U.PORTO

MESTRADO INTEGRADO EM PSICOLOGIA
ÁREA DA PSICOLOGIA CLÍNICA E DA SAÚDE

Associations between neutral and calm expressions' recognition and callous-unemotional traits in adolescents

Matilde de Nogueira Neves e Castro Silva

M

2021

Universidade do Porto
Faculdade de Psicologia e de Ciências da Educação

ASSOCIATIONS BETWEEN NEUTRAL AND CALM EXPRESSIONS' RECOGNITION AND CALLOUS-UNEMOTIONAL TRAITS IN ADOLESCENTS

Matilde de Nogueira Neves e Castro Silva

Outubro, 2021

Dissertação apresentada no Mestrado Integrado em Psicologia, Faculdade de Psicologia e de Ciências da Educação da Universidade do Porto, orientada pelo Professor Doutor ***Fernando Barbosa*** (FPCEUP)

AVISOS LEGAIS

O conteúdo desta dissertação reflete as perspetivas, o trabalho e as interpretações do autor no momento da sua entrega. Esta dissertação pode conter incorreções, tanto conceptuais como metodológicas, que podem ter sido identificadas em momento posterior ao da sua entrega. Por conseguinte, qualquer utilização dos seus conteúdos deve ser exercida com cautela.

Ao entregar esta dissertação, o autor declara que a mesma é resultante do seu próprio trabalho, contém contributos originais e são reconhecidas todas as fontes utilizadas, encontrando-se tais fontes devidamente citadas no corpo do texto e identificadas na secção de referências. O autor declara, ainda, que não divulga na presente dissertação quaisquer conteúdos cuja reprodução esteja vedada por direitos de autor ou de propriedade industrial.

Resumo

Introdução: Estudos recentes têm sublinhado que faces neutras e faces calmas poderão ser particularmente difíceis de reconhecer e distinguir. Os traços de frieza emocional têm sido associados a dificuldades de reconhecimento de expressões faciais de emoção.

Objetivos: Os objetivos definidos para este estudo passam por testar as seguintes hipóteses: (a) o desempenho no reconhecimento de expressões faciais calmas e neutras é inferior ao reconhecimento de outras emoções, (b) as faces neutras são classificadas com uma valência mais negativa do que as expressões faciais calmas, (c) há um efeito dos traços de frieza emocional no desempenho no reconhecimento de expressões faciais calmas e neutras, sendo estas menos corretamente reconhecidas na presença de altos traços de frieza emocional, e (d) há um efeito dos traços de frieza emocional na valência atribuída a expressões faciais calmas e neutras, sendo estas classificadas com uma valência mais negativa na presença de altos traços de frieza emocional.

Métodos: Foi investigada uma amostra de 72 adolescentes entre os 13 e os 18 anos de idade, que foram recrutados numa escola secundária na área metropolitana do Porto. O Inventário de Traços de Frieza Emocional foi utilizado para avaliar níveis de traços de frieza emocional. Um conjunto de 58 imagens de faces com expressões emocionais retiradas do *NimStim Set of Facial Expressions* foi utilizado para avaliar a capacidade dos participantes para reconhecer expressões faciais de emoção.

Resultados: Este estudo sugere que o reconhecimento de expressões faciais neutras e, especialmente, de calma é menos preciso comparativamente às restantes emoções, sendo que essa precisão diminui na presença de altos traços de frieza emocional. Pelo contrário do que apresentado na literatura, as expressões faciais neutras são classificadas como mais desagradáveis que as expressões de calma, independentemente de os níveis de traços de frieza emocional serem altos ou baixos.

Conclusões: O presente estudo poderá dar um contributo relevante para o campo científico que se dedica a estudar o reconhecimento das expressões faciais de calma e neutralidade, o potencial viés do seu reconhecimento e o papel dos traços de frieza emocional neste processo.

Palavras-chave: Reconhecimento de expressões faciais de emoção neutras/calmas; traços de frieza emocional

Abstract

Background: Recent studies have highlighted that neutral and calm faces may be particularly difficult to recognize and distinguish. Callous-unemotional (CU) traits have been associated with difficulties in emotional facial recognition.

Objectives: The goal of this study is to test the following hypotheses: (a) the recognition scores of calm and neutral faces are significantly lower comparing to the other emotions; (b) valence attributed to neutral faces is significantly more negative comparing to calm facial expressions; (c) there is an effect of CU traits on the recognition of calm and neutral expressions, being these expressions less accurately recognized by participants with higher CU traits; and (d) there is an effect of CU traits on the valence attributed to neutral and calm facial expressions, with the first being reported as more negative than the former by participants with higher CU traits.

Methods: The sample included adolescents aged 13 to 18 years, recruited in a secondary school located in the metropolitan area of Porto. The Inventory of Callous-Unemotional Traits was used in this study to assess levels of CU traits. A set of 58 pictures of faces expressing emotions from NimStim Set of Facial Expressions was used to assess the participants' capacity to accurately recognize emotional facial expressions.

Results: This research suggests that both neutral and especially calm expressions show poorer recognition accuracy comparing to other emotions (happiness, sadness, surprise, disgust, fear, and anger), with these ratings being poorer when in the presence of high CU traits. Contrarily to the literature, neutral expressions are perceived as more unpleasant than calm expressions, regardless of the presence of high CU traits.

Conclusions: This study could be a significant promoter to the investigation field that focus on understanding neutral and calm expression recognition, the potential similarity bias associated with these emotions, and the role of CU traits in their recognition.

Key words: Neutral/Calm facial emotional recognition; Callous-unemotional traits.

Introduction

Human beings are inherently a social species, which thrives in the context of interpersonal relationships (Wilhelm et al., 2010). Facial expressions of emotions are one of the cornerstones of social interactions, as they mirror the persons' mental and emotional states (Keltner et al., 2003). Hereupon, the accurate recognition of faces is crucial to perceive facial expressions of emotion (Chen, 2014). Their recognition depends on perceptual abilities and includes three components: face perception, corresponding to the skill to discriminate and compare facial stimuli; face memory, corresponding to the skill to remember distinct facial stimuli; and speed of face recognition, corresponding to how quick an individual will accurately respond to face stimuli (Holland et al., 2020).

It is important to consider that face recognition ability, more specifically the recognition of facial expressions of emotion, reflects the individual's emotional intelligence. This concept names a group of skills that allow humans to monitor their own and other people's emotions, to distinguish them and to act according to them (Mayer & Salovey, 1993). Emotional intelligence is indispensable to competent social functioning, and it is deeply associated with the concept of social cognition (Chen, 2014). Social cognition comprises the mental processes through which humans understand theirs and others' intentions, dispositions, and behaviors (Mitchell & Phillips, 2015). These mental processes can guide one's social behavior (Garrido et al., 2011).

Various studies have focused on understanding the specificities of emotional facial recognition. According to Wilhelm et al. (2014), emotional facial recognition is the capacity to visually probe the configuration of facial muscle orientations and movements and identify the emotion to which a given expression is most comparable. The Facial Action Coding System (FACS; Ekman et al., 2002) allows the quantification of facial muscle movements and their synthesis into facial expressions of emotion.

Although each facial expression of emotion can be defined by linear combinations of basic sets of muscle movements, some emotional expressions share some of these sets. For example, neutral facial expressions share the action of specific facial muscles, such as brow lowerer, corrugator supercilii and depressor supercilii, with displays of anger, fear, and sadness (Schirmer & Adolphs, 2017).

Recent studies have started to approach the possibility that prototypical neutral faces may not always be interpreted as such. For instance, several studies have started studying

the hypothesis that individuals with depression attribute specific emotions (generally, sadness) to neutral faces (Cheeta et al., 2021; Leppänen et al., 2004). Similarly, social anxiety may also implicate the attribution of negative emotions, such as anger and sadness, to neutral faces, which may be explained by different patterns of amygdala activation in response to neutral faces in comparison to individuals without this disorder (Alves et al., 2012; Cooney et al., 2006). These abnormal amygdala responses to neutral facial expressions and consequent negative interpretations of those have also been found for autism spectrum disorders (Eack et al., 2015), depression (Bourke et al., 2010), schizophrenia (Kohler et al., 2003), and borderline personality disorder (Daros et al., 2013; Mitchell et al., 2014). Additionally, childhood adverse experiences (such as emotional, physical, and sexual abuse) may implicate that the individuals interpret prototypical neutral stimuli as hostile stimuli, associating them with anger (Ardizzi et al., 2015; Pfaltz et al., 2019). In sum, neutral faces may in fact confound experimental designs, namely if participants attribute emotions such as sadness and anger to faces that were intended as baseline conditions (Lee et al., 2008).

Interestingly, the evidence also shows that high CU traits, which are a precursor for adult psychopathy, can predict impairments in recognizing emotions from nonverbal and verbal cues (Dawel et al., 2012). Psychopathy is defined as a personality structure characterized by impairments in the individual's affective and interpersonal functioning such as lack of guilt, lack of empathy, manipulation skills, superficial charm, and callousness (Hare, 2003; Hare & Neumann, 2008), and can be measured in children and adolescents as CU traits. Psychopathy is marked by a decreased capacity to inhibit errant social conduct (antisocial behavior) as well as impairments in comprehending and experiencing certain emotions, such as fear and sadness (Vasconcellos et al., 2014).

Recent studies have started to explore the possibility that the presence of high levels of CU traits can impact the recognition of neutral facial expressions, implicating negative attributions to such faces. For instance, several studies have started studying the hypothesis that adolescents with features of primary psychopathy (i.e., low anxiety and low emotional reactivity) show low right amygdala activity in response to neutral male faces (Fanti et al., 2020). This finding does not mean that neutral faces are not perceived as negative, as adolescents with high CU traits show amygdala hypo-reactivity in response to aversive stimuli (Viding et al., 2012). Similarly, female adolescents with conduct disorder displayed poor differentiation between neutral and negative facial expressions (Fairchild et al., 2014), whereas violent offenders were likely to interpret neutral emotion as disgust (Hoaken et al.,

2007). Furthermore, Dadds et al. (2006) showed that neutral faces are erroneously perceived as hostile or angry by individuals with high levels of CU traits.

Although some studies refer to neutral expressions in their results, there is currently a dearth of research specifically focused on the recognition of neutral emotions in community samples of children and adolescents and its association with CU traits. In addition, Tottenham et al. (2009) argue that recognition scores of neutral and calm expressions are lower comparing to other emotions (happiness, sadness, anger, surprise, fear, and disgust) due to the increased difficulty of recognizing these expressions as they are considered as perceptually similar. The author also suggests that neutral emotions are classified as having a more negative valence than calm emotions. So, in order to bridge the gap in this line of research, the present study aimed to understand the impact of high levels of callous-unemotional traits on the recognition of neutral and calm expressions, and also whether the neutral faces are reported as more negative than the calm ones, despite the perceptual similarity of these stimuli.

With the intention of examining this problem, the present study comprises four main hypotheses: (a) the recognition scores of calm and neutral faces are significantly lower comparing to the other emotions; (b) valence attributed to neutral faces is significantly more negative comparing to calm facial expressions; (c) there is an effect of CU traits on the recognition of calm and neutral expressions, being these expressions less accurately recognized by participants with higher CU traits; and (d) there is an effect of CU traits on the valence attributed to neutral and calm facial expressions, with the first being reported as more negative than the former by participants with higher CU traits.

The goal of the study is to test the above-mentioned hypotheses.

Methods

1. Participants

The participants for the current study were 72 adolescents (43 female) recruited from a secondary school located in the metropolitan area of Porto who were enrolled in grades 8 to 12. The age of the participants ranged from 13 to 18 years old (M = 15.54, SD = 1.26).

All children and adolescents with ages between 12 and 18 years old were invited to the study. The exclusion criteria were cognitive, motor, or sensory deficits that could compromise the individual performance. None of the participants were excluded.

Participants were divided into two groups, one of lower CU traits and another of higher CU traits based on the median split of the ICU scores. Age, participants' sex and ICU scores for the total sample and each group are displayed in Table 1. The ICU scores were significantly different between groups (for equal variances not assumed), t (45.089) = -11.118, p < .001, d = 5.387.

Table 1.
Descriptive statistics regarding participants' age and sex, callous-unemotional scores for the total sample, higher callous-unemotional (Higher CU traits) and lower callous-unemotional (lower CU traits) groups

	Total Sample			Higher CU traits			Lower CU traits		
Variable	*M*	*SD*	*N*	*M*	*SD*	*n*	*M*	*SD*	*n*
Age	15.54	1.26	72	15.51	1.36	35	15.57	1.17	37
Sex									
Male	-	-	29	-	-	17	-	-	12
Female	-	-	43	-	-	18	-	-	25
ICU	22.54	9.01	72	29.94	7.10	35	15.54	2.98	37

Written informed consent was obtained from participants aged 18 and from the parents/tutors of all participants under 18 years old, who also gave assent. The Ethics Committee of the Faculty of Psychology and Educational Sciences of the University of Porto, the Data Protection Officer of the University of Porto and the General Education Board, all gave a favorable opinion regarding the study.

2. Materials and Instruments

2.1. Callous-Unemotional Traits

The Inventory of Callous-Unemotional Traits (ICU; Frick, 2003; Portuguese version by Pechorro et al., 2014) was used in this study to assess levels of callous-unemotional traits. This instrument was chosen due to its validation for the Portuguese population and its suitableness to the age range of the participants.

The ICU includes 5 versions: Youth Self-Report; Parent Report; Parent Report - Preeschool Version; Teacher Report; and Teacher Report - Preeschool Version (Pechorro & Barroso, 2017). Only the Youth Self-Report was used in the present study. It consists in a 24-item scale with three subscales evaluating three constructs: callousness (items 2, 4, 7, 8, 9, 10, 11, 12, 18, 20 and 21); unemotionality (items 1, 6, 14, 19, 22); and uncaring (items 3, 5, 13, 15, 16, 17, 23, 24). Each item is rated on a 4-point Likert scale (0 = totally false, 1 = sometimes false, 2 = sometimes true, and 3 = totally true). Twelve items (items 1, 3, 5, 8, 13, 14, 15, 16, 17, 19, 23, 24) require reverse scoring before calculation of the total scores. Coefficient alpha for the total scale in our study was .83, and for each subscale in our study were .73, .62, and .70, respectively. The participants' total scores ranged from 10 to 45.

2.2. Emotion Recognition Task

A set of 58 pictures of faces expressing emotions from NimStim Set of Facial Expressions (Tottenham et al., 2009) was used to assess the participants' capacity to accurately recognize facial expressions of emotion. This database shows some qualities that distinguishes it from other face sets such as: being available in color; having a large variety of facial expressions (672 stimuli); including the neutral expression (often used as a comparison condition) and the calm expression; and lastly, containing open and closed mouth versions of each expression, including different degrees of arousal for various emotions.

The emotion recognition task in this study was organized in 2 blocks. The first block included 8 faces showing happiness, 8 faces showing sadness, 8 faces showing anger, 7 faces showing disgust, 7 faces showing fear, 4 faces showing surprise, 8 faces showing neutral emotion, and 8 faces showing calm emotion. The protocol was defined regarding the stimuli available in the NimStim Set of Facial Expressions for the selected emotional categories and

models. In the second block the facial expressions of calm were excluded. This exclusion was supposed to help researchers understand if calm emotion stimuli interfere in the recognition of other emotional categories, integrating a wider research work. In the present study, we will only focus on block 1 ratings.

Each emotion was performed by two models of each sex, which were chosen because of their higher accuracy ratings in the validity study (male models: 28 and 32; female models: 3 and 7; Tottenham et al., 2009). Each emotion was displayed in two intensities (close and open mouth), with exception of surprise (only open mouth). This manipulation was required for a wider research work, aiming to understand the effect of stimuli intensity on recognition ratings. In this study, this data was not included in the analysis.

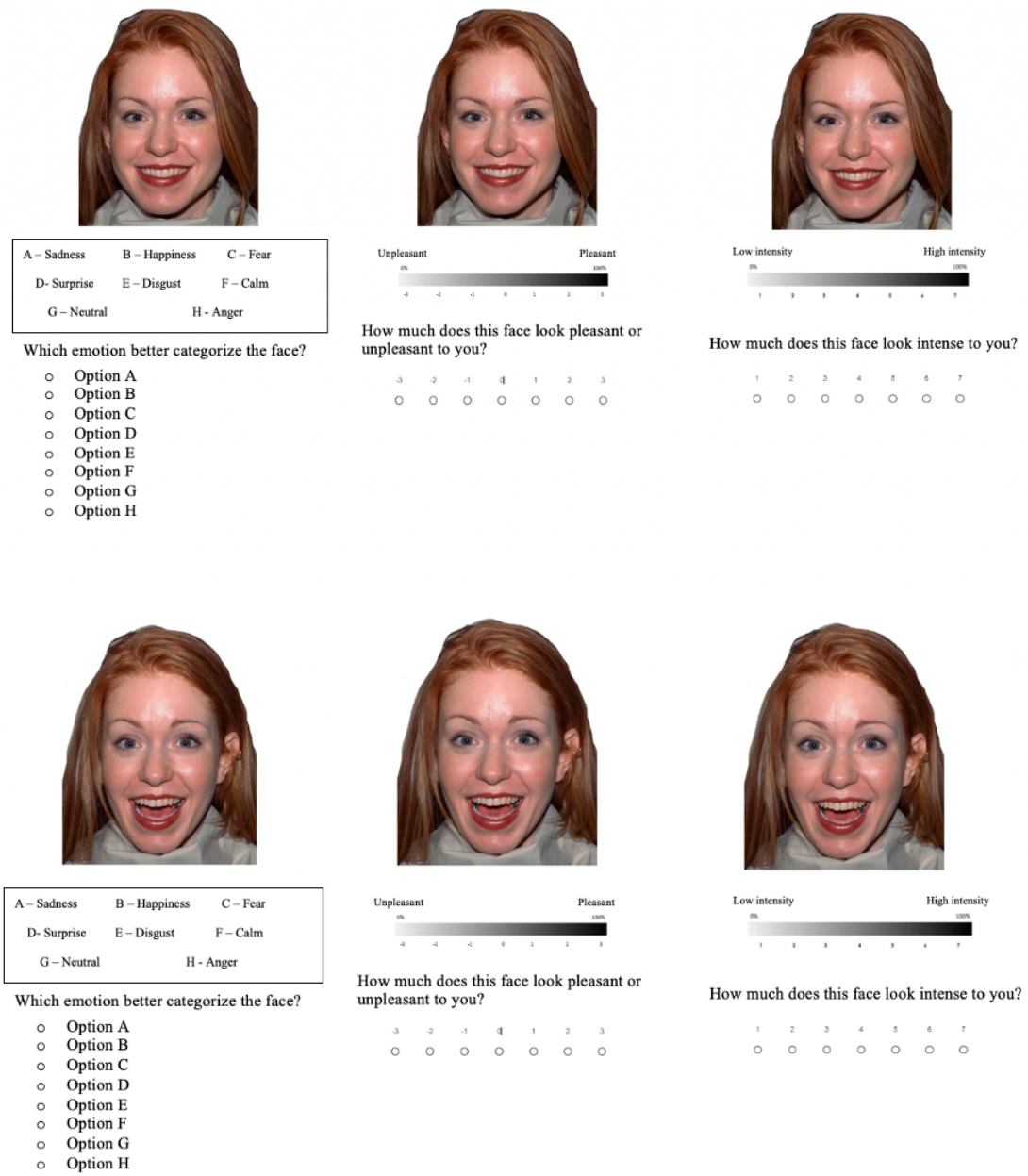
3. Procedure

Each participant was tested in a single experimental session and in groups of approximately 20 participants at a time. The data collection took place in a classroom in the institution where participants were recruited. The access to the protocol was given to participants through an internet link. The protocol consisted of the administration of the first block of the emotional recognition task, the administration of ICU, and the second block of the recognition task.

After a practice phase consisting of one example from happy facial expression (see Figure 1), the participants were presented with 58 stimuli in random order.

The pictures were presented using Qualtrics® Survey Software (Qualtrics, Provo, UT, USA) and the participants used their phones to respond. They were instructed to identify the displayed emotion, in a forced-choice format between the existent emotional categories. Then they were instructed to rate the stimulus for valence (pleasantness) and intensity (arousal) using Likert scales (-3 to 3 to valence and 1 to 7 to intensity) of the same stimulus. The following order of tasks was respected in each trial, i.e. for each stimulus: identify emotional category; valence rating; and intensity rating. In this study, we will focus only on valence ratings in order to respond to the aims of the research. Each picture was exhibited until the participants' response, with no time-limit for responding.

Figure 1.
Schematic example of one trial of the experimental protocol



The recognition accuracy ratings for each emotion (ratio between number of hits and number of stimuli in the category) and the valence ratings attributed to neutral and calm expressions were established as dependent variables. Means and standard deviations were computed for ratings of each emotional category and for attributed valence to neutral and calm expressions. Recognition accuracy ratings and attributed valence in the global sample, as well as differences between participants with higher and lower CU traits, were examined

using repeated measures ANOVA, mixed ANOVA models, and t-tests. Shapiro-Wilk's tests confirmed the assumption of normal distribution ($p < .001$). Levene's test was used to check for homogeneity of variances and Mauchly's test was applied to examine sphericity. The Huynh-Feldt correction was applied whenever necessary ($\varepsilon > .75$).

Results

Table 2 shows descriptive statistics for emotion recognition accuracy ratings and emotion attributed valence. Surprise expression (M = 0.90, DP = 0.15) was the most frequently accurately recognized emotion, followed by happiness, anger, disgust, fear, sadness, neutral and calm.

A repeated measures ANOVA was computed to test for the effects of the emotional category on accuracy ratings, and results were found significant, $F(6.15, 436.75) = 84.87$, $p < .001$, $\omega^2 = .54$.

The Bonferroni *post-hoc* tests showed that the recognition of calm was significantly less accurate ($M = 0.36$, $DP = 0.18$; $p < .001$) than all other emotions. Furthermore, although better recognized than calm, recognition accuracy of neutral expression (M = 0.53, DP = 0.22) was significantly lower than all other emotions, with exception for fear ($M = 0.60$, DP = 0.23; $p = 1.00$) and sadness ($M = 0.54$, $DP = 0.17$; $p = 1.00$).

Table 2.
Descriptive statistics for emotion facial recognition and expression attributed valence for higher and lower scoring callous-unemotional traits groups

	Total Sample			Higher CU traits			Lower CU traits		
Variable	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*
Recognition									
Total	0.66	0.10	72	0.63	0.11	35	0.68	0.72	37
Happiness	0.84	0.19	72	0.82	0.19	35	0.86	0.19	37
Sadness	0.54	0.17	72	0.51	0.18	35	0.57	0.17	37
Surprise	0.90	0.15	72	0.88	0.15	35	0.91	0.15	37
Anger	0.81	0.18	72	0.76	0.22	35	0.86	0.12	37
Fear	0.60	0.23	72	0.55	0.25	35	0.65	0.22	37
Disgust	0.80	0.15	72	0.76	0.18	35	0.83	0.10	37
Neutral	0.53	0.22	72	0.51	0.23	35	0.55	0.21	37
Calm	0.36	0.18	72	0.36	0.17	35	0.36	0.20	37
Attributed valence									
Neutral	-0.07	0.41	72	0.00	0.40	35	-0.14	0.41	37
Calm	0.15	0.31	72	0.19	0.30	35	0.11	0.33	37

On average, neutral expressions (M = -0.07, SD = 0.41) were rated with a more negative valence comparing to calm expressions ($M = 0.15$, $SD = 0.31$). This difference was found significant, $t(71) = 5.15$, $p < .001$, $d = .36$.

Additionally, a mixed ANOVA model was computed having *Group* (higher, lower CU traits) as between subjects factor, *emotional category* as within subjects factor, and accuracy ratings as dependent variable.

The interaction between *emotional category* and *Group* was found not significant, $F(6.24, 436.70) = 0.62$, $p = .724$, $\omega^2 = .009$. A main effect of *Group* was observed, $F(1, 70) = 7.05$, $p = .010$, $\omega^2 = .09$, with the higher scoring CU traits group showing poorer recognition accuracy ratings. Furthermore, a significant effect of *emotional category* was also found, $F(6.24, 436.70) = 84.21$, $p < .001$, $\omega^2 = .55$, with surprise expressions showing the highest recognition accuracy ratings, followed by happiness, anger, disgust, fear, sadness, neutral and calm (see Table 2). No other significant differences were found.

Finally, a mixed ANOVA model was computed having *Group* (higher, lower CU traits) as between subjects factor, *Expression* (neutral, calm) as within subjects factor, and valence ratings as dependent variable.

The interaction between *Expression* and *Group* was found not significant, $F(1, 70) = 0.65$, $p = .424$, $\omega^2 = .009$. There was also not observed a main effect of *Group*, $F(1, 70) = 2.28$, $p = .136$, $\omega^2 = .03$. Furthermore, a significant effect of *Expression* was found, $F(1, 70) = 26.18$, $p < .001$, $\omega^2 = .27$, with calm expressions having a higher attributed valence than neutral expressions in both groups.

Discussion and conclusions

The present study focused on bridging a gap in the research regarding the specific recognition of neutral and calm facial expressions. According to Tottenham et al. (2009), these expressions are considered as perceptually similar, resulting in an increased difficulty of accurately recognizing each of them. Also, neutral expressions may not always be interpreted as such (e.g., Cheeta et al., 2021; Leppänen et al., 2004) being strongly associated to a negative valence (e.g., Bourke et al., 2010; Eack et al., 2015).

Furthermore, as previous research shows that CU traits can predict impairments in recognizing emotions from nonverbal and verbal cues (Dawel et al. 2012), this study also assessed how the presence of CU traits could affect not only the recognition of facial expressions of emotion in general, but also the recognition of neutral and calm expressions. Unfortunately, previous literature investigating emotion recognition in individuals with high CU traits has been mostly focused on basic emotions (e.g., happiness, sadness, anger), neglecting the neutral and calm expressions.

Therefore, this research aimed to understand whether neutral and calm expressions are in fact hardly recognized, and whether neutral expressions are classified as more unpleasant than calm expressions, comparing groups with higher and lower CU traits from a community sample of adolescents.

To this end, ANOVA models and t-tests were computed. The results confirmed most of the proposed hypotheses for the sample and groups that were investigated.

According to previous studies by Tottenham et al. (2009), which argue that both calm and neutral expressions show lower recognition scores comparing to other emotions, in the present research it was found that neutral and especially calm expressions showed a poorer recognition accuracy comparing to other facial expressions of emotion, confirming our first hypothesis. Interestingly, calm expressions showed the worst recognition accuracy ratings.

It is worth mentioning, however, that neutral expressions were recognized at the level of fear and sadness (although with lower accuracy than surprise, happiness, anger, and disgust). This finding is consistent with the idea that neutral expressions may be perceived as negative and could be associated with the evidence that neutral expressions and facial expressions of fear or sadness share the action of specific facial muscles, such as brow lowerer, corrugator supercilii and depressor supercilia. Nevertheless, anger also shares these muscles (Schirmer & Adolphs, 2017), and was better recognized. In any case, this initial

finding suggests that both neutral and calm expressions, being poorly recognized, may be mistaken with other facial expressions of emotion, with unknown confounding effects on previous studies in the field.

Furthermore, the results of the present study showed that recognition accuracy ratings were lower for the higher CU traits group comparing to the lower CU traits group, supporting the idea that high CU traits can predict impairments in recognizing emotions from nonverbal and verbal cues (Dawel et al., 2012). However, there was not found any significant differences for neutral and calm expressions recognition accuracy ratings comparing higher and lower CU traits groups, refuting the hypothesis that CU traits have an effect on recognition accuracy of neutral and calm expressions.

Nevertheless, the found results are in accordance with the literature (e.g., Dadds et al., 2011; Newman et al., 2010). In fact, researchers argue that CU traits are linked to a dysfunction in attentional mechanisms to socially relevant cues, which underlies the deficits in recognizing emotions such as happiness, surprise, disgust, sadness, fear, and anger (e.g., Dadds et al., 2011; Newman et al., 2010). Also, some recent research started exploring the possibility that dispositional empathy is related to the attention mechanisms allocated when discriminating facial expressions of emotion (Bajouk & Hansenne, 2019) and that individuals with higher levels of empathy engage more attention resources to this process (Choi & Watanuki, 2014). This supports the idea that individuals with higher CU traits, who show lower levels of empathy, may engage less attentional resources when recognizing facial expressions of emotion; at least our results regarding the effect of CU traits on recognition accuracy ratings are consistent with this thesis.

Moreover, some recent studies showed that negative interpretations of neutral expressions have been found for autism spectrum disorders (Eack et al., 2015), depression (Bourke et al., 2010), schizophrenia (Kholer et al., 2003), borderline personality disorder (Daros et al., 2013; Mitchell et al., 2014), and CU traits (Dadds et al., 2006). Childhood adverse experiences can also implicate that the individuals interpret neutral expressions as hostile (Ardizzi et al., 2015; Pfaltz et al., 2019). In the present study, the prediction that neutral expressions are classified as more unpleasant comparing to calm was confirmed. This result is congruent with Tottenham et al. (2009) research that suggested that neutral expressions are classified as having a more negative valence than calm faces. This outcome can be justified by the evidence that neutral expressions share the action of specific facial muscles with emotions such as anger and sadness (Schirmer & Adolphs, 2017), usually classified as less pleasing (Hofmann & Doan, 2018). Also, Barrett et al. (2019) argues that

facial movements that express emotional states are variable and dependent on the context they are on. Therefore, the accurate recognition of facial expressions of emotion that share similar sets of facial muscles requires contextual information. Further investigation could focus on this information and develop a recognition task including dynamic presentation of emotions or vignette-based stories to control the possible effects of the contexts in which the emotions are processed in everyday life.

The aforementioned outcome was observed in the total sample, which reveals that neutral expressions are rated as more unpleasant than calm expressions independently of CU traits. Thus, not only neutral faces are often erroneously rated as aversive stimuli by individuals with high levels of CU traits, as suggested by previous studies (e.g., Dadds et al., 2016), but also by individuals with low CU levels. Some studies have stated that children with conduct problems and low CU traits classify neutral expressions as being angry and hostile (e.g., Cadesky et al., 2000; Frick et al., 2003). This recommends further study of the hypothesis that, in general, neutral facial expressions are poorly differentiated from negative facial expressions (Fairchild et al., 2014) and can be perceived as hostile or angry (Dadds et al., 2006), or as disgust (Hoaken et al., 2007), despite CU traits. Further investigation could also focus on examining which emotions were mostly erroneously attributed to neutral faces to confirm whether it is mistaken by a negative emotion, as the low valence rating of neutral expressions suggests.

The present study faced some methodological limitations that can be taken into consideration for future research. Firstly, the sample was relatively small and unrepresentative, once the data was collected in only one school in the metropolitan area of Porto. Therefore, the found results cannot be generalized to the Portuguese population. Also, there was not an assessment for comorbidities, and it is impossible to know if the results are due only to the presence of higher levels of CU traits. The variance regarding the age range was also not optimal.

Due to the few resources available, the data collection happened in groups of approximately 20 participants at a time. It would be better to apply the data collection protocol individually and in a controlled environment, without possible distractions. Also, as participants used their phones to complete the emotion recognition task, the visual quality of the stimuli was not controlled. These methodological shortcomings should be improved in further research. Moreover, all the collected data regarding all emotion categories could be fully analyzed in order to make comparisons not only between neutral and calm expressions, widening the possible results.

Furthermore, future studies could explore additional parameters that may influence the recognition of neutral and calm faces. For instance, it would be interesting to analyze gender effects on the recognition accuracy and valence ratings, both at the participant and at the model level. Some studies started examining the hypothesis that the models' gender can bias face recognition (e.g., Calvo & Lundqvist, 2008; Dores et al., 2020). These authors argue that facial expressions of sadness, fear, disgust, and contempt are more easily recognized in female models, in contrast with anger, surprise, and neutral facial expressions, which may be more easily recognized in male models.

Finally, further investigation could also focus on understanding if the antecedent displayed emotion has impact on the facial expression of emotion being currently recognized. As Russel and Fehr (1987) argued, the perception of an emotional face is relative instead of absolute as its categorization is influenced by the previous observed emotion, which serves as a comparison stimulus. The potential results could improve neutral expression recognition-based studies helping researchers to understand whether different associations of neutral faces with different emotion categories (e.g., anger, sadness, disgust; Cadesky et al., 2000; Chapman et al., 2017; Hoaken et al., 2007) could be explained by antecedent stimuli.

In sum, the present study and future research improvements could be greatly advantageous for future facial expression recognition-based investigation.

In conclusion, this research suggests that neutral and especially calm expressions show poorer recognition accuracy comparing to other emotions (happiness, sadness, surprise, disgust, fear, and anger), with these ratings being poorer when in the presence of high CU traits. Surprisingly and contrarily to the literature, neutral expressions are perceived as more unpleasant than calm expressions, regardless of the presence of high CU traits.

As a closing remark, this study could be a significant promoter to the investigation field that focus on understanding neutral and calm expression recognition, the potential similarity bias associated with these emotions, and the role of CU traits in their recognition.

Referências bibliográficas

Alves, N. T., Rodrigues, M. R., de Souza, I. B. M. B., & de Sousa, J. P. M. (2012). Ansiedade social e atribuição de emoções a faces neutras [Social anxiety and attribution of affect to neutral faces]. Estudos de Psicologia, 17(1), 129–134. https://doi.org/10.1590/S1413-294X2012000100016

Ardizzi, M., Martini, F., Umiltà, M. A., Evangelista, V., Ravera, R., & Gallese, V. (2015). Impact of childhood maltreatment on the recognition of facial expressions of emotions. *PLoS ONE*, *10*(10). https://doi.org/10.1371/journal.pone.0141732

Bajouk, O., & Hansenne, M. (2019). Dispositional Perspective-Taking and Empathic Concern Modulate the Impact of Cognitive Load on Empathy for Facial Emotions. *Psychological Reports*, *122*(6), 2201–2219. https://doi.org/10.1177/0033294118799337

Barrett, L. F., Adolphs, R., Marsella, S., Martinez, A. M., & Pollak, S. D. (2019). Emotional Expressions Reconsidered: Challenges to Inferring Emotion From Human Facial Movements. *Psychological Science in the Public Interest*, *20*(1), 1–68. https://doi.org/10.1177/1529100619832930

Bourke, C., Douglas, K., & Porter, R. (2010). Processing offacial emotion expression in major depression: A review. *Australian and New Zealand Journal of Psychiatry, 44*(8), 681–696.

Cadesky, E. B., Mota, V. L., & Schachar, R. J. (2000). Beyond words: how do children with ADHD and/or conduct problems process nonverbal information about affect? *J. Am. Acad. Child Adolesc. Psychiatry 39*, 1160–1167. https://doi:10.1097/00004583-200009000-00016

Calvo, M.G., & Lundqvist, D. (2008). Facial expressions of emotion (KDEF): Identification under different display-duration conditions. *Behav. Res. Methods, 40*, 109–115.

Chapman, H., Gillespie, S. M., & Mitchell, I. J. (2018). Facial affect processing in incarcerated violent males: A systematic review. *Aggression and Violent Behavior*, *38* (December 2016), 123–138. https://doi.org/10.1016/j.avb.2017.10.006

Cheeta, S., Beevers, J., Chambers, S., Szameitat, A., & Chandler, C. (2021). Seeing sadness: Comorbid effects of loneliness and depression on emotional face processing. *Brain and Behavior*, *11*(7), e02189. https://doi.org/10.1002/BRB3.2189

Chen, J. (2014). Face recognition as a predictor of social cognitive ability: Effects of emotion and race on face processing. *Asian Journal of Social Psychology*, *17*(1), 61–69. https://doi.org/10.1111/ajsp.12041

Choi, D., & Watanuki, S. (2014). Effect of empathy trait on attention to faces: An event- related potential (ERP) study. *Journal of Physiological Anthropology, 33*, 4. https://doi:10.1186%2F1880-6805-33-4

Cooney, R., Atlas, L. Y., Joormann, J., Eugène, F., & Gotlib, I. H. (2006). Amygdala activation in the processing of neutral faces in social anxiety disorder: Is neutral really neutral? *Psychiatry Research - Neuroimaging*, *148*(1), 55–59. https://doi.org/10.1016/j.pscychresns.2006.05.003

Dadds, M. R., Perry, Y., Hawes, D. J., Merz, S., Riddell, A. C., Haines, D. J., Solak, E., & Abeygunawardane, A. I. (2006). Attention to the eyes and fear-recognition deficits in child psychopathy. *British Journal of Psychiatry*, *189*(SEP.), 280–281. https://doi.org/10.1192/bjp.bp.105.018150

Daros, A., Zakzanis, K., & Ruocco, A. (2013). Facial emotion recognition in borderline personality disorder. *Psychological Medicine, 43*(9), 1953–1963.

Dawel, A., O'Kearney, R., McKone, E., & Palermo, R. (2012). Not just fear and sadness: Meta-analytic evidence of pervasive emotion recognition deficits for facial and vocal expressions in psychopathy. In *Neuroscience and Biobehavioral Reviews* (Vol. 36, Issue 10, pp. 2288–2304). Elsevier Ltd. https://doi.org/10.1016/j.neubiorev.2012.08.006

Dores, A. R., Barbosa, F., Queirós, C., Carvalho, I. P., & Griffiths, M. D. (2020). Recognizing emotions through facial expressions: A largescale experimental study. *International Journal of Environmental Research and Public Health*, *17*(20), 1–13. https://doi.org/10.3390/ijerph17207420

Eack, S. M., Mazefsky, C. A., & Minshew, N. J. (2015). Misinterpretation of facial expressions of emotion inverbal adults with autism spectrum disorder. *Autism, 19*(3), 308–315.

Ekman, P., Friesen, W. V., and Hager, J. C. (2002). The Facial Action Coding System: A Technique for the Measurement of Facial Movement. CA: Consulting Psychologists Press.

Fanti, K. A., Konikou, K., Cohn, M., Popma, A., & Brazil, I. A. (2020). Amygdala functioning during threat acquisition and extinction differentiates antisocial subtypes. *Journal of Neuropsychology*, *14*(2), 226–241. https://doi.org/10.1111/jnp.12183

Fairchild, G., Hagan, C. C., Passamonti, L., Walsh, N. D., Goodyer, I. M., & Calder, A. J. (2014). Atypical neural responses during face processing in female adolescents with conduct disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, *53*(6), 677-687.e5. https://doi.org/10.1016/j.jaac.2014.02.009

Frick, P. J. (2003). The Inventory of Callous-Unemotional Traits. Unpublished rating scale, University of New Orleans.

Frick, P. J., Cornell, A. H., Barry, C. T., Bodin, S. D., and Dane, H. E. (2003). Callous-unemotional traits and conduct problems in the prediction of conduct problem severity, aggression, and self-report of delinquency. *J. Abnorm. Child Psychol. 31*, 457–470. https://doi:10.1023/A:1023899703866

Garrrido, M. V., Azevedo, C., & Palma, T. (2011). Cognição Social: Fundamentos, Formulações. *Psicologia*, *XXV* (1), 113–157.

Hare, R. D. (2003). The Hare Psychopathy Checklist-Revised.

Hare, R. D., & Neumann, C. S. (2008). Psychopathy as a clinical and empirical construct. In *Annual Review of Clinical Psychology* (Vol. 4, pp. 217–246). https://doi.org/10.1146/annurev.clinpsy.3.022806.091452

Hoaken, P. N., Allaby, D. B., & Earle, J. (2007). Executive cognitive functioning and the recognition of facial expressions of emotion in incarcerated violent offenders, non-violent offenders, and controls. *Aggressive Behavior, 33*(5), 412-421. http://dx.doi.org/10.1002/ab.20194.

Hofmann, S. G., & Doan, S. N. (2018). Defining emotions. *The Social Foundations of Emotion: Developmental, Cultural, and Clinical Dimensions.*, 11–21. https://doi.org/10.1037/0000098-002

Holland, A. C., O'Connell, G., & Dziobek, I. (2021). Facial mimicry, empathy, and emotion recognition: a meta-analysis of correlations. *Cognition and Emotion*, *35*(1), 150–168. https://doi.org/10.1080/02699931.2020.1815655

Keltner, D., Ekman, P., Gonzaga, G. C., & Beer, J. (2003). Facial expression of emotion. In *Handbook of affective sciences.* (pp. 415–432). Oxford University Press.

Kohler, C. G., Turner, T. H., Bilker, W. B., Brensinger, C. M., Siegel, S. J., Kanes, S. J., & Gur, R. C. (2003). Facial emotion recognition in schizo-phrenia: Intensity effects and error pattern. *American Journal of Psychiatry, 160*(10), 1768–1774.

Lee, E., Kang, J. I., Park, I. H., Kim, J. J., & An, S. K. (2008). Is a neutral face really evaluated as being emotionally neutral? *Psychiatry Research*, *157*(1–3), 77–85. https://doi.org/10.1016/j.psychres.2007.02.005

Leppänen, J., Milders, M. V., Bell, J. S., Terriere, E., & Hietanen, J. K. (2004). Depression biases the recognition of emotionally neutral faces. *Psychiatry Research*, *128*(2), 123–133. https://doi.org/10.1016/J.PSYCHRES.2004.05.020

Mitchell, A. E., Dickens, G. L., & Picchioni, M. M. (2014). Facial emotion processing in borderline personality disorder: A systematic review and meta-analysis. *Neuropsychology Review, 24*(2), 166–184.

Mayer, J. D., & Salovey, P. (1993). The intelligence of emotional intelligence. *Intelligence*, *17*(4), 433–442. https://doi.org/10.1016/0160-2896(93)90010-3

Mitchell, R. L. C., & Phillips, L. H. (2015). The overlapping relationship between emotion perception and theory of mind. In *Neuropsychologia* (Vol. 70, pp. 1–10). Elsevier Ltd. https://doi.org/10.1016/j.neuropsychologia.2015.02.018

Pechorro, P., & Barroso, R. (2017). *Inventário de Traços Calosos-Insensibilidade Emocional / Inventory of Callous-Unemotional Traits (ICU)*. *March 2020*.

Pechorro, P., Ray, J. V., Barroso, R., Maroco J., & Gonçalves, R. A. (2016). Validation of the Inventory of Callous-Unemotional Traits among a Portuguese sample of detained juvenile

offenders. *International Journal of Offender Therapy and Comparative Criminology, 60*, 349-365.

Pfaltz, M. C., Passardi, S., Auschra, B., Fares-Otero, N. E., Schnyder, U., & Peyk, P. (2019). Are you angry at me? Negative interpretations of neutral facial expressions are linked to child maltreatment but not to posttraumatic stress disorder. *European Journal of Psychotraumatology*, *10*(1). https://doi.org/10.1080/20008198.2019.1682929

Schirmer, A., & Adolphs, R. (2017). Emotion Perception from Face, Voice, and Touch: Comparisons and Convergence Sensory Modalities for Emotion Expression. *Trends in Cognitive Sciences*, *21*, 216–228. https://doi.org/10.1016/j.tics.2017.01.001

Tottenham, N., Tanaka, J. W., Leon, A. C., McCarry, T., Nurse, M., Hare, T. A., Marcus, D. J., Westerlund, A., Casey, B. J., & Nelson, C. (2009). The NimStim set of facial expressions: Judgments from untrained research participants. *Psychiatry Research*, *168*(3), 242–249. https://doi.org/10.1016/j.psychres.2008.05.006

Vasconcellos, S., Salvador-Silva, R., Dias, A. C., Davóglio, T. R. & Gauer, G. (2014). Psicopatia e Reconhecimento de Expressões Faciais de Emoções: Uma Revisão Sistemática.

Viding, E., Sebastian, C. L., Dadds, M. R., Lockwood, P. L., Cecil, C. A., De Brito, S. A., & McCrory, E. J. (2012). Amygdala response to preattentive masked fear in children with conduct problems: Therole of callous-unemotional traits. *American Journal of Psychiatry, 169*, 1109–1116. https://doi.org/10.1176/appi.ajp.2012.12020191

Wilhelm, O., Herzmann, G., Kunina, O., Danthiir, V., Schacht, A., & Sommer, W. (2010). *PERSONALITY PROCESSES AND INDIVIDUAL DIFFERENCES Individual Differences in Perceiving and Recognizing Faces-One Element of Social Cognition*. https://doi.org/10.1037/a0019972

Wilhelm, O., Hildebrandt, A., Manske, K., Schacht, A., & Sommer, W. (2014). Test battery for measuring the perception and recognition of facial expressions of emotion. *Frontiers in Psychology*, *5*(MAY). https://doi.org/10.3389/FPSYG.2014.00404