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Emotional recognition in children and adolescents with callous-unemotional trait: A systematic review of eye-tracking studies

María Isabel Moreno-Albalat & Virginia Sánchez-Jiménez*

Universidad de Sevilla, Sevilla (Spain)

Keywords

Emotions
Attentional processes
Psychopathic traits
Childhood
Adolescence

Abstract

Callous-unemotional or emotional insensitivity is an individual trait characterized by a lack of guilt and remorse, absence of empathy, and lack of concern for the feelings of others, among other characteristics. Published works have shown that the child and adolescent population presents difficulties in emotional recognition, although not all works conclude whether this difficulty is generalized to all emotions or is restricted to specific emotions. The use of methodologies such as eye-tracking in these studies is helping to advance this line of research, allowing us to determine which attentional processes are involved in these difficulties and in which specific emotions they occur. However, this line of research is incipient, so the objective of this systematic review has been to analyze and organize the existing information on the difficulties in emotional recognition presented by children and adolescents with high levels of callous-unemotional in the published articles on this topic that use eye-tracking. Following the PRISMA Declaration, four databases were reviewed (ProQuest, ERIC, Scopus, and Web of Science), obtaining 140 results, of which only 15 were included and analyzed. The analysis obtained as a result a confirmation and characterization of this deficit, finding difficulties in the recognition of negative emotions, fundamentally those of fear, anger, and sadness, with a high percentage of studies pointing out on the basis of this the difficulties of attentional focus found in these emotions, although the existence of other processes that could explain these difficulties was not rule out.

El reconocimiento emocional en niños, niñas y adolescentes con callo emocional: una revisión sistemática de estudios de seguimiento ocular

Palabras clave

Emociones
Procesos atencionales
Rasgos psicopáticos
Infancia
Adolescencia

Resumen

El callo emocional o insensibilidad emocional es un rasgo individual caracterizado por falta de culpabilidad y remordimiento, ausencia de empatía y falta de preocupación por los sentimientos de los demás, entre otras características. La investigación ha demostrado que la población infantil y adolescente presenta dificultades en el reconocimiento emocional, si bien no todos los trabajos concluyen si esta dificultad es generalizada a todas las emociones o se restringe a emociones específicas. El uso de metodologías como el seguimiento ocular está ayudando a avanzar en esta línea de investigación, permitiendo determinar qué procesos atencionales están implicados en estas dificultades y en qué emociones concretas se presentan. Sin embargo, esta línea de investigación es incipiente, por lo que el objetivo de esta revisión sistemática ha sido analizar y organizar la información existente sobre las dificultades en reconocimiento emocional que presentan los niños, niñas y adolescentes con altos niveles de callo emocional en los artículos publicados sobre esta temática que emplean el seguimiento ocular. Siguiendo la Declaración PRISMA, se revisaron cuatro bases de datos (ProQuest, ERIC, Scopus y Web of Science), obteniendo 140 resultados, de los cuales solo 15 fueron incluidos y analizados. El análisis obtuvo como resultado una confirmación y caracterización de este déficit, encontrando dificultades para reconocer emociones negativas, fundamentalmente las de miedo, ira y tristeza, con un alto porcentaje de estudios señalando en la base de esto las dificultades de focalización atencional encontradas en estas emociones, aunque sin descartar la existencia otros procesos que podrían explicar estas dificultades.

* *Corresponding author:* Virginia Sánchez-Jiménez. Departamento de Psicología Evolutiva y de la Educación, Universidad de Sevilla. C/ Camilo José Cela s/n. 41018, Sevilla, Spain. virsan@us.es

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Callous-unemotional trait (CU), also known as emotional insensitivity, is an individual trait characterized by a lack of guilt and remorse, absence of empathy and superficial expression of emotions, lack of concern about other people's feelings or personal performance, and insensitive use of other people (Frick et al., 2003; Frick, 2009). According to authors such as De la Peña Olvera (2022) and Sica et al. (2019), these characteristics are equivalent to the specifiers of limited prosocial emotions (LPE), as is described in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM5) of the American Psychiatric Association (2014), within Disruptive, Impulse-Control, and Conduct Disorders.

Due to these characteristics, CU is associated with emotional and behavioral difficulties (Ciucci et al., 2014). In school-age children, it has been related to different negative results, such as high levels of disruptive behavior in the classroom, breaching of rules, interpersonal conflicts with adults (De Ridder et al., 2016), bad relationships with peers, which may result in violence and bullying (Ciucci et al., 2014), worse learning, and low sociomoral development. This influences academic performance, due to low intrinsic motivation and low commitment to schoolwork, which do not depend on intellectual quotient.

The prevalence rates of this trait vary as a function of the studied population, ranging between 2-7% in community samples and up to 50% in clinical samples. For instance, the prevalence of CU in clinical samples with conduct disorder (CD) varies between 10% and 32% (Kahn et al., 2012), whereas it ranges between 36% and 51% in clinical samples with autism spectrum disorder (ASD) (Carter Leno et al., 2015). This high comorbidity poses a challenge to the scientific community, as it is difficult to determine the specific characteristics of the trait or the comorbid disorder. Regarding its etiology, Blonigen et al. (2005) and Fontaine et al. (2010) reported that the development of high levels of CU was influenced by genetic factors, with 68% of explained variance in the analyzed population (Larsson et al., 2008). Other studies have pointed out the contribution of environmental factors (Kahn et al., 2013), such as the absence of warmth in the parenting practices and severe punishment, as relevant developmental antecedents of this trait. Therefore, the study of how educational practices in the family context influence emotion recognition and the subsequent development of CU is providing results that may be very relevant for the intervention with these children and their families. Some studies have found that the lack of maternal warmth, the low maternal sensitivity (Bedford et al., 2015; Bedford et al., 2017), and the low positive regard towards the infant (Wright et al., 2018) are factors that contribute to the development of CU.

Different studies (Blair et al., 2014; Dawel et al., 2012) conclude that people with high levels of CU present a deficient development of empathy, which is manifested as the impairment of the recognition of facial emotions, which is an essential component for social interaction (Díaz Vázquez, 2022). Although these difficulties in emotion recognition are inherent to this trait, there is no consensus in the scientific community in relation to the causes of these difficulties and, consequently, with regard to whether these difficulties are restricted to specific emotions or whether it is a generalized deficit. The distress-specific hypothesis (Blair, 1995) indicates that these difficulties are limited to the processing of negative emotions of distress and suffering, which would explain why the inhibitory mechanisms are not activated in the face of other people's distress, resulting in indifference and insensitivity towards others. The attention-to-eyes hypothesis (Dadds et al., 2006) suggests that the cause of the deficit would be a malfunctioning of the attentional mechanisms underlying emotion recognition, which would result in a lack of attention to the eye area and, consequently, a poor generalized recognition of all emotions. Lastly, the enhanced-selective-attention hypothesis (Newman, 1998) points to greater capacities of selective attention in this population, which would lead to focusing the attention on those stimuli that are interesting for the person, disregarding stimuli that are considered irrelevant. According to the authors, this greater capacity to focus the attention would not be restricted to social or physical stimuli, but to relevant stimuli that are coherent with the objectives and desires of these people. Therefore, if the objective of a child is to grab a toy that is being used by a peer, he/she would focus his/her attention on this stimulus, setting aside other relevant signs, such as the emotions of annoyance or pain of the peer who initially had the toy.

The incorporation of eye-tracking to research on emotion recognition in children and adolescents with CU is providing valuable results, as it allows specifically evaluating the attention they pay to emotional stimuli, particularly to the eye area (Billeci et al., 2019; Carter Leno et al., 2023; Centifanti et al., 2021; Dawel et al., 2012; Demetriou & Fanti, 2022). However, not all studies are drawing the same conclusions. For example, Dawel et al. (2015) tracked the eye movements of adolescents with CU in the face of emotion recognition tasks, in which the objectives and interests of the participants were manipulated. The results indicated that the deficits in emotion recognition were not limited to specific emotions, but to those situations in which emotion recognition competed with the interests and objectives of the participants, which is in line with the hypothesis of improved selective attention. On their part, Billeci et al. (2019) found that deficits in the emotional recognition of children with CU were only restricted to sadness, thereby associating it with poorer attention to the eye area.

The present study

The aim of this review was to advance in this line of research, gathering and analyzing the evidence that has been published to date about the specific difficulties in facial emotion recognition (FER) in children and adolescents with CU in studies that used eye-tracking. Specifically, the following research questions were formulated: Which specific emotions pose a greater difficulty to students with CU aged 5-18 years? Which processes are associated with these difficulties in emotion recognition?

The results provide reliable and updated information to researchers and professionals who work with these students, allowing them to adjust their interventions to the needs of this population.

Method

A systematic review was carried out, following the PRISMA 2020 statement (Page et al., 2021).

Search strategy

For this systematic review, the UNESCO Thesaurus and MeSH Terms were used to define the keywords. Once the keywords were established, they were combined using Boolean operators and truncation, obtaining the following search expression in all fields: ("callous-unemotional" OR "callous unemotional") AND ("child*" OR "adolesc*") AND ("emotion recognition" OR "emotional impairment") AND ("eye-track*"). This expression was used in four databases: ProQuest, ERIC, Scopus and Web of Science.

Selection criteria and procedure

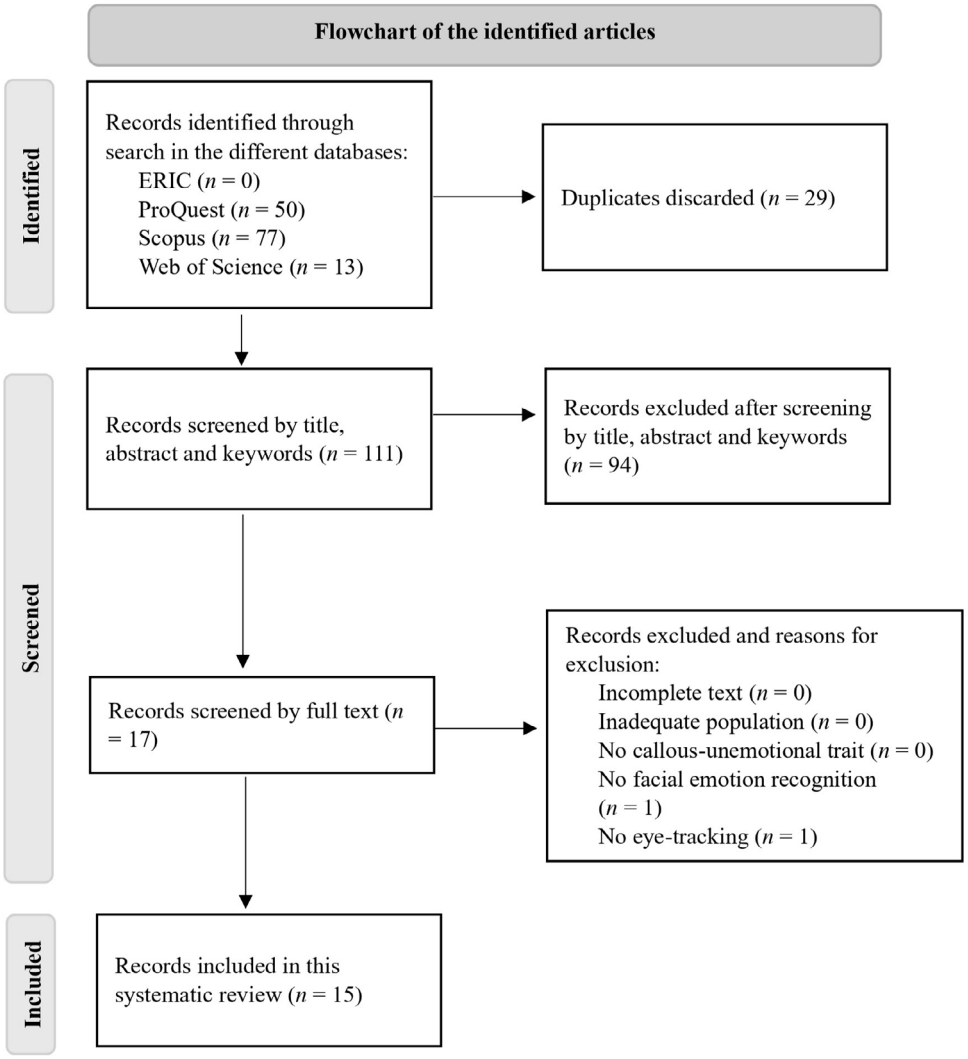
For the selection of articles and publications of interest, the following inclusion criteria were applied: 1) publications written in English or Spanish, 2) empirical studies published in scientific journals, 3) studies with populations aged 5-18 years with high CU, 4) studies whose main topic was CU and the recognition of interpersonal facial emotions, and 5) studies that used the eye-tracking methodology.

Flowchart and article selection

The article selection began with an initial running of the search expression, which produced a total of 140 articles. Using a reference manager (EndNote), the duplicates were discarded (n = 29), obtaining a total of 111 publications. A first screen-

Figure 1

Flowchart of the article search and selection; adapted from Page et al. (2021)



ing was conducted by reading the title, abstract and keywords of these articles, excluding 94 articles based on the established inclusion criteria. The remaining 17 articles were analyzed in a second screening by full-text reading, obtaining a final sample of 15 articles (Figure 1).

Results

All 15 articles included in the current work are quantitative studies conducted in Europe, with a predominance of British studies (47%) (see Appendix A for a description of the studies).

In total, the participants of these studies were 1,701 children and adolescents aged 5-18 years, with two studies extending the participant age to 19 years (Bours at al., 2018; Menks at al., 2021). With regard to gender, 67% of the articles included a mixed population, whereas the rest of the studies (33%) used male populations.

The participants were from clinical samples in 73.33% of the studies, 26.67% of whom presented ASD, 60% had CD, 33.33% presented attention deficit and hyperactivity disorder (ADHD), and 33.33% had oppositional defiant disorder (ODD). The rest of the studies used community samples to evaluate the presence of traits compatible with ASD (6.67%), antisocial behavior (6.67%), anxiety and behavioral problems (6.67%), or absence of associated symptoms (6.67%).

A total of 86.67% of the studies used accessibility sampling methods, and two studies (13.33%) indicated the randomization of the sample, although only for accessing the comparison group. In this regard, 40% of the studies used control groups with typical development, with these groups being defined based on the absence of disorders or clinical traits, whereas 53.33% of the studies grouped the participants according to the levels of CU or associated symptoms. Only one study did not use a comparison group (Hartmann & Schwenck, 2020).

The studies were quasi-experimental and used facial stimuli to analyze emotion recognition. Only two articles (13.33%) were longitudinal studies, whereas the rest of the articles were cross-sectional studies. In 73.33% of the studies, static stimuli were employed to present emotions, which were shown as images of people, drawings, and cartoons. Regarding the rest of the studies, 6.67% presented dynamic stimuli through people who were either physically present or in videos, whereas the remaining 26.67% combined both types of stimuli.

A total of seven emotional expressions were studied throughout the 15 studies included in this review: 1) happiness (analyzed in 86.7% of the studies), neutrality (80%), surprise (6.67%), sadness (86.7%), fear (93.3%), rage or anger –according to the terminology used by the authors– (93.3%), disgust (26.67%), and pain (6.67%). Thus, the most studied emotions were anger and fear, followed by sadness and happiness. No studies were found to delve into moral emotions such as guilt, shame, or pride.

The studies evaluated accuracy in emotion recognition (93.3% of the articles), understanding it as the precision in the identification of the presented emotions. Moreover, all studies recorded the mean duration of fixations to the eye area as a measure of attentional focus on areas that are relevant for emotion recognition. The time to first fixation on the eye area (understood as an indirect measure of attentional focus), also known as reaction time, was explored in 53.3% of the studies. Other studies also recorded the number of fixations (33.3%) as a measure of total time dedicated to looking at the emotional stimulus.

In all the studies that used comparison groups, the results obtained both in the accuracy and in the attentional processes of the groups with high CU were compared with those obtained in the groups with normative development or in the groups with low CU levels.

For the accuracy in emotion recognition, the emotions in which the population with high CU presented the greatest difficulties were fear (78.6% of the articles in which it was studied) and anger (64.3%), with respect to the comparison groups. The difficulties in recognizing happiness, sadness, and disgust were somewhat less conclusive, as they were found in approximately 50% of the studies, despite the fact that happiness and sadness are two of the most widely analyzed emotions. Specifically, and regarding happiness, seven studies reported worse recognition, with three of these studies showing a shorter duration of gazing in the eye area (Carter Leno et al., 2021; Demetriou & Fanti, 2022; Kyranides et al., 2020) and two studies associating it with a longer reaction time (Levantini et al., 2022; 2023). It is necessary to point out the emotions of surprise (Martin-Key et al., 2018) and pain (Kyranides et al., 2020), which were only analyzed in one study, although difficulties were found in the emotion recognition of the participants with high CU level with respect to the control group and the group with low CU level.

The duration of fixations to the eye area was explored, fundamentally, in fear and anger (100% of the studies), and in happiness, sadness, and neutrality (86.7%). This duration was significantly shorter in the participants with CU than in those of the comparison group in over 50% of the studies for fear and sadness, and around 40% for anger. The analysis of this indicator in the rest of the emotions (pain, disgust, or surprise) was poorly studied, finding difficulties for pain (one study) and disgust (two out of four studies). For the time to first fixation (attentional focusing), the results were similar to the total duration of fixations to the eye area. Lastly, the emotion in which the participants showed the smallest number of fixations was sadness (40% of the studies in which it was analyzed) with respect to the comparison group.

As a summary, the analyzed results are presented in Table 1.

In relation to the moderating role of the characteristics of the visual stimuli, the results about the characters' faces (age, gender, ethnicity, other physical appearances, etc.) did not provide significant data. Greater accuracy was found in the recognition of those stimuli in which the emotion was presented more intensely (Airdrie et al., 2018; Martin-Key et al., 2018). In this line, Bedford et al. (2021) reported that, in dynamic expressions of sadness, emotion recognition improved when the stimulus was shown facing the participant, with the gazing direction.

Overall, the population with high CU levels showed lower accuracy in emotion recognition, mainly in one or more neg-

ative emotions, in 80% of the analyzed populations (Airdrie et al., 2018; Bedford et al., 2021; Billeci et al., 2019; Bours et al., 2018; Carter Leno et al., 2023; Centifanti et al., 2021; Dadds et al., 2008; Demetriou & Fanti, 2022; Hartmann & Schwenck,

Table 1

Emotions and indicators of emotion recognition analyzed in the included studies

		(Airdrie et al., 2018)	(Bedford et al., 2021)	(Billeci et al., 2019)	(Bours at al., 2018)	(Carter leno et al., 2021)	(Carter leno et al., 2023)	(Centifanti et al., 2021)	(Dadds et al., 2008)	(Demetriou & Fanti, 2022)	(Hartmann & schwenck, 2020)	(Kyranides et al., 2020)	(Levantini et al., 2022)	(Levantini et al., 2023)	(Martin-key et al., 2018)	(Menks et al., 2021)	% Studies	% difficulties found
Happiness	A	~	-	~	~	~	-	-	~	-		-	-	-	~		86.7	53.9
	DF	-	~	~	~	~	-	~	~	-		-	~	~	~		86.7	30.8
	TF	-	~		~	~			~				-	-	~		53.3	37.5
	NF			~					~	~				~			26.7	0
Sadness	A	~	~	-	~	~	-		~	-	-	-	-	-	~		86.7	53.9
	DF	-	~	-	~	~	-		~	-	~	-	-	-	~		86.7	53.9
	TF	~	~		~	~			~				-	-	~		53.3	25
	NF			-					~	~	~			-			33.3	40
Fear	A	-	~	~	-	~	-	-	-	-	-	-	-	-	-		93.3	78.6
	DF	~	~	~	~	-	-	~	-	-	~	-	-	-	~	-	100	53.3
	TF	-	~		~	-			-				-	-	~		53.3	62.5
	NF			~					~	~	~			-			33.3	20
Anger	A	-	-	~	~	~	-	-	~	-	-	-	-	-	~		93.3	64.3
	DF	-	~	~	~	~	-	~	~	-	~	-	-	~	~	-	100	40
	TF	-	~		~	~			~				-	-	~		53.3	37.5
	NF			~					~	~	~			~			33.3	0
Disgust	A			~					~				-	-			26.67	50
	DF			~					~				-	-			26.67	50
	TF			~					~				-	-			20	66.7
	NF			~					~					-			20	33.3
Surprise	A																0	0
	DF																0	0
	TF														-		6.67	100
	NF																0	0
Pain	A											-					6.67	100
	DF											-					6.67	100
	TF																0	0
	NF																0	0
Neutral	A	-	~	~	-	~		-	~	-		-	-	-	~		80	58.3
	DF	-	~	~	~	~		~	~	-		-	~	~	~	~	86.7	23.1
	TF	-	~		~	~			~				-	-	~		53.3	37.5
	NF			~					~	~				-			26.7	25

Note. - : Difficulties with respect to the peers; ~ : No association. A: Accuracy in emotion recognition; DF: Duration of fixations to the eye area; TF: Time to first fixation on the eye area (reaction time); NF: Number of fixations.

2020; Kyranides et al., 2020; Levantini et al., 2022; Levantini et al., 2023). This deficit was related to high CU level when the gaze was not fixed on the eye area. Thus, in 37.68% of the cases in which both indicators were studied, the accuracy in emotion recognition was lower when the duration of the fixations on the eye area was shorter than that of the population with typical development. This association was more relevant when the stimuli were static, whereas when these were presented in a dynamic manner, the performance of the participants improved significantly (Bedford et al., 2021; Martin-Key et al., 2018).

The effects of gender and age have been analyzed in some of the studies, with 53.33% of the studies using populations of the same educational stage (primary or secondary education), although no significant differences were found in the results when age was adjusted as a covariable (Airdrie et al., 2018; Carter Leno et al., 2021; 2023; Centifanti et al., 2021; Dadds et al., 2008; Demetriou & Fanti, 2022; Hartmann & Schwenck, 2020). The remaining 46.67% did include populations of different stages, similarly finding no differences when the effect of age was adjusted as a covariable. Comparisons by age groups were not analyzed.

For gender, the studies with cross-gender samples did not report greater difficulties as a function of gender (e. g., Demetriou & Fanti, 2022; Menks et al., 2021). Only two studies (Hartmann & Schwenck, 2020; Martin-Key et al., 2018) stated that girls showed higher levels of visual preference than boys, that is, they showed better eye-preference levels than boys.

Discussion

Research is currently increasing in the field of emotion recognition in children and adolescents with psychopathic traits. Eye-tracking techniques are generating new advances on this topic. However, few studies use these technologies; they are focused solely on populations with high CU levels, and CU is usually evaluated along with other comorbid disorders. With the aim of unifying the information about this topic, this systematic review analyzed the difficulties in the recognition of primary emotions in children and adolescents with CU in studies that used eye-tracking.

Regarding emotion recognition, the results of this review indicate that children and adolescents with CU have difficulties in recognizing negative emotions, especially those of fear, anger, and sadness. The analysis of positive emotions was less frequent, with happiness being the most studied emotion (86.6% of the studies), where the results showed that these children present difficulties in over 50% of the studies. These works used clinical samples (e. g., Carter Leno et al., 2023; Levantini et al., 2023) and community samples (Demetriou & Fanti, 2022; Kyranides, et al., 2020) of different ages, thus it cannot be concluded whether the presence of comorbidity or the different age of the sample may be moderating the results. Therefore, the results of this study do not provide accurate conclusions regarding happiness emotion recognition.

The use of eye-tracking allowed extracting results about the duration of fixations, which is a relevant indicator of attentional focus. In at least half of the studies, high CU was associated with lower fixation on the eye area compared to other areas, such as the mouth, and with respect to comparison groups. This tendency was not associated with specific emotions. According to Blair et al. (2001), the difficulty in focusing the attention on the important elements would hinder emotion recognition and it could result in the inactivation of inhibitory mechanisms such as that of aggressive behavior. This could lead to greater violence problems, and even to antisocial and psychopathic disorders (Halty & Caperos, 2023). At this point, it is relevant to highlight the need for delving into the study of pain, given its salience in explaining the behavior of these children and adolescents according to the distress-specific hypothesis. The study of Kyranides et al. (2020) found a clear difficulty in the accuracy of recognition and in the duration of gaze fixation on the eye area in this emotion, which, according to Wolf and Centifanti (2014), could be due to a confusion with displeasure. That is, young people with high CU levels would perceive that their peers are rejecting them when they actually feel pain, which could explain their aggressive or even bullying behavior.

In general, the analyzed studies indicate that the difficulties of attentional focus lie in the abovementioned problems, although neither in all studies nor in all the analyzed emotions, thus further research is required to provide more solid evidence on the implication of this process in emotion recognition. Therefore, and although not conclusively, these results are rather in line with the distress hypothesis (Blair, 1995), which suggests that greater difficulties would be in negative emotions. In this sense, further research on pain would allow advancing in this interpretative model. Likewise, it is worth pointing out the absence of studies that analyzed the recognition of moral emotions, such as guilt or shame, given their influence on the regulation of adjustment and social behavior (Sánchez-Jiménez et al., 2012), thus future studies could advance in this research line.

Limitations, new research lines and practical implications

The results of this work open new research and intervention lines about these difficulties. Thus, some studies identified that dynamic stimuli are easier for participants, which indicates that these children and adolescents require more contextual keys to identify emotions in others (Bedford et al., 2021; Carter Leno et al., 2023). On the other hand, other studies have shown that longer time spent looking in the eye and the use of explicit instruction that redirects the gaze of the participants to the eye area significantly improve the accuracy of emotion recognition in static stimuli (Centifanti et al., 2021). Future studies could test the efficacy of these interventions.

Nevertheless, this study presents important limitations that must be taken into account when generalizing the results regarding the effect of CU on the difficulties of emotion recognition. On the one hand, the effects of gender and age were not systematically analyzed in any of the studies included in this review. As was previously mentioned, not all studies had an age interval that allowed for the analysis of developmental

differences in the participants with CU (Bedford et al., 2021; Billeci et al., 2019; Bours et al., 2018; Kyranides et al., 2020; Levantini et al., 2022; Levantini et al., 2023; Martin-Key et al., 2018; Menks et al., 2021). In other studies, the effect of age was adjusted as a covariable, without providing conclusive results in this sense (Airdrie et al., 2018; Carter Leno et al., 2021; Demetriou & Fanti, 2022; Hartmann & Schwenck, 2020), thus it is not possible to draw accurate conclusions. Another limitation is related to the diversity of the populations used by the included studies, which hinders the comparability of the results. Some studies used community samples, whereas others employed clinical samples, such as participants with ASD (Bours at al., 2018; Carter Leno et al., 2021; Carter Leno et al., 2023; Centifanti et al., 2021), ADHD (Airdrie et al., 2018; Centifanti et al., 2021; Levantini et al., 2022; Levantini et al., 2023; Menks at al., 2021), or CD (Airdrie et al., 2018; Billeci et al., 2019; Bours at al., 2018; Centifanti et al., 2021; Hartmann & Schwenck, 2020; Levantini et al., 2022; Levantini et al., 2023; Martin-Key et al., 2018; Menks at al., 2021). This diversity in the participants raises the question of whether the difficulties found are due to the presence of the trait, the comorbid disorder, or both. This research question has not been tested in all studies, thus it is difficult to draw a conclusion in this regard. For instance, Billeci et al. (2019) reported that high CU levels were directly associated with the difficulties in recognizing sadness, even adjusting for the presence of externalizing problems and the presence or absence of CD diagnosis. On the contrary, Bours et al. (2018) could not establish that high CU levels alone explain the difficulties in recognizing fear and neutral facial expressions. A similar conclusion was drawn by Hartmann and Schwenck (2020), who found that the interaction between high CU levels and great externalizing problems explained the errors in recognizing anger, whereas high CU levels and low levels of externalizing problems explained a slower processing of emotional information, which was associated with lower attention to the eye area. As is pointed out by these and other authors, it may be necessary to explore the overlapping of traits in order to find the explanation for the difficulties that these children and adolescents present in emotion recognition, rather than separately considering the characterization of the different disorders.

Furthermore, although these studies pose a relevant contribution to explaining the attentional mechanisms underlying the difficulties in the emotion recognition of these children and adolescents, most of these works are cross-sectional studies and do not provide information about the antecedents that explain their development and evolution. In this respect, the analysis of the influence of family interaction patterns as developmental antecedents of the early onset of these atypical elements could help to identify and prevent future behavioral problems during development. For example, Bedford et al. (2017) followed the patterns of gaze in the mother-child interaction, maternal sensitivity, emotion recognition, and CU levels in the children throughout seven years. The results showed that the gaze patterns in the mother-child interaction at six months predicted the presence of CU at seven years when the levels of maternal sensitivity were low. These results suggest the need to incorporate other variables, specifically those related to the quality of family dynamics, in order to understand the context in which CU is developed, given its relevance for the intervention with this population.

Author contributions

Conceptualization: M.I.M.A., V.S.
Formal analysis: M.I.M.A.
Methodology: M.I.M.A., V.S.
Supervision: V.S.
Writing – Original Draft: M.I.M.A.
Writing – Review & Editing: M.I.M.A., V.S.

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Declaration of interests

The authors declare that there is no conflict of interest.

Data availability statement

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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The references marked with an asterisk (*) correspond to those included in this review.

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Appendix A

Table 1

Main results of the studies included in this systematic review

Reference	Participants				Emotion recognition		
	Sample size	Sex	Age (years)	Comorbidity	Stimulus of the analyzed emotion	Emotions analyzed	Type of task
(Airdrie et al., 2018)	63	Mixed	11-18	ADHD, CD	Static stimuli	Happiness, sadness, fear, anger and neutrality	*Facial Emotion Recognition task*: visual selection of the corresponding emotion among 5 options
(Bedford et al., 2021)	292	Mixed	7	ASD traits	Static and dynamic stimuli	Happiness, sadness, anger, fear and neutrality	*Static and Dynamic ER paradigms*: visual selection of the corresponding emotion among 5 options
(Billeci et al., 2019)	58	Male	7-10	CD	Static stimuli	Anger, sadness, happiness, fear, disgust and neutrality	Visual selection of the corresponding emotion among 6 options
(Bours at al., 2018)	122	Male	12-19	ASD, ODD, CD	Static stimuli	Anger, sadness, fear, happiness and neutrality	Visual selection of the corresponding emotion among 5 options
(Carter Leno et al., 2021)	189	Mixed	11-15	ASD	Dynamic stimuli	Happiness, sadness, anger, fear and neutrality	Selection by clicking on the corresponding emotion among 5 options
(Carter Leno et al., 2023)	204	Mixed	10-16	ASD	Static stimuli	Happiness, sadness, surprise, anger and fear	Selection by clicking on the corresponding emotion among 5 options
(Centifanti et al., 2021)	73	Mixed	11-16	ADHD, ODD, CD, ASD, depression	Static stimuli	Fear, anger, happiness and neutrality	*Face Perception Task*: verbal response
(Dadds et al., 2008)	100	Male	8-15	Antisocial traits	Static stimuli	Happiness, sadness, anger, disgust, fear and neutrality	*UNSW Facial Emotion Task*: Writing the corresponding emotion among 6 options
(Demetriou & Fanti, 2022)	59	Mixed	5-10	No	Static stimuli	Fear, anger, sadness and happiness	Selection by clicking on the corresponding emotion among 4 options
(Hartmann & Schwenck, 2020)	94	Mixed	8-14	ODD, CD	Static stimuli	Anger, sadness and fear	Selection by clicking on the stimulus that represents the corresponding emotion among 3 options
(Kyranides et al., 2020)	80	Mixed	16-17	Behavioral problems and anxiety	Dynamic stimuli	Anger, fear, happiness, sadness, pain and neutrality	Digital writing of the stimulus that represents the corresponding emotion among 6 options
(Levantini et al., 2022)	92	Male	7-12	ODD, CD, ADHD	Static stimuli	Happiness, sadness, anger, fear, disgust and neutrality	Visual selection of the corresponding emotion among 6 options
(Levantini et al., 2023)	116	Male	7-12	ODD, CD, ADHD	Static stimuli	Happiness, sadness, anger, disgust, fear and neutrality	Selection of the corresponding emotion among 6 options
(Martin-Key et al., 2018)	101	Mixed	13-18	CD	Static and dynamic stimuli	Anger, sadness, fear, happiness, surprise, disgust and neutrality	*Emotional face categorization*: selection by clicking on the corresponding emotion among 7 options
(Menks at al., 2021)	58	Mixed	14-19	CD, ADHD	Static stimuli	Neutrality, anger and fear	*fMRI task*: selection by clicking on the corresponding emotion among 3 options

Note. ER: Emotion recognition; CU: Callous-unemotional trait; ASD: Autism spectrum disorder; ICU: Inventory of Callous-Unemotional Traits; ADHD: Attention deficit and hyperactivity disorder; CD: Conduct disorder; ODD: Oppositional defiant disorder.

María Isabel Moreno-Albalat, Virginia Sánchez-Jiménez

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