difficulty with executive functions (EF) in general, and impairments CF in particular, have been recorded (Garon, Smith, & Bryson, 2017). This makes it difficult for them to break away from repetitive behaviors and transition quickly and effectively from one task to another (Boyd, McBee, Holtzclaw, Baranek, & Bodfish, 2009). Series of experiments studies have investigated CF in individuals with ASD, beginning in the mid-1980s with the first experimental test of EF and CF conducted by Rumsey (1985). Subsequent studies have largely confirmed the impairment of CF in individuals with ASD, while a few others (despite their limited number) have acknowledged the absence of such impairments (Van Eylen et al., 2011). Some studies suggest that individuals with ASD who have deficits in CF struggle with social interaction (e.g., the inability to shift one's visual attention from the eyes to the mouth, a rigidity in applying social norms, inability to change social behavior or conversation subjects to adapt to shifting contextual needs, repetition of words and phrases), as well as limited and repetitive activities and behaviors, such as insistence on the same routine and rituals, and persistence in the same topics, movements, and activities (Geurts, Corbett, & Solomon, 2009).

Geurts and colleagues (2009) highlight that studies addressing CF in individuals with ASD can be characterized by two types of contradictions. The first contradiction is evident in the use of a specific measure; different results can be obtained from studies that utilize the same task. These inconsistencies could result from characteristics in participant like age, intelligence, and associated disorders. The second contradiction is the presence of discrepancies between measures. For example, the results of the *Wisconsin Card Sorting Test* (*WCST*) indicate deficits in CF among individuals with ASD, while studies using other CF tasks generally fail to detect these deficits (Geurts et al., 2009). According to some researchers, deficits in CF are persistent and associated with repetitive and restricted behaviors in ASD, although there are many inconsistent findings (Yerys et al., 2009). Other studies investigating CF in natural environments through the *Behavioral Assessment Inventory* of EF have shown that individuals with ASD experience difficulties and problems related to flexibility in daily life (Gioia, Isquith, Retzlaff, & Espy, 2002). However, contradictory results have been obtained from studies measuring CF in clinical or research settings (Van Eylen et al., 2011).

Researcher Rumsey (1985) conducted the first experimental test of EF in individuals with ASD, applying to the WCST, which measures CF abilities. According to this study, people with ASD exhibit deficits in CF, as detected by the same CF test. The study also confirmed that adults with ASD perform worse on the same test, committing more errors compared to the group of control (Rumsey, 1985). In

another study comparing the performance of children with ASD with average intelligence to a control group at the same intellectual level the researchers found that children with ASD made errors three times more frequently compared to children in the control group (Prior & Hoffman, 1990).

A group of researchers in Taiwan discovered significant difficulties in CF a sample of 26 Taiwanese children with ASD (Shu, Lung, Tien, & Chen, 2001). Children with ASD and those with developmental language disorders did not significantly differ in their attendance errors, suggesting that the tendency for attendance errors may be related to verbal skills (Liss et al., 2001). Another study examined the natural performance of persistence in individuals with ASD who have average intelligence (IQ of 70 or above according to intelligence tests). The same study observed lower rates of persistence in children with ASD through a computerized version of the WCST compared to the classic card version, which may reflect the reduced verbal and social task requirements (Ozonoff, 1995). Although some researchers did not find the same results in all individuals with ASD who possess average intelligence (Minshew & Rattan, 1992), poor performance may be related to the overall intellectual engagement level (general intelligence level), verbal ability, and task requirements (Robinson, Goddard, Dritschel, Wisley, & Howlin, 2009). However, many studies have found difficulties in CF in individuals with ASD, and poor performance may be related to the overall intellectual engagement level (general intelligence level), verbal ability, and task requirements (Robinson et al., 2009)

A study investigated whether this deficiency in CF is related to ASD itself or to the intellectual disability (cognitive impairment) associated with it. The study concluded that although children with ASD were able to switch tasks accurately like the control group, their ability to self-regulate performance by using feedback to prevent superior responses was weak (Robinson et al., 2009). Research has indicated that people with ASD suffer from deficits in CF (Van Eylen et al., 2011). Another study used the WCST to assess CF in children with ASD. The study's findings showed that children with ASD performed worse on the test tasks than did TD children (Reed, Watts, & Truzoli, 2011). In a study on 31 children with ASD (25 males and 6 females) and 31 children from the control group, aged between 8 and 12 years, matched for age, intelligence quotient, and gender, an emotion switch task based on gender was performed. The researchers used a computer screen to display images of male and female faces, either angry or happy (reporting emotions or the gender). The researchers found that overall performance did not differ between the groups, but a subset of the ASD group had slow and inaccurate performance, with slow shifting from emotion to gender experiences. The environmental switching task did not present any challenges for children with ASD. Children with ASD did not show difficulties in the environmental switching task, but they faced difficulty in solving or disentangling the emotional task set, with shifting performance associated with the amount of repetitive behavior (De Vries & Geurts, 2012).

The purpose of the study was to determine CF in kids with ASD and how it related to variables such as age and gender. The study concluded that CF deficits were higher in females compared to males, and for age, the study found that younger children had greater deficits in CF compared to older children (Memari et al., 2013). This tudy aimed to compare children with ASD and typically developing children in inhibition and CF; this study used the WCST to assess CF and the STROOP test to assess inhibition. The study results concluded that CF and inhibition deficits were present in children with ASD compared to TD (Pooragha, Kafi, & Sotodeh, 2013). In a Japanese study investigating the relationship between the need for closure and CF in individuals with ASD, 28 individuals with ASD and 28 individuals from the control group were included, with ages ranging between 20 and 45 years. This study used the Japanese version of the CF Scale (CFS-j). The study concluded that the need for closure was lower in the group with ASD and had difficulty in decision-making flexibility compared to the control group (Fujino et al., 2013).

Based on the above, we conclude that the majority of the studies we have discussed indicate the presence of CF deficits in individuals with ASD. Most researchers have found clear evidence of these deficits in individuals suffering from ASD. However, not all results unanimously agree on this deficit, especially among individuals with a high level of intelligence. In our study, we will attempt to examine this relationship to either confirms or refutes this deficit in children with ASD compared to TD.

Thus, the research problem can be summarized as highlighting and determining the impact of ASD on CF and evaluating this ability by measuring and comparing it with TD of the same age. In other words, we will try to answer the following question: are there statistically significant differences between children with ASD and TD in terms of CF?

Based on this, the present study aims to evaluate the performance of CF in individuals with ASD and compare their performance in this task with a group of children without neurodevelopmental disorders of the same age.

METHOD

Participants

The autism spectrum disorder (ASD) group was composed of 54 children (42 boys and 12 girls), aged between 6 and 12 years and who are verbally. All of them were officially diagnosed with autism spectrum disorder (between mild and moderate, according to the scales they passed during diagnosis by specialists) by a group of specialists (child psychiatrist, pediatrician, neurologist etc.) according to DSM-IV-TR and DSM 5 criteria (APA, 2000; APA, 2013). We chose 35 samples from the Oumi Association for Autism Spectrum Disorder: they continue their studies in different schools in the city of M'diq. 10 samples from the Mirror Association for Autistic Children and those who are pursuing their studies in primary school (Omar Al-Khayyam School) in the Moroccan city of Fes, and 9 samples from the Sabah Association for Autistic Children those who are pursuing their studies in primary school attending (Imam Malik School) in the same city (Fes).

The typically developing children (TD) group comprised 54 children (42 boys and 12 girls), aged between 6 and 12 years. They all were selected based on not having any sensory, motor, or cognitive disorder that could affect their cognitive performance. A total of 19 students are studying at Shahid Mohammed Al-Zerqatouni Primary School in the city of Fes, and we selected the remaining 35 samples in different schools in the city of M'diq.

The total number of research samples is 108 (they all continue their studies within educational institutions in primary schools), with 54 samples diagnosed with ASD and 54 samples typically developing by any neurodevelopmental disorder. We will distribute these samples according to gender, although we are not interested in studying the gender variable in this study, just to clarify more about the sample selection. The study was approved by all parents.

Based on Table 1 by comparing the average performance between ASD (n = 54) and children with TD (n = 54) in CF tests, it is clear that children with ASD suffer from deficits in CF. This is evident in the TMT (A) and (B), which rely on time and determine the level of CF. The same tests also reveal that children with ASD performed on average for longer periods of time than those with TD, suggesting CF deficiencies. The PCT also reveals that the average completion time and number of errors committed by children with ASD in both parts of the test were higher compared to TD, indicating deficits in CF. As for the NCST, which shows the level of perseveration, the averages indicate that children with ASD tend to have more perseverative responses compared to neurotypical children, indicating deficits in CF.

Measures

In this study, we utilized three neuropsychological tests to measure CF in individuals with ASD and typically developing children.

These tests are used to evaluate CF and include the following research tools.

– *New Card Sorting Test*. The New Card Sorting Test (NCST) measures cognitive flexibility ability, that was developed (Roy, Fournet, Roulin, & Le Gall, 2013). The researchers drew inspiration from Wisconsin Card Sorting Test (WCST) (Heaton,1981), Modified Wisconsin Card Sorting Test (MWCST) (Cianchetti, Corona, Foscoliano, Contu, & Sannio Fancello, 2007), and Modified Card Sorting Test (MCST).

  The NCST consists of 48 cards, in addition to four guiding cards, based on three criteria (color, number, shape). This test measures cognitive flexibility in children and adolescents between the ages of 6 and 16 years (Roy, Le Gall, Roulin, & Fournet, 2020). The reliability of this test has been investigated (Guerra, Hazin, Roulin, Le Gall, & Roy, 2021).

  The researcher faces the children (one by one) and places the NCST (one red triangle, two green stars, three yellow plus signs, four blue circles) in front of the children and gives all the instructions. Passing the test begins according to the approved procedures, and so on until the child reaches the last card given to him.

– *Playing Cards Test*. This test falls within the Behavioural Assessment of the Dysexecutive Syndrome in Children (test battery) (BADS; Wilson, Evans, Alderman, Burgess, & Emslie, 1996). PCT is a neuropsychological test that measures CF and consists of 21 cards with two parts (first

Table 1 – Mean performance, minimum, maximum values, and standard deviations for children with ASD and TD

	Group ASD (n = 54)				Group ASD (n = 54)			
Measure	Minimum	Maximum	*M*	*SD*	Minimum	Maximum	*M*	*SD*
TMT (A)	.51	7.12	2.94	1.86	.18	1.23	.65	.34
TMT (B)	1.22	8.47	4.92	2.17	.52	3.17	2.08	.77
PCT completion time	1.05	6.39	2.21	1.53	.52	2.08	1.01	.37
Errors in part one of PCT	.00	7.00	1.36	2.19	.00	1.00	.05	.22
Errors in part two of PCT	.00	9.00	5.31	2.56	.00	8.00	1.94	1.92
NCST	3	20	9.89	4.78	.00	18	5.42	4.68

rule and second rule). In the first part, the individual is asked to respond Yes to a red card and No to a black card. The second part contains a different rule that the individual says Yes if the card is the same colors the one before it and No if the card is of a different color (Rozenblatt, 2018; Siu & Zhou, 2014).

– *Trail Making Test*. Trail Making Test (TMT) is neuropsychological test measures a range of abilities, including CF and visuomotor skills (Seron, & Van Der Linder, 2014). It consists of two parts, A and B (Czermainski, Riesgo, Guimarães, Fumagalli de Salles, & Bosa, 2014). In the first part (TMT-A) individuals draw lines to sequentially connect 25 numbers (from 1 to 25), and in the second part (TMT-B) where individuals similarly draw a sequential line, but must alternate between numbers (from 1 to 13) and letters (from A to L) (Bowie & Harvey, 2006; Reitan, 1958).

Procedure

Approval was obtained from the associations to which children with autism spectrum disorder belong, and tests were passed within the schools in which they continue their studies or within the associations to which they belong (great cooperation from the Learning Support *Assistant*). Informed consent was also obtained from the parents of both ASD children and TD children.

Educational institutions (most notably the academy) have agreed to pass the tests to ordinary children who are continuing their studies in school.

All participants were tested individually in a room either at the school or the association. Before starting the neuropsychological assessment, the experimenter initially engaged the children in a conversation about general topics that interested them to establish rapport.

Data analysis

We focused on presenting the data that we reached through the tests that we applied on the sample of children with ASD and TD children. First, we used descriptive statistics to calculate the minimum, average, and maximum values and cognitive deviation for the two groups in the variable number of errors, habituation response, and time period.

Independent *t*-tests to investigate statistical significances between the two groups. The duration of time, the number of

errors, and the perseverance response were calculated for the two samples.

It's important to point out that initially we note that high scores on neuropsychological tests do not always indicate high performance. When it comes to the number of errors, time, and perseverance responses, the situation may differ entirely. The higher the number of errors, time, or perseverance responses, the weaker the performance.

Findings

By analyzing the data we obtained from the tests that included three variables, we reached a conclusion: which are the time, number of errors, and perseveration errors for both autism and typical development.

A *t*-test revealed that the ASD group presented a significantly higher reponse time than the TD group [Path TMT (A): T = −5.26, p = .00; TMT (B): T = −5.36, p = .00; PCT: T = −5.36, p = .00]. Statistically significant differences were found (see Table 2).

In addition, children in the ASD group made significantly more errors than children in the TD group during stage [PCT (1): T = −5.36, p = .01; PCT (2): T = −4.57, p = .00]. Similar to time, Statistically significant differences were found (see Table 2 and Table 3)

The mean number of perseveration errors was higher for the ASD group than for the TD group (NCST: p = .06, T = −2.91), but no significant group differences were found (see Table 3).

DISCUSSION

The current study aimed to investigate the cognitive flexibility skills of autistic children of children with ASD and typically developing through the variables of time, number of errors, and perseveration errors, in order to evaluate the cognitive flexibility of the two groups, using three tests TMT (Bowie & Harvey, 2006; Reitan, 1958), PCT (Wilson et al., 1996) and NCST (Roy et al., 2020).

When comparing the performance of the ASD and the TD groups, the data revealed that children with ASD take longer (slow response) and make more errors (the total number of errors) and tended to make more perseveration errors (repeat response) compared to TD. This is consistent with our

Table 2 – The average of children with ASD and TD through the TMT (A) and the TMT (B); the PCT variable related to time

Sample	Sample size	*M*	*SD*	*t*-test	Significance level
Children with ASD sample TMT (A)	54	2.94	1.86	−5.26	.00
Neurotypical children sample TMT (A)	54	.65	.34		
Children with ASD sample TMT (B)	54	4.92	2.17	−5.36	.00
Neurotypical children sample TMT (B)	54	2.08	.77		
Children with ASD sample PCT	54	2.21	1.53	−3.33	.003
Neurotypical children sample PCT	54	1.01	.37		

Table 3 – The average of children with ASD and TD through the PCT variable related to errors in the first part, the second part and the NCST

Sample	Sample size	*M*	*SD*	*t*-test	Significance level
Children with ASD sample PCT first part	54	1.36	2.19	−2.60	.01
Neurotypical children sample PCT first part	54	.05	.22		
Children with ASD sample PCT second part	54	5.31	2.56	−4.57	.00
Neurotypical children sample PCT second part	54	1.94	1.92		
Children with ASD sample NCST	54	9.89	4.78	−2.91	.06
Neurotypical children sample NCST	54	5.42	4.68		

predictions and indicates cognitive flexibility impairments in children with ASD. Both groups understood the tasks instructions (in the three tests) and were equally able to learn rules from feedback.

ASD children were significantly slower than typically developing children, pointing to reduced cognitive flexibility skills for the autistic group (Andreou, Konstantopoulos, & Peristeri, 2022). Using the Trail Making Test (A) and a group of other tests, it was found that processing speed in autism spectrum disorder is characterized by a large and significant processing speed deficit (Haigh, Walsh, Mazefsky, Minshew, & Eack, 2018), suggesting that cognitive flexibility is a deficit in ASD.

Our study's results are consistent with Rumsey study (1985), which confirms that individuals with ASD make many more errors compared to the control group members when applying the WCST. This is what our study revealed through the PCT, where it was found that children with ASD make many errors in performing CF tasks compared to neurotypical children, confirming the existence of deficiencies at the level of CF. Our study also aligns with Prior and Hoffman's study (1990), which confirms that children with ASD commit errors three times more compared to the control group.

Similarly, the study by Van Eylen and colleagues (2011) is consistent with the results of this study, as indicates that individuals with ASD tend to make perseverative errors compared to children in the control group. This is what we found in our study through the NCST, showing that the number of perseverative errors committed by children with ASD is higher compared to TD. Individuals who had more parent-reported language deficits, education and lower level of intelligence, and more engagement in solitary instead of social daily activities or showed lower daily sleep time were more likely to demonstrate perseverative (Memari et al., 2013). In addition, the results are consistent of this research also agree with studies by Shu and colleagues (2001), Reed and colleagues (2011), Pooragha and colleagues (2013), which confirm the impaired performance of children with ASD in WCST compared to TD children. However, a range of studies have achieved different results. Our findings differ in all individuals with ASD who possess an average IQ (above 70) (Minshew & Rattan, 1992; Ozonoff, 1995).

This variation between studies may be due to a number

of factors. This difference may be due to a group of studies regard is that individuals with ASD are characterized by a large heterogeneity both in the ASD phenotype (Wing, 1997), and in neurocognitive characteristics (Van Eylen et al., 2011). In addition to age, a meta-analytic study showed a decrease in the number of perseverations (including both errors and answers) as age increases (Landry & Al-Taie, 2016).

Thus, it appears that the results of this research confirm the presence of clear deficiencies in CF among children with ASD compared to TD. These results also align with most previous studies on CF in individuals with ASD, which confirm the existence of deficiencies in CF. In summary, most studies addressing CF in children with ASD confirm the presence of deficiencies in CF, which is reflected in several areas, such as:

- social interaction, which is evident in the inflexibility in applying social rules, changing social behavior, and the inability to shift attention to a space outside of oneself;
- social communication, which appears through the inability to flexibly combine language elements, perseveration on a single specific meaning of words, weak flexibility in interpreting words in an alternative way, and inflexible use of language and perseveration on one type of activity;
- restricted and repetitive activities and behaviors, which are most common in individuals with ASD, manifesting through insistence on the same routine and rituals, perseveration on the same subject, movements, and activities. In addition, the impaired observational learning in daily classroom activities among children with ASD is related to deficiencies in CF. These children have difficulty transitioning from one learning task to another compared to neurotypical children, all of which result from impairments in EF in general and CF in particular.

This is confirmed by most studies addressing CF in individuals with ASD, which clearly reveal the presence of deficiencies in CF compared to neurotypical individuals. This makes this group suffer from difficulties in various fields (reading, writing, adaptive behavior, reasoning, calculation, etc.).

CONCLUSION

In summary, the present study investigated cognitive flexibility in children with autism spectrum disorder compared to typical development by using three tests (TMT, PCT, NCST). We focused on measuring three variables: time (slow response), number of errors (the total number of errors), and perseveration errors (repeat response).

As predicted, individuals with ASD made more perseveration errors and they took a long time to complete the tasks and make more errors.

Findings indicate that individuals with ASD do have cognitive flexibility impairments. However, further research is needed to fully establish this claim.

Ethical considerations: Comply with ethical guidelines. The study was approved by the Regional Academy of Education and Training of the Fes-Meknes region, Fes Regional Directorate. Approval of the Shahid Muhammad al-Zarqtouni primary school in Fes. Approval from the Mirror Association for Autistic Children, and Oumi Association for Autism Spectrum Disorder, and Sabah Association for Autistic Children. The study was approved by all parents.

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Exploring the association between parenting style and emotional intelligence among adolescents of Jharkhand: An empirical study

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ABSTRACT. La presente ricerca è stata condotta con l'obiettivo di indagare l'associazione tra gli stili genitoriali e l'intelligenza emotiva e le loro dimensioni, di sapere se lo stile genitoriale (e le sue dimensioni) predice l'intelligenza emotiva, di scoprire il valore predittivo degli item della scala dello stile genitoriale nei punteggi dell'intelligenza emotiva utilizzando l'analisi di regressione lineare stepwise. Il campione di 320 adolescenti di Jharkhand è stato selezionato con un disegno di campionamento misto (campionamento a grappolo seguito da campionamento stratificato). I dati sono stati analizzati con il software SPSS V20 e i risultati mostrano che lo stile genitoriale predice significativamente l'intelligenza emotiva.

SUMMARY. The present research was carried out with the aims to investigate 1) the association between parenting styles and emotional intelligence and their dimensions, 2) to know whether parenting style (and its dimensions) predicts emotional intelligence, 3) to find out the predictive value of the items of the parenting style scale in the scores of emotional intelligence using stepwise linear regression analysis. The sample of 320 adolescents of Jharkhand was selected using mixed sampling design (cluster sampling followed by stratified sampling). The data was analysed using SPSS V20 software. Parental rejection style has significant negative correlation with emotional intelligence. One of the dimensions of parenting style i.e., warmth/affection was found to be positively associated with the overall emotional intelligence and its dimensions. Whereas, the other negative dimensions of parenting (aggression/hostility, neglect/ indifference and rejection/undifferentiated) were negatively related with the overall emotional intelligence and with the dimensions of emotional intelligence (understanding emotions, understanding motivation, empathy and handling relations). Furthermore, result also shows that parenting style (and its dimensions) significantly predicted emotional intelligence.

Keywords: *Adolescents, Parenting style, Emotional intelligence*

INTRODUCTION

Since decades researchers have shown their interest in conducting researches to the themes related to family processes and their relation to child's physical and psychological development. Family as we know, is the first school of the child. Parents teach their children how to become a better person, how to behave in social settings and many more other things. Along with this, individual characteristics also play a significant role in having a fulfilling life. But of the various factors, parents are one of the important personalities that influences child's life. Through their world of influence, parents mold and shape their child into adults (Baumarind, 1971). Since ages mothers are considered to play the significant role in child's overall development. With the recent changes in the demographic conditions in the family, both parents are working. So, it becomes the responsibility of both the parents to help the child develop into a psychologically healthy person. Parental style can be considered as an attitude that parents have about child rearing practice (Perween & Imam, 2019). Bruno in 1986 tend to define parenting style as a pattern of certain behaviour exhibited by the parents towards their child (Kaur & Kaur, 2021). Diana Baumarind (1967) is known to be the pioneer in the field of conceptualizing parenting style. She stated parenting style is of three different ways: (1) Authoritative parenting style, (2) Authoritarian parenting style and (3) Permissive parenting style. Parenting style can be explained in two components namely parental acceptance and rejection. Parental acceptance maybe expressed physically in the form of founding, hugging, kissing etc. or in the form of complementing, appreciating, or speaking kind words to or about one's child verbally. While parental rejection includes hostility, aggression, anger etc. (Sristee & Singh, 2023). Parental acceptance and rejection theory also known as theory of socialization given by Rohner focuses on behavioral, cognitive, emotional development of child and adult functioning (Hussain & Munaf, 2012). A good parenting style helps an individual to develop psychologically and emotionally. Different people have different ability to process emotional activities. These abilities of an individual have been conceptualized under the heading emotional intelligence. Emotional intelligence in a nutshell can be understood as the meta-ability to comprehend, understand and manage the emotions of oneself and that of others (Amandeep, 2017). Those individuals who can regulate their emotional state are healthy because they can perceive and appraise their emotions appropriately and know very well when and how to behave (Salovey, Bedell, Detweiler, & Mayer, 1999). It is usually said that emotional intelligence can also be trained. But it is also believed that emotional behaviour can be nurtured through human interactions (Alegre, 2011). Emotional development is found to be developed rapidly during the initial years of their development through interactions with their parents (Caulfield, 1996).

Taking into considerations many studies related to how parental behaviour affects the level of emotional intelligence, Asghari and Besharat (2011) concluded that authoritative and permissive parenting style leads to high level of emotional intelligence whereas authoritarian and neglecting parenting styles lead to low level of emotional intelligence. Alegre (2011) argued that parental responsiveness, parental emotion-related coaching and parental positive demandingness can enhance children's emotional intelligence, while parental negative demandingness can lower emotional intelligence of children. In another study conducted by Shalini and Acharya (2013) results indicated authoritative and authoritarian parenting styles practiced by fathers were significantly associated with emotional intelligence. Also, it was found that fathers showed authoritative parenting styles mostly towards girls than boys. Goldman in his study stated that parents who shares a warmth and healthy bond with their children, those children are more likely to have good control over their emotional development (Mehta, 1995). The way parents upbring their child is an important indicator of parenting functioning and child's overall development along a wide spectrum. And the concept of emotional intelligence is a very well-known and well-researched concept in the field of psychology. But very few studies have reported how parenting style affects the levels of emotional intelligence, especially in the context of tribal and non-tribal adolescents of Jharkhand. The present study develops insight and adds to the growing body of the literature that seeks to understand the role of parenting style in understanding emotional intelligence and helps in cultivating the positive well-being and virtue in adolescents.

OBJECTIVES

The study is being conducted with the following objectives:

– to establish the association between emotional intelligence

and parenting style and their dimensions among tribal and non-tribal adolescents of Jharkhand;
- to find out the predictive value of the items of the parenting style scale in the scores of emotional intelligence using stepwise linear regression analysis;
- to see if parenting style and its dimensions namely warmth/ affection, aggression/hostility, neglect/indifference and rejection/undifferentiated predicts emotional intelligence.

Hypotheses

To meet the above objectives following hypotheses have been formulated:
- $H(a_1)$: there would be significant relationship between emotional intelligence and parenting style and their dimensions.
- $H(a_2)$: the items of parenting style scale would significantly predict emotional intelligence.
- $H(a_3)$: parenting style and its dimensions namely warmth/ affection, aggression/hostility, neglect/indifference and rejection/undifferentiated would predict emotional intelligence.

METHODS

Research design

The present study uses a cross-sectional, correlational survey research design.

Samples

The study has been carried out in the Ranchi and Ramgarh districts of Jharkhand. 320 adolescents of Jharkhand age ranging between 13-17 years (160 tribal adolescents and 160 non-tribal adolescents has been employed in the study using mixed sampling method (cluster sampling followed by stratified sampling method). The study consists of equal numbers of boys (Mean age = 14.77) and girls (Mean age = 14.75).

Measures

- *Parental Acceptance Rejection Questionnaire (PARQ Hindi version)*. The Parental Acceptance-Rejection Questionnaire is a self-report tool that is developed to measure how individual perceive their parental behaviour to be accepted or rejected by their parents. PARQ is a two-dimensional scale of parental behaviour with acceptance (i.e. warmth) at the one end of the continuum and parental rejection defining the other end. It is a Hindi adaption of Rohner's Parental Acceptance-Rejection Questionnaire (PARQ) and is introduced by Prakash and Bhargava (1980). The scale consists of total 60 items. It is a 4-point Likert scale having response categories: 4 = Almost always true, 3 = Sometimes true, 2 = Rarely true and 1 = Almost never true. And out of 60 items 7 items (i.e., 7, 14, 21, 28, 35, 42 and 49) are negatively scored. In these items the scoring will be done as 1 = Almost always true, 2 = Sometimes true, 3 = Rarely true and 4 = Almost never true. This tool assesses how an individual perceives his mother's behaviour when he was about 7 through twelve years old. Higher the score calculated higher is the rejection.
- *Emotional Intelligence Scale.* This tool has been introduced by Dr Arun Kumar Singh and Dr Shruti Narain in 2014. It consists of 31 items divided into four areas: 1. Understanding emotion, 2. Understanding motivation, 3. Empathy, 4. Handling emotion. This scale can be administered on 12 years and above. Out of 31 items, 4 items (i.e.13, 17, 20, 21) are negative items. For each item subject has to respond in Yes or No categories. For positive items, +1 score will be given for Yes response and 0 for No response and vice-versa.

Procedure

As the study population included school going students, different schools of Ranchi and Ramgarh districts of Jharkhand were selected. The school administrations were consulted to seek permission to take data from their reputed schools. Firstly, students were asked to fill in the consent form and then socio-demographic detail. After this they were asked to read the instructions and then items of the questionnaire and answer accordingly. The data was taken in two different sessions as per the convenience of subjects.

Raw data was analyzed with the help of SPSS software using correlation, step-wise regression analysis and hierarchical regression analysis.

RESULT

From the Table1 we can see that Pearson correlation was calculated to see the association between parental rejection type of parenting style along with its dimensions and overall emotional intelligence and among its dimensions among 320 adolescents (male = 160, female = 160) of Jharkhand. Parental rejection was found to be negatively and significantly correlated with emotional intelligence (–139, $p<.01$), understanding motivation (–.161, $p<.01$), empathy (–.137, $p<.01$). Warmth/affection (dimension of parenting style) was to seen to be significantly and positively correlated with emotional intelligence (.361, $p<.01$), understanding emotions (.101, $p<.01$), understanding motivation (.269, $p<.01$), empathy (.336, $p<.01$) and handling relations (.228, $p<.01$). Aggression/hostility (dimension of parenting style) was found to be negatively and significantly associated with emotional intelligence (–.201, $p<.01$), understanding motivation (–.202, $p<.01$) and empathy (–.187, $p<.01$). Neglect/indifference (dimension of parenting style) is associated negatively and significantly with emotional intelligence (–.379, $p<.01$), understanding motivation (–.345, $p<.01$), empathy (–.342, $p<.01$) and handling relations (–205, $p<.01$). Rejection/undifferentiated (dimension of parenting style) associated significantly and negatively with emotional intelligence (–.182, $p<.01$), understanding motivations (–.170, $p<.01$) and empathy (–.203, $p<.01$).

In the light of above result in the Table 1 Hypothesis $H(a_1)$ that states "There would be significant relationship between emotional intelligence and parenting style and their dimensions" was accepted.

Table 2 shows the results of stepwise regression analysis with items of parenting style as predictor variables and emotional intelligence as criterion variable. From the result table it is clearly seen that out of 60 items of the parenting style scale 6 items i.e., item number 58, 26, 3, 28, 50, and 38 were found to be significantly predicting emotional intelligence. 7.4% of variance is explained by Item no. 58 in the first model that measures sympathetic behaviour of the mother/caretaker towards the child. in the scores of emotional intelligence ($F = 25.206$, $p<.01$, $df = 318$). Item no. 26 in the second model which defines the reinforcement behaviour of the mother/caretaker has predicted emotional intelligence with a variance of 11.9% ($F = 16.105$, $p<.01$, $df = 317$). In model no. 3, Item no. 3 has reported a variance of 15.8 % in the scores

Table 1 – Correlation between parenting style and its dimensions and emotional style and its dimensions

Variables	Total emotional intelligence	Understanding emotions	Understanding motivation	Empathy	Handling relations
Parental rejection	–.139**	–.004	–.161**	–.137**	–.047
Warmth/affection	.361**	.101**	.269**	.336**	.228*
Aggression/hostility	–.201**	–.042	–.202**	–.187**	–.088
Neglect/indifference	–.379**	–.075	–.345**	–.342**	–.205**
Rejection/Undifferentiated	–.182**	.006	–.170**	–.203**	–.084

Legenda. ** = correlation is significant at the .01 level (1-tailed); * = correlation is significant at the .05 level (1-tailed).

Table 2 – Stepwise linear regression models for the prediction effect of items of parenting style on emotional intelligence

Model	*R*	*R* square	Adjusted *R* square	*R* square change	β	*F* change	Sig. of *F* change
1 (ps58)	.271[a]	.074	.071	.074	–.271	25.206	.001
2 (ps26)	.344[b]	.119	.113	.045	–.213	16.105	.001
3 (ps3)	.398[c]	.158	.150	.040	–.206	14.920	.001
4 (ps28)	.418[d]	.175	.165	.017	.133	6.351	.012
5 (ps50)	.438[e]	.192	.179	.017	–.137	6.644	.010
6 (ps38)	.457[f]	.209	.194	.017	–.133	6.719	.010

Legenda. a.ps58 = item in the parenting style scale that measures sympathetic behaviour of the mother/caretaker; b.ps26 = item in the parenting style scale that measures reinforcement behaviour of the mother/caretaker; c.ps3 = item in the parenting style scale that measures ignorant behaviour of the mother/caretaker; d.ps28 = item in the parenting style scale that measures caring behaviour of the mother/caretaker; e.ps50 = item in the parenting style scale that measures acceptance nature of the mother/caretaker; f.ps38 = item in the parenting style scale that measures submissive nature of the mother/caretaker.

of emotional intelligence (F = 14.920, p<.01, df = 316) that measures the ignorant behaviour of the mother/caretaker towards the child. Item no. 28 in model no. 4 which shows the caring behaviour of the mother towards the child predict emotional intelligence with a variance of 17.5% (F = 6.351, p<.01, df = 315). 19.2% of variance is explained by Item no. 50 in model no. 5 in the scores of emotional intelligence (F = 6.644, p<.01, df = 314) that shows the acceptance nature of the mother/caretaker. Item no. 38, in model no. 6 showed a variance of 20.9% (F = 6.717, p<.01, df = 313) which depicts the submissive nature of the mother/caretaker. The sign of the obtained β value is negative because those items that are positively scored represents rejection and hence negatively predicts the emotional intelligence and the sign of β value is positive because in this scale the items that are negatively scored represents acceptance and hence positively predict emotional intelligence.

Hence the second hypothesis formulated that states that "Parenting style and its dimensions would predict emotional intelligence" stands out to be correct.

A four-step hierarchical regression analysis was performed to identify factors predicting emotional intelligence. The independent variables (dimensions of parenting style) were entered as follows: Step1 included total parenting style score, Step2 included warmth/affection, Step 3 included aggression/hostility and Step 4 included neglect/indifference. Table 3 indicated that, in the first model control factor (emotional intelligence) explained 1.9 percent of total variance (F = 6.281, p<.01, df = 318). The result revealed that total rejection parenting style score predicted emotional intelligence negatively (β = –.139, p<.01). In model 2, warmth/affection and total parenting style score explained 15.7 percent of variance in emotional intelligence (F = 51.374, p<.01, df = 317). The result reveals that total parenting style score and warmth predicted emotional intelligence (β = .371, p<.01). The ΔR^2 value of .137 reveals 13.7 percent variance difference between model 1 and 2. In model 3, aggression/hostility, total parenting style score and warmth/affection showed an additional 16.3 percent of variance (F = 6.427, p<.01, df = 316). The result reveals that aggression/hostility,

Table 3 – Hierarchical regression models for the prediction effect of dimensions of parenting style on emotional intelligence

	B	SE	β	*R*	*R* square	Adjusted *R* square	*R* square change	*F* change	Sig of *F* change
Total	–.025	.055	–.139	.139	.019	.016	.019	6.281	.013
Parenting Style (Rejection)									
Warmth/affection	.085	.065	.371	.396	.157	.151	.137	51.374	.001
Aggression/hostility	–.027	.082	–.191	.404	.163	.155	.106	6.427	.001
Neglect/indifference	–.205	.086	–.318	.422	.178	.168	.115	8.743	.017

Legenda. B = unstandardized Beta coefficient; SE = standard error; β = standardized Beta coefficient.

total parenting style score and warmth/affection predicted emotional intelligence (β = –.191, p<.001). The ΔR^2 value of .105 reveals 10.5 percent variance difference between model 2 and 3. In the last model, neglect/indifference, total parenting style score, warmth/affection and aggression/hostility showed another 17.8 percent of variance (F = 8.743, p = .017, df = 315). The result reveals that neglect/indifference, total parenting style score, warmth/affection and aggression/hostility predicted emotional intelligence (β = –.318, p<.017). The ΔR^2 value of .115 reveals 11.5 percent variance difference between model 3 and 4. The obtained β value is positive because warmth/affection dimension of parenting style positively predicts emotional intelligence while negative β value represents that total parenting style score that represents rejection and the other dimensions of parenting style i.e., aggression/hostility and neglect/indifference negatively predict emotional intelligence.

Hypothesis stating that "The items of parenting style scale would significantly predict emotional intelligence" was found to be partially correct as only the overall score of parenting style and three dimensions of parenting style namely warmth/affection, aggression/hostility and neglect/indifference predicted emotional intelligence significantly. While the last dimension rejection/undifferentiated was not found to be statistically significant.

DISCUSSION

The present study emphasizes its scope on understanding the nature of parenting style and how it affects the development of emotional intelligence among adolescents. This research was carried to investigate the association between parental rejection style and emotional intelligence, to see the predictive ability of items of parenting style scale and to see the predictive value of dimensions of parenting style on emotional intelligence. From the analysis of data, it was reported that parental rejection type is negatively associated with emotional intelligence. Only one dimension of parenting style i.e., warmth was found to be positively and significantly correlated with emotional intelligence and its dimensions. When a child is shown warmth and affection, he feels acceptance by his/her parents. They feel they have supportive and responsive parents and so their

self-worth is high and they are emotionally intelligent. Studies carried out by Asghari & Besharat (2011) and Alegre (2011) supported the findings that child reared with authoritative parenting style that includes warmth and support increases the level of emotional intelligence. The rest of the dimensions of parenting style i.e., aggression, negative and undifferentiated, were found to be negatively and significantly associated with emotional intelligence and its dimensions. Hostile and negative environment can lead to a feeling of insecurity, low self-esteem, low self-concept and low self-worth which lowers the level of emotional intelligence in an individual (Farrell, 2015; Perween & Imam, 2019). After analyzing the data, it was also seen that items that were measuring sympathetic nature, reinforcement behaviour, caring & concern, ignorant nature of mother towards the child, approval and submissive nature of the mother were able to predict the level of emotional intelligence significantly as some items showed acceptance towards the child, being aware of the child's need and the outer world in which he lives. While some items predicted emotional intelligence negatively and significantly as these items show the ignorant behaviour of the parents or any care giver with whom the child used to spent most of the time. The three dimensions of parenting style i.e., warmth, aggression and negative were found to be significantly predicting the levels of emotional intelligence.

CONCLUSION

The present study adds to the existing literature about parenting style and how it is related to adolescents' emotional intelligence. Parenting style is one of the significant factors that determines the development of an individual psychologically. Out of the various types of parenting style, parental acceptance and rejection is one of the important types of parenting style. The result from the study illustrated that parental acceptance and caring behaviour will help in enhancing the level of emotional intelligence among adolescents. While parental rejection or distant or disapproving caregiving can hinder the development of emotional intelligence among adolescents.

Implications

Humans can create best out of everything and India is the nation having largest number of adolescent populations. This research will help to efficiently develop our human resources, help them grow psychologically which in turn will lead to a healthy nation. This study will help parents and teachers to carry out those programs and practice those behaviours that will foster emotional intelligence. This study will also help in developing parenting style framework that account for the needs and challenges of adolescents. This study will also help to develop policies and techniques aimed at promoting parenting education so that the parental behaviour can facilitate the development of healthy psychological traits in the adolescents.

Limitations

- The study is confined to a smaller geographical area considering only two districts of Jharkhand.
- This study uses a quantitative method of data collection which may lead to biases of response.

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Does color preference influence its perception? A pilot study

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ABSTRACT. In accordo con i moderni modelli neurobiologici, la Gestalt considera la percezione come il risultato dell'integrazione tra segnali corporei (interocettivi e propriocettivi) e stimoli sensoriali esterni, un processo che avverrebbe nella Zona Incerta. La soggettiva percezione cromatica emerge da questa integrazione corpo-sensi. Questo studio pilota ha messo in relazione la percezione dell'immagine ambigua di un famoso 'vestito' con la preferenza cromatica, rilevando una correlazione tra colore preferito e colore percepito e suggerendo che le preferenze influenzano direttamente l'esperienza percettiva.

SUMMARY. According to modern neurobiological models of consciousness, Gestalt psychotherapy theory views perceptual experience as a phenomenon emerging from the interaction between interceptive and proprioceptive processes on the one hand and exteroceptive information on the other. This interaction, from a neurobiological perspective, can be imagined as occurring within the integrative activity of the thalamus, where information from both the body and the sensory organs converges in its nucleus, known as the Zona Incerta. The ambiguous image of a 'dress', which went viral in 2015, provides an additional tool to investigate color experience as some people see the dress as blue and black, others yellow and white. The present pilot study related the perception of the dress image to color preference using the Lüscher Color Test. The survey evidence is strongly suggestive that color preference closely related to the body and emotions directly modifies perceptual experience.

Keywords: *Perceptual experience, Body-senses integration, Color preference, Gestalt psychotherapy theory, Lüscher color test, Zona incerta*

INTRODUCTION

Researchers agree that preverbal mental states (emotions, proprioception and enteroception), intervene in perceptual processes (Carvalho & Damasio, 2021; Pessoa, 2022). Early Gestalt psychology studies had already shown that object-related emotions substantially altered the perception of those objects (Wagemans et al., 2012) by changing their basic properties (brightness, color saturation and size) (Bruner & Postman, 1949). However, actually there is still no agreement on the mechanism underlying this effect. Understanding whether mental states determine the quality of experience by acting directly on perceptual processes (thus being an integral part of perception itself), or by altering the cognitive representation of perception, directs dramatically different solutions to what Chalmers called the "hard problem of consciousness" (Chalmers, 1997).

Gestalt psychotherapy believes that the influence of the body and emotions on perception is determined by a complex process called "es" that incorporates perceptual-motor memories and emotional states and constitutes the subject-referable (subjective) dimension of the perceptual field (Robine, 2006). The "es" function is based on bodily and emotional experiences, influences perception and is in turn modified by perception itself, which modulates bodily and emotional responses, according to an incoercible and inseparable circularity (Francesetti, 2015).

Aesthetic appreciation fosters the formation of a perceptual Gestalt from an ambiguous and undifferentiated perceptual environment. This statement, in the context of Gestalt psychotherapy, has three complementary directions: the preceptive aspect (figure emergence), the phenomenal aspect (insight emergence) and the phenomenological aspect (sense revelation).

Aesthetic meaning in Gestalt psychotherapy is seen as a catalyst for perceptual experience in chaotic contexts. This manifests itself as a possibility of creative transformation of the field that makes what was previously confused or latent spiky (Sarasso et al., 2020).

This is the framework for the present work with the aim of clarifying that mental states, encompassed in the concept of the "es" function, although acting at a level subsequent to the transduction of stimuli participate totally in the genesis of perceptual experience (Gestalt) and do not influence only its cognitive representation. We developed a pilot study on color perception using the strange perceptual phenomenon determined by an image of a dress posted in 2015 on a social network service and quickly went viral. The phenomenon revealed unpredictable differences in the human perception of colors that in our opinion clarify how mental states, perceptual processes and subjective consciousness of the same are different sides of an identical inseparable phenomenon. We studied the dress photo using the Lüscher Color Test (LCT), which assesses color preferences and the emotional states underlying them. The results allowed us (although still a pilot study) to capture the direct effect of mental states on color experience.

Color perception

Color is a ubiquitous feature of our psychological experience, and as a basic aesthetic process it plays a role in many aspects of human behavior. For example, color allows us to distinguish between objects of similar shape, facilitates the emergence of the figure from the background and the recognition of the environment (Gegenfurtner & Rieger, 2000; Osorio & Vorobyev, 1996). What is still missing, however, is a definitive neural and psychological theory that explains, in a comprehensive way, the perception of color and psychologically relevant hues (Emery, Volbrecht, Peterzell, & Webster, 2017).

The color of the visible world is related to the wavelength of light rays reaching the receptors in the retina. In the case of a blue-colored object, for example, the surface of the object mainly reflects electromagnetic waves with a length around 500 nanometers. The human being's retina possesses three types of cones that respond to wavelengths between approximately 400 and 700 nm; each of the cone populations responds maximally to a specific frequency, but variably responds to other frequencies as well. Thus, light reaching any part of the retina is translated into three neuronal responses, the combination of which generates a three-dimensional color space that allows the experience of some 26,000 different colors that we can distinguish from one another even if we cannot name them all. However, it should not be assumed that there is substantial identity between specific wavelengths and specific colors (Wolfe et al., 2023). In the words of Steven Shevell, "there is no red in 700 nm light"; color, like pain, is the result of the interaction between a physical stimulus is a specific biological system (Shevell, 2003).

Among the main theories explaining the experience of color, we will give relevance in this paper to Hering's theory of color oppositeness, which clarifies that some color pairs, defined as opposites, cannot be perceptually combined. The opposite color pairs are: the green/red pair and the blue/yellow pair. It is not possible to see a green tending to red and a blue tending to yellow while it is possible to see a green tending to yellow is a red tending to blue (Stockman & Brainard, 2010).

We know that the experience of colors is generated in the visual cortex but it is not clear how this happens. During the last century, researchers had identified a population of color-related neurons in the occipital V1 area (Zeki, 1983). These cells were sending inputs to V2 area and V4 area proposed by Zeki as specialized for color (Livingstone & Hubel, 1988). These cells, however, were shown to respond to polymodal stimuli (color, light intensity and orientation) and it is unclear therefore, whether we can separate color processing the other perceptual processes (Shapley & Hawken, 2011). However, the existence of cases of achromatopsia following brain damage documents the existence of specific central processing of color experience (Zeki, 1990).

More recently, numerous neurobiological models of psychic functions have highlighted the importance of thalamic and truncated brain areas in determining the subjective experience of perception. In this sense, the Zona Incerta (ZI) (Wang, Chou, Zhang, & Tao, 2020), a largely inhibitory subthalamic region that connects to many brain areas, appears to play a relevant role in the integration of sensory and emotional processes within visual and auditory experiences (Arena et al., 2023).

Color preference

Color preference is an important aspect of visual experience. Thanks to modern well-calibrated displays and standardized computer-generated colors, scholars have established that there are indeed, in human samples, reliable and repeatable patterns of color preference (Sokolova, Fernández-Caballero, Ros, Latorre, & Serrano, 2015). These preference patterns are evident if preference is studied in the three primary dimensions of color experience: hue, saturation and brightness (Whitfield, & Wiltshire, 1990). Decades of research have documented, in fact, that on average, adults in the United States and the United Kingdom prefer shades of blue more and shades of yellow-green (especially dark) less.

Some research has suggested explanations of the phenomenon based on biological adaptations. Hurlbert and Ling's (2007) study, for example, found a female tendency for reddish shades. The authors argued that this difference could be evolutionarily attributed to foraging behavior carried out predominantly by females.

Other studies have emphasized the link between emotions and color. It has been widely documented that color characteristics such as saturation, hue or brightness induce emotional reactions (Franklin, Bevis, Ling, & Hurlbert, 2010; Teller, Civan, & Bronson-Castain, 2004), and that chromatic images convey emotional information better than achromatic ones (Schloss, Strauss, & Palmer, 2013). The green, for example got the most links to positive emotions, followed by yellow, blue, red and purple. The basic hypothesis is that people can appreciate colors to the extent that they appreciate the emotions that are evoked or associated with those colors (Schloss et al., 2013).

Another interesting explanation of color preferences comes from the ecological valence theory (EVT), which proposes that adults like colors according to these colors are associated with liked objects. EVT states that people tend to like blue and cyan because they like clear skies and clean water and tend to dislike brown and olive colors because they dislike feces and rotting food. Then preference crystallizes because it is adaptive for organisms to approach objects and situations associated with colors they like and avoid objects and situations associated with colors they dislike (Niranjana, 2020).

Finally, a relationship between color preference, anxiety and depressive states, schizophrenia, gender, and character traits has been documented (Del Longo, 2011; Jung, Mahmoud, El Samanoudy, & Al Qassimi, 2022; Tao et al., 2015). It is likely that the presence of anxiety states or major emotions, even nonconscious ones cause color preference to vary as has been documented by Lüscher in his color test (Del Longo, 2011).

The fundamental question of how color preference arises is still unanswered. It is evident, however, the link between mental states and color preference (Taylor & Franklin, 2012).

Color preference is an aspect of mental state to the extent that at the same time, it reflects and modulates affective and emotional dimensions of the individual. Numerous studies have shown systematic associations between colors and emotional states, suggesting that color choices are not arbitrary but related to underlying psychological processes

(Bloom, 2003; Francesetti, 2012; Sarasso et al., 2022; Sarasso et al., 2024; Spagnuolo Lobb, 2023)

There is no doubt that aesthetic experience arises in perception at an early level, but we wondered whether the reverse is also true, that is, whether perception is formed early within a matrix determined by the complexity of the mental state of which aesthetic preference is an expression.

Studying color preference

Preference for a given sample of colors can be measured by simultaneously showing observers all the colors on a color table and asking them to rank them from most preferred to least preferred (Palmer, & Schloss; 2015). Color tests using color tables are useful tools for studying people's emotional state and proprioceptive body experience (Kadlubovich & Chernyak, 2022).

The Lüscher Color Test (LCT) is one of the most widely used psychological reagents by humanistic therapists and in the arts to explore the relationship between mental states and color preferences. The main advantage of this test is its ease of administration (Lüscher, 1997). Although its validity, as a descriptive instrument of psychic functioning, has often been considered, by methodologically questionable studies, to be insufficient or too low (Braun & Bonta, 1979; Donnelly, 1974; French & Alexander, 1972; Singg & Whiddon, 2000). Its effectiveness as an instrument capable of assessing the impact of psycho-physiological-emotional states on color preference is unquestionable. Some studies have shown that the TCL has more than 80% agreement with other personality assessment instruments in detecting in subjects the presence of psychological distress (Donnelly, 1977; Ledford, & Hoke, 1981). In addition, concordance, although low, has been found between this test and the MMPI (Holmes, Wurtz, Waln, Dungan, & Joseph, 1984). The LCT identifies the four the basic colors of Hering's pairs of opposites and considers them indicators of both basic emotional functioning and that determined by people's current life situation. The basic colors are arranged by subjects in the first two preferred positions (+ function) if the current life experience is flatly and fluidly colored by the specific emotion related to the color. If the psycho-physiological-emotional experience connected with the specific color conflicts with the current life experience, the color is placed in the last two preference positions indicative of color rejection (- function).

AIMS OF THE STUDY

The quality of psycho-physiological-emotional experience related to life events, which can be defined as mental state is an unconscious process and is described in equivalent ways by the theory of self of Gestalt psychotherapy (Francesetti & Roubal, 2020), Damasio's concept of proto-se (Damasio & Damasio, 2023) and recent work by Luiz Pessoa (2023). The authors of the present paper believe that the mental state directly modulates perceptual experiences and that this action is detectable through the study of color preferences.

In 2015, a photo of a dress went viral on the web. This photo referred to as 'the dress' showed a stylish dress with stripes of two colors. A percentage of people who see this picture assert that the stripes are blue and black, another, slightly smaller percentage of people say the stripes are white and gold, and finally to an even smaller number of people the dress appears blue and yellow. Some studies have attempted to give an answer to the mystery, but a clear explanation has not yet been obtained (Gegenfurtner, Bloj, & Toscani, 2015; Wallisch, 2017). Conway believes that such chromatic dispersion is related to the shades of light in the photo that causes people's perceptual system to eliminate blue frequencies or yellow frequencies (Lafer-Sousa et al., 2015).

The phenomenon of the dress image provides an opportunity to investigate the link between color preference and color perception by using the LCT, an easy-to-use instrument, to assess the color preference of individual subjects.

The aim of this research is to investigate the relationship between color perception and basic psycho- physiological-emotional state by evaluating the relationship between the results obtained from the Lüscher test and the perception responses generated by the photo 'the dress'.

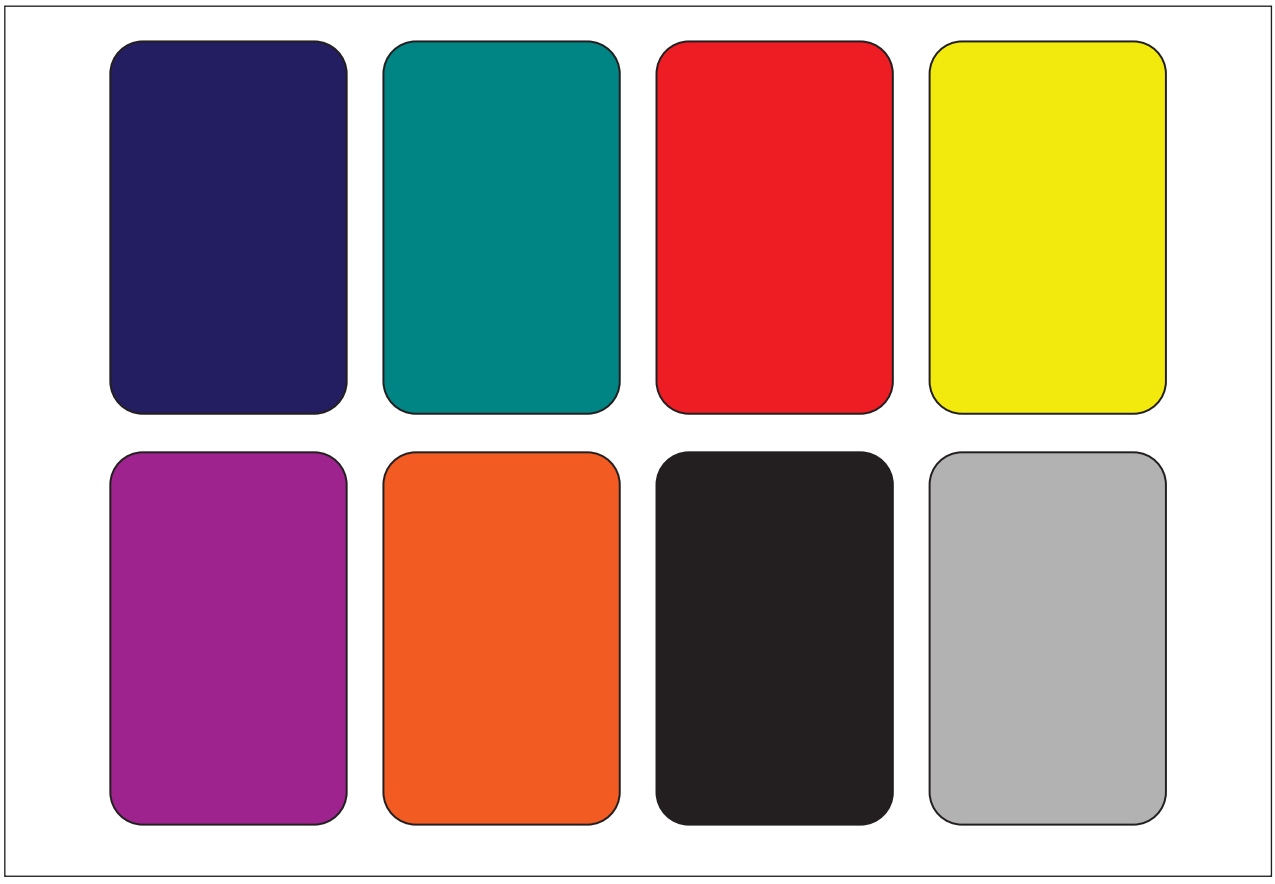
This is a pilot study that opens up the possibility of further investigating the link between mental states and perceptual processes with the ultimate goal of defining a descriptive model of subjective conscious experience.

METHODS AND MATERIALS

Lüscher Color Test

The Lüscher Color Test is a widely used instrument to assess an individual's personality through his or her color preferences. Created by Max Lüscher in 1947, this test is based

Figure 1 – Lüscher chart of card colors



on the idea that color choices reflect aspects of an individual's personality and emotional state. In the 8-color test, published in 1969, eight color cards are used, each representing a possible choice by the participant. These colors are red, green, yellow, blue (primary colors), purple, brown, gray and black (auxiliary colors) (see Figure 1). The participant is presented with the 8 colored cards and asked to sort the colors according to his or her preferences, starting with the color he or she prefers most. After a first administration, a second administration is to be carried out shortly afterwards, assuming that it is to be considered the most reliable one.

According to the author, the arrangement and order of the colors chosen provide psychological information about an individual's personality and emotional state. For example, red is often associated with a dynamic and energetic personality, green may indicate harmony and adaptability, yellow may reflect an optimistic attitude, and blue is commonly associated with a reflective nature (see Table 1).

For the purpose of our study, the colors preferred by the subject and placed in the first and second positions are important (see Table 2).

Photo of 'the dress'

The dress in the photo is of two colors, but surprisingly some people see it as blue and black, others white and yellow-gold, still others see it as blue and brown.

A large-scale study of the dress published in *Current Biology*, involving 1400 people, showed that 57% of participants saw the dress blue-black, 30% white-gold, 11% blue-brown, and 2% reported seeing it other colors (Gegenfurtner et al., 2015).

In our study, the picture of the dress displayed in three distinct ways allowed us to divide the sample into three subgroups based on the color the subjects reported perceiving.

Table 1 – The meaning of colors in Lüscher's Color Test

N.	Color	Meaning
1	Blue	*Depth of feelings*
2	Green	*Elasticity of will*
3	Red	*Force of will*
4	Yellow	*Spontaneity*
0.	Grey	*Non-involvement*
5	Violet	*Identification*
6	Brown	*Bodily senses*
7	Black	*Renunciation*

Table 2 – The four functions described by Lüscher's Color Test

Symbol	Functions	Position
+	Appropriate behavior enabled for desired goals	1° and 2°
X	Appropriate behavior activated during the existing situation	3° and 4°
=	Inappropriate behavior deactivated in the existing situation	5° and 6°
–	Rejected or repressed behavior in the existing situation	7° and 8°

Sample and procedures

The study was conducted in a sample of 100 adult subjects aged 20 to 64 years (average age 36), 68 females and 32 males. Subjects with pathological personality traits and those with color blindness were excluded from the research.

Prior to the administration of the LCT, the perception of colors in the image of 'the dress' was assessed for each of the subjects. Subjects after observing 'the dress' on a laptop computer screen indicated the colors they had displayed in the image on a 120-color HSB (Hue-Saturation-Brightness) color spectrum presented simultaneously on the same computer screen.

Subsequently, the same subjects were administered the Lüscher Color Test as per the prescribed protocol.

Color preferences were initialed according to Lüscher's standard protocol of categorizing the position of the eight colors in the 4 features and the abnormal placement in the last 3 positions of the main colors. However, for the purpose of the pilot phase of the study, only colors placed in the first 2 positions considered indicative of a color preference were used.

Figure 2 – The dress original photo

Statistical methods

The subjects, who displayed in the image 'the dress' the yellow and white colors, were assigned to group 1, those who displayed in the image the brown and blue colors were assigned to group 2 finally, those who displayed in the image the blue and black colors, were assigned to group 3.

Then the sample was divided into three groups based on preferred color. This classification resulted in the following groups: an A group that preferred the yellow, a second B group that preferred the blue, and a third C group that preferred another color.

First, the *t*-test was used to determine if there were any differences in the age of the sample subjects with respect to both the color sight (yellow or blue) and the preferred color (yellow or blue).

In addition, the color sight and the preferred color were compare trough Chi-squared test by excluding the group of subjects who preferred another color.

Then, considering the preference for the yellow or blue colors as a predisposing condition for viewing in the dress figure the yellow (outcome number 1) and the blue (outcome number 2), respectively, the Odds Ratio for the two outcomes was calculated.

Participants were divided into three distinct groups based on their perception of the colors of the image known as 'the dress'. Subjects who reported seeing the dress as white and gold were assigned to group 1; those who saw it as brown and blue to group 2; and those who perceived it as blue and black to group 3.

Separately, subjects were also categorized according to self-reported color preference, generating three additional groups: group A (preferred yellow), group B (preferred blue), and group C (preferences other than yellow or blue).

To analyze any differences in mean age between the groups, independent samples *t*-tests were used. The analysis was conducted in two separate comparisons:

- to assess age differences between those who perceived the image as white-gold and those who perceived it as blue-black;
- to compare age between those who preferred yellow and those who preferred blue.

The *t*-test was chosen because it allows comparison of the means of two independent groups, assuming that the data follow an approximately normal distribution and that the variances are similar.

To explore the association between color perception and color preference, the Chi-squared test with Fisher's Exact Test was used for both the inter sample and for males and females. This test allows us to assess whether there is a statistically significant relationship between two categorical variables, in this case color perception (yellow *vs* blue *vs* yellow and blue together) and color preference (yellow *vs* blue). For the purpose of this analysis, subjects in group C (with different preferences) were excluded, so as to structure a 3x2 contingency table, aiding the interpretability and statistical robustness of the test.

Finally, to quantify the strength of the association between color preference and perception of dress color, the odds ratio (OR) was calculated. In this analysis, the exposure variable was color preference (yellow *vs* blue), while the outcome was dress color perception (yellow-based *vs* blue-based perception). The odds ratio estimates the odds of perceiving the dress as white-gold in subjects preferring yellow versus those preferring blue. This measure is commonly used in

observational studies to assess relative risk in the presence of dichotomous variables.

All statistical analyses were performed using SPSS version 25, and the statistical significance threshold was set at $p<.05$.

RESULTS

Table 3 describes the perception of the dress colors of the sample subjects. 36 subjects, who displayed in 'the dress' image the yellow and white colors, were assigned to group 1; 22 subjects, who displayed in 'the dress' image the blue and yellow colors, were assigned to group 2; 42 subjects, who displayed in 'the dress' image, the blue and black colors, were assigned to group 3. This distribution in three groups approximately corresponds to that found in the literature.

Table 4 shows the classification of the sample according to the subjects' color preference: a group A of 46 subjects who preferred the yellow, a second group B of 33 subjects who preferred the blue, and a third group C of 21 subjects who preferred another color.

An initial analysis of the sample, considering the gender of the subjects, revealed no statistically significant differences in either color vision or color preference between males and females. Similarly, no statistically significant differences were found with respect to the age of the subjects: the age of the subjects did not change between those who preferred yellow and those who preferred blue, nor between those who saw yellow and those who saw blue.

Next, a Chi-squared test, the Fisher's exact test, was performed to compare the color sight and the preferred color, taking into account the gender of the subjects in the sample, examining only the group of individuals who expressed a preference for the yellow (group A) and the group of individuals who expressed a preference for the blue (group B). This analysis showed a significant correlation between the

Table 3 – Colors displayed in the image "the dress"

	N. subjects	Colors displayed in the image "the dress"
Group 1	36	WHITE - YELLOW (OUTCOMES No. 1: vision of the color yellow in the dress)
Group 2	22	BLUE - YELLOW (OUTCOMES No. 1 and 2)
Group 3	42	BLUE - BLACK (RESULT No. 2 vision of the color blue in the dress)

Table 4 – Preferred color

	N. subjects	Preferred color
Group A	46	YELLOW
Group B	33	BLUE
Group C	21	OTHER COLORS

color sight and the preferred color for both males and females (see Table 5).

From the results gender did not seem to influence the correlation between the color sight and the preferred color.

Relative to the visualization of the yellow and blue colors, observation of the dress image (since the second group perceives both yellow and blue) produced two possible outcomes: 27 subjects had outcome 1 "the dress is yellow", 35 subjects had outcome 2 "the dress is blue". Table 6 describes the calculation of the odds ratio (OR) for outcome 1 at the observation of the photo: "the dress is yellow".

33 subjects in the examined sample indicated yellow as their favorite color in the Lüscher test by placing it in the first or second position. 20 of these 33 subjects (two-thirds) saw yellow in the dress photo. 29 subjects in the sample did not choose yellow as their preferred color by inserting it in the third to eighth positions of the LCT; of these 29 subjects, 7 (one-third) see yellow in the dress picture. Considering the yellow color preference as a condition that predisposes to the perception of the yellow in the dress photo, the OR was calculated showing that among subjects who prefer the yellow, the perception of this color is a 4,83 times more frequent occurrence.

Table 7 describes the calculation of the odds ratio (OR) for outcome 2 at the observation of the photo: "the dress is blue".

Twenty-nine subjects in the surveyed sample indicated blue as their favorite color in the Lüscher test by placing it in the first or second chosen position of the test. 22 of these 29 subjects (three-quarters) saw blue in the dress picture. 33 subjects in the sample did not choose blue as their preferred color by inserting it in the third to eighth positions of the LCT, of these 33 subjects, only one-third (No. 3) see blue in the dress picture. Considering the preference of the blue as a condition that predisposes to the perception of the blue in the dress photo, the odds ratio was calculated showing that among subjects who prefer the blue, the perception of this color is a 4,83 times more frequent occurrence.

Table 5 – Chi-squared test

Gender			Color vision			Total	X^2 Fisher's Exact Test	*p*	Confidence Interval 99%	
			yellow	blue	yellow/ blue				LL	UL
F	Color preferred	yellow	15	9	7	31	6.833	.029	0.024	0.033
		blue	4	14	4	22				
	Total		19	23	11	53				
M	Color preferred	yellow	5	4	6	15	7.393	.024	0.020	0.028
		blue	3	8	0	11				
	Total		8	12	6	26				
M and F	Color preferred	yellow	20	13	13	46	11.511	.003	0.002	0.005
		blue	7	22	4	33				
	Total		27	35	17	79				

Table 6 – Frequency of outcome 1: "the dress is yellow" in relation to yellow as the preferred color

Preferred color	They see yellow in the photo	They don't see yellow in the photo	Total
They prefer yellow	20	13	33
They don't prefer yellow	7	22	29
Total	27	35	62
OR: 4.83 - IC 99% (LL = 1.327 – UL = 18.263)			

Table 7 – Frequency of outcome 2: "the dress is blue" in relation to blue as the preferred color

Preferred color	They see blue in the photo	They don't see blue in the photo	Total
They prefer blue	22	7	29
They don't prefer blue	13	20	33
Total	35	27	62
OR: 4.835 - IC 99% (LL= 1.135 - UL = 20.583)			

DISCUSSION AND CONCLUSIONS

Our sample has 3 subgroups derived from the color perception of the dress photo; the first of them perceives yellow, the third perceives blue, and finally the second has the perception of both colors. The first reflection that emerges from observing the data is related to the fact that the subjects in the study perceive opposite colors in the dress photo according to the theory of color oppositeness. Consequently, the perception of either the blue or the yellow (opposing colors for which no intermediate color combinations are allowed) cannot be generated by a different saturation of the color stimulus due to the different response intensities of the S-cones and L-cones. Basically, it is not conceivable that in the group that perceives yellow, for example, there is a response intensity of the L-cones (responding to waves of the length between 570 and 630 nm-yellow color) so great that it covers the response of the S-cones (responding to waves of the length between 450 and 500 nm-blue color). The perception of yellow or blue, in fact, is not determined by the interaction of the response intensity of these two populations of cones; if both S-cones and L-cones are stimulated in an image, both colors are generally perceived (although each person may perceive a different saturation of them), as also documented by subgroup 2 of our sample that perceives both yellow and blue (Krauskopf, Williams, & Heeley, 1982).

The Chi-squared comparation of the color sight and the preferred color, between the group of individuals who expressed a preference for the yellow (group A) and the group of individuals who expressed a preference for the blue (group B), showed a significant correlation between the color sight and the preferred color for both males and females. Specifically, subjects who perceived yellow more frequently had a preference for the yellow while subjects who

perceived blue preferred the blue. This obvious link between preference of one of the two opposite colors and perception of the same in the dress picture is also documented by the OR: the subsample of subjects who prefer the yellow sees, in the picture image, this color 4,8 times as frequently as the group of subjects who do not prefer the yellow; at the same time the subsample of subjects who prefer the blue, sees this color in the picture 4,8 times as frequently as the population who do not prefer blue.

Considering color preference as a multimodal process that takes place at the level of the diencephalon and telencephalon, (Csillag, Kabai, & Kovach, 1985) it is a reliable hypothesis that both linguistic and cognitive as well as emotional and bodily processes converge to determine it. In this sense, color preference emerges as an essential part of the perceptual process of colors; in our opinion, this phenomenon may represent one of the ways through which body states and emotions modulate perception.

To explain the phenomenon of the perception of two different colors, we must hypothesize the presence of higher-order chromatic mechanisms by which the brain infers the color of its subjective experience of the image from the mosaic produced by the activity of the cones (Brainard, 2015).

Although in nearly 30 years of research there has been no agreement on higher-order mechanisms related to color preference, (Eskew Jr, 2009) it seems impossible to rule out the existence of these processes. We propose an interpretation of the central order phenomenon with processes located in the interaction between the functions of the brainstem and those of the thalamus. We believe that processes occur at this anatomical level that totally exclude access to the sensory cortical areas, and thus to consciousness, of the response of the cones to electromagnetic frequencies related to yellow or blue.

In the following paragraphs we will develop a hypothesis explaining the mechanism underlying this direct impact of emotional and body states on perception.

Most theories of emotion and body states (pre-verbal mental states) agree that an emotional episode begins with a sensory experience, such as a visual perception, that elicits a cascade of affective, cognitive, physiological, and/or behavioral responses (Panksepp & Biven, 2014). However, there is currently a tendency to assume that the perception–emotion relationship is, in fact, bidirectional, with emotion also intervening in the perceptual process (Fuchs, 2020).

Damasio, moving beyond the idea that emotion affects perception and introducing the concept of proto-self, describes this interaction in this way: "In my view, the essential change in the proto-self results from its instant-by-instant involvement, triggered by whatever object is perceived. The involvement takes place in close temporal proximity to the sensory processing of the object" (Carvalho & Damasio, 2021). It seems indeed that emotions and body states color every aspect of our experiences by a multimodal mechanism (Jertberg et al., 2019).

For example, the simple act of identifying an emotionally relevant stimulus in a visual, auditory or tactile task induces subtle but systematic changes in heart rate. Perception thus affects the regulation of heart rate. Interestingly, the connection also goes in the opposite direction: interoceptive neural activity at the time an external stimulus is presented influences the fate of the external stimulus, making it, for example, more or less likely that a neutral visual or somatosensory stimulus will be detected (Schaefer & Gray, 2007).

Gestalt psychotherapy, with its theoretical model strongly rooted in Gestalt psychology (Goldstein, 2014), offers an interesting interpretation on how exteroception and enteroception interact producing the experience of es (Goldstein, 2014). Exteroceptive perception, proprioception and enteroception are closely intertwined. The way we perceive a face, facial expression or scene is influenced by the muscular, vegetative, affective and emotional tone of our body and affects our behavioral response (Perls, Hefferline, & Goodman, 1951). According to gestalt psychotherapy, es related perceptual coding simultaneously involves multiple levels of self-representation, including physiological homeostasis, the body's physical integrity, its morphology and position. The close interaction between enteroception and exteroception implies that perceptual scenes are always affectively colored. Enteroception, i.e., perception of the physiological state of the body, operates in conjunction with exteroception and cognition to restore homeostatic balance. Interoceptive signals interact with the perception of external stimuli as also documented by recent evidence showing interoceptive influences on cognition and perception.

Relative to neurophysiological mechanisms a specific thalamus area appears to fulfill this important integrative function. The Zona Incerta, a region of the subthalamus (which appears to be a continuation of the ascending root formation of the brainstem) receives afferents, from the sensory cortices and the brainstem itself, and projects efferences to the

reticular nucleus of the thalamus and the superior colliculi. This area seems to have the right anatomotopographic location to act directly on visual perception. Its afferents and efferences hint at its role in integrating proprioceptive and interceptive information collected by the thalamus with the exteroceptive information sent by the sensory cortices and modulating perception through the reticular nucleus and superior colliculus (Shaw & Mitrofanis, 2002), More clearly, the ZI seems to play a function of harmonizing polymodal stimuli, starting inside and outside the organism, which generates the preverbal sense of Self on which the conscious experience of reality and thus also the consciously perceived color in an image largely depends (Chometton, Barbier, & Risold, 2021).

The perspective presented in this paper suggests that perception is the product of the interaction between many brain areas. Very interesting is the role of proprioception and enteroception and emotionality, which as processes located in the body and the biology of the person provide the subjective coloring of perceptual experience. This subjective dimension contains both the history and current state of the body and imprints individual differences in perceptions (Braun & Bonta, 1979). According to Gestalt psychotherapy, the emergence of subjective experience is the first stage of consciousness on whose fluidity and ability to rebalance homeostasis the person's adaptive capacity depends.

Limitations of the study and future developments

The small sample size (it requires major expansion to enable us to make a strong statement of the value of the evidence that has emerged) allows us to use this scientific investigation as a pilot study that offers interesting perspectives for further research correlating color preference, mental state, and color perception in the dress picture.

However, our work has some limitations: the first limitation is having explored as the only correlate in the perception of blue or yellow in the dress pictures, the subjects' automatic preference using only the TCL to assess it. Moreover, color preference was considered, based on literature data as an adequate indicator of an individual's mental state. Of course, these two items are approximations, but in our opinion, they are acceptable, as the research is proposed as an exploratory investigation that need of significant expansion.

The second limitation concerns the lack of a control group with the sequence of test administration reversed to test the possible influence of color perception in 'the dress' task on the subsequent test of preference (TCL).

At a later stage a study will be expanded in three directions: increasing the number of subjects and using mental state assessment tools and further methods to assess the preferred color of the sample members by associating, for example, colors with an object and using color cards with different brightness and saturation and ultimately introducing a control group to assess the possible influence of one measure on the other.

However, even with the limitations we have just clarified the present study allows us to clearly propose the relationship between brainstem and thalamic processes and perception as an explanatory element of the difference of subjective experience in the world, recognizing how preverbal nonconscious psychic phenomena can determine, in accordance with gestalt psychotherapy an important part of the perceptual experience in which psychopathological mechanisms can be identified.

Data availability statement: The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author. **Ethics statement:** The studies involving human participants were reviewed and approved by Consiglio del Dipartimento 11/26.05.2020 Prot. n. 46540. The patients/participants provided their written informed consent to participate in this study.
Author contributions: VC, EM, OR, FM, and LM contributed to conception and design of the study. ET and OR organized the database. RS and VC performed the statistical analysis. CS, VC, CM, FM, and LM wrote the first draft of the manuscript. VC, EM, and LM wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version. **Supplementary material:** The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.671790/full#supplementary-material

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