

Implications of Emotional Processing in the Development of Conduct Problems

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Abstract

Conduct problems develop during childhood across different trajectories, some of which are associated with more severe consequences, and it is therefore necessary to know their development in depth to improve prevention and tailored interventions. Aiming to clarify these trajectories, the present study follows a longitudinal design that includes five data collection waves (T1, T2, T3, T4, T5) in a sample of 333 school-aged children (45.3% girls; $M_{age} = 10.37$; $SD = 0.9$). A predictive model of conduct problems is analyzed, encompassing physiological variables of emotional processing measured through electrodermal reactivity, and through which the effects of temperament, parenting, callous-unemotional traits, and empathy are studied, as well as possible mediation effects. Significant direct effects from fearlessness ($\beta = .20$; $p < .001$), parental inconsistency ($\beta = .17$; $p < .01$), and callous-unemotional traits ($\beta = .29$; $p < .01$) on conduct problems were identified, confirming different developmental pathways of conduct problems. Moreover, the results suggest a marginal effect of affective empathy in fear reactivity ($\beta = -.04$; $p < .06$). Finally, the limitations and practical implications of the findings, as well as possible future directions, are discussed.

Keywords: emotional reactivity; fearlessness; parental inconsistency; callous-unemotional traits; empathy.

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Implicaciones del Procesamiento Emocional en el Desarrollo de los Problemas de Conducta

Resumen

Los problemas de conducta se desarrollan en la infancia a través de diferentes trayectorias, algunas de las cuales se asocian a consecuencias más severas, siendo necesario conocer su desarrollo en profundidad para poder prevenirlas y adaptar de forma específica las intervenciones. Para tratar de esclarecer estas trayectorias, en el presente estudio se sigue un diseño longitudinal que incluye cinco momentos de recogida de datos (T1, T2, T3, T4, T5) utilizando una muestra de 333 niños (45.3%) en edad escolar ($M_{edad} = 10.37$; $DT = 0.9$). Se analiza un modelo predictivo de los problemas de conducta, que incluye variables fisiológicas del procesamiento emocional medidas a través de la reactividad en la actividad electrodérmica, y a través del cual se estudian los efectos del temperamento, la parentalidad, los rasgos de dureza e insensibilidad emocional y la empatía, así como posibles efectos de mediación. Se encontraron efectos directos significativos del bajo miedo ($\beta = .20$; $p < .001$), la inconsistencia parental ($\beta = .17$; $p < .01$) y los rasgos de dureza emocional ($\beta = .29$; $p < .01$) sobre los problemas de conducta, confirmando distintas vías de desarrollo de los problemas de conducta. Además, los resultados sugieren un efecto marginal de la empatía afectiva en la reactividad frente al miedo ($\beta = -.04$; $p < .06$). Finalmente, se discuten las limitaciones e implicaciones prácticas de los resultados, así como posibles direcciones futuras.

Palabras clave: reactividad emocional; bajo miedo; inconsistencia parental; dureza e insensibilidad emocional; empatía.

Physiological Indicators of Conduct Problems and Emotional Processing

Conduct problems (CP) encompass a broad range of behaviors characterized by the violation of the rights of others and of social norms, which entail aggression to people or animals, property destruction, and deceitfulness or theft (American Psychiatric Association [APA], 2013). Despite their commonalities, they may follow developmental trajectories that involve different risk factors (Hawes et al., 2014), including temperamental variables, socioemotional functioning or parenting practices (Romero et al., 2025). Aiming to understand their heterogeneity beyond the behavioral level, physiological indicators (e.g., electrodermal activity and heart rate) have been also included in developmental models, and distinct patterns of physiological functioning have been linked to different subtypes of CP (Fanti, 2018).

Electrodermal activity (EDA) is among the indicators which have been studied in relation to CP (Fanti, 2018). Although it is not an emotion-specific measure, it is related to levels of arousal that may correspond to different emotional states (Fanti, 2018), making it particularly relevant to examine considering the emotional processing deficits that individuals with CP might present (Georgiou & Fanti, 2021). Measures of hyper- and hypoarousal have been associated with different subtypes of CP. In the presence of callous-unemotional (CU) traits, patterns of reduced activation have been observed, whereas the opposite pattern has been observed in children with CP who do not exhibit these traits (Fanti, 2018). Nonetheless, whilst deficits in electrodermal responding could imply a higher risk towards the development of CP (Cacioppo et al., 2017), the findings regarding this relationship are inconclusive (Fanti et al., 2019).

The Integration of Individual and Family Variables in the Prediction of Conduct Problems

To understand how physiological indicators are associated with CP, it is important to study them within the context in which they tend to develop, which, given their multifactorial nature, includes several individual and family variables.

Fearlessness has been identified as one of the precursors of CP (Fanti et al., 2023; 2024), and it is associated with limited physiological reactivity to aversive stimuli (Fanti, 2018). The risk of initiating antisocial behaviors associated with fearlessness appears to be explained by factors such as insensitivity to punishment and lack of behavioral inhibition (Frick & Morris, 2004). Another variable that appears to be associated with CP is empathy, closely related to CU traits. While affective empathy emerges in early childhood and is associated with the ability to automatically react to or experience the emotions of others (Eisenberg & Strayer, 1987), cognitive empathy is a more complex phenomenon, involving emotional recognition and perspective-taking (Frick & Kemp, 2021). Low levels in both components of empathy have been associated with antisocial behavior (Waller et al., 2020) and CU traits (Georgiou et al., 2019). Moreover, lower levels of empathy in fearless children appear to be longitudinally associated with an increased risk of developing CU traits (Goffin et al., 2018), which have been defined by a lack of empathy and guilt, as well as blunted affect

(Hawes et al., 2014). Children with high levels of CU traits appear to show low electrodermal reactivity to fear and sadness stimuli (Georgiou & Fanti, 2021).

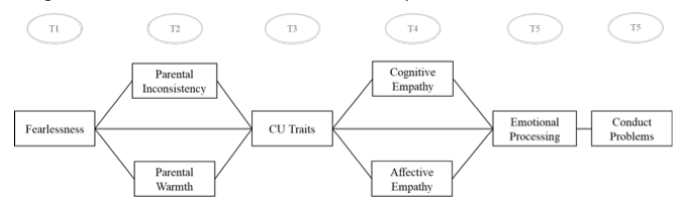
Although certain psychophysiological profiles may confer a higher risk for CP, the presence of CP and the environmental responses to them can also influence the development of psychopathology (Fenning et al., 2019). While inconsistent parenting practices can reinforce self-regulation difficulties in children and predict higher irritability and fearlessness (Lengua & Kovacs, 2005), parental warmth is associated with the development of adaptive socioemotional behaviors and prosocial attitudes (Chau et al., 2023). Along these lines, even though CU traits tend to be quite stable, they are influenced by environmental factors and can be modified through interventions focusing on parenting practices, some of which specifically aim to enhance parental warmth (Fleming et al., 2022), with better outcomes when implemented in early childhood (Hawes et al., 2014).

The Present Study

The primary aim of the present study is to investigate how emotional processing may contribute to the development of CP within a broad predictive framework, in which the influence of individual and family variables is interrelated, as outlined in the theoretical model presented in Figure 1.

The rationale behind the selection of variables and measurement times was informed by previous theoretical models (i.e., *The Interfear* model; Fanti et al., 2023; 2024), which considered a range of temperamental, personality, and family-related factors, but did not incorporate physiological indicators. Hence, the purpose of the present study is to explore how the physiological patterns that occur when children process their emotions, could influence the development of CP, and how those patterns underlying emotional processing could be linked to temperamental, behavioral and family variables that have been identified as relevant in the literature due to their influence in the development of CP.

Figure 1. Theoretical Model on the Development of Conduct Problems



Note. T = Time of data collection; CU = Callous-unemotional.

It is hypothesized that fearlessness (measured at Time 1 [T1]) will emerge as an early predictor of CP (T5) and that it will also be associated with inconsistent and low-warmth parenting practices (T2), which, in turn, are expected to contribute to the development of CU traits (T3). Furthermore, given that fearlessness tends to be associated with maladaptive physiological responses to emotional stimuli, results are expected to reflect this pattern, presumably indicating lower emotional reactivity (T5) in relation to CP. Additionally, lower levels of cognitive and affective empathy (T4) are expected to be influenced by CU traits, potentially mediating the relationship between these traits and emotional reactivity.

Method

Participants

The data for this study were drawn as part of the *ELISA Socioemotional Project*, which is embedded within the *Estudio Longitudinal para una Infancia Saludable* (Longitudinal Study for a Healthy Childhood; [ELISA]), a project conducted in Galicia (NW Spain) aimed at understanding behavioral, emotional, personality, and psychosocial development from early childhood. The initial ELISA cohort comprised 2,467 children (48.1% girls), aged 3 to 6 years ($M = 4.25$; $SD = 0.91$), recruited from 72 schools (57 public, 13 charter, and 2 private). Participants have been followed longitudinally with data provided by families and teachers across multiple waves: baseline (T1; 2017) and follow-ups conducted in 2018 (T2), 2019 (T3), 2021 (T4), 2022 (T5), and 2023 (T6). All assessments were conducted at approximately one-year intervals, with the exception of a longer interval between T3 and T4 due to disruptions caused by the COVID-19 pandemic.

In spring 2023, the *ELISA Socioemotional* project was launched to specifically assess emotion recognition, processing, and expression. A total of 441 children participated in this subproject. After applying the inclusion criteria, which included (1) Having family-reported data from at least one of the two previous waves of the ELISA study, and (2) Not having a diagnosis of Autism Spectrum Disorder, three participants were excluded, resulting in a final sample of 438 children. For the purposes of the present study, an additional inclusion criterion was established, consisting of having complete data in the passive viewing task from the *Elisa Socioemotional* project, where emotional clips from both *The Lion King* and *Aladdin* movies were presented. As a result, the current sample consists of 333 participants (45.3% girls) aged 8 to 12 years ($M = 10.37$; $SD = 0.9$). Information reported by families via questionnaires administered at T2, T3, T4, T5, and T6 of the ELISA project (subsequently referred as T1, T2, T3, T4 and T5, to gain clarity in results description), will be combined with information regarding emotional processing collected from children during the *ELISA Socioemotional* phase. For clarification purposes, a flow diagram of participants selection is presented in Figure 2.

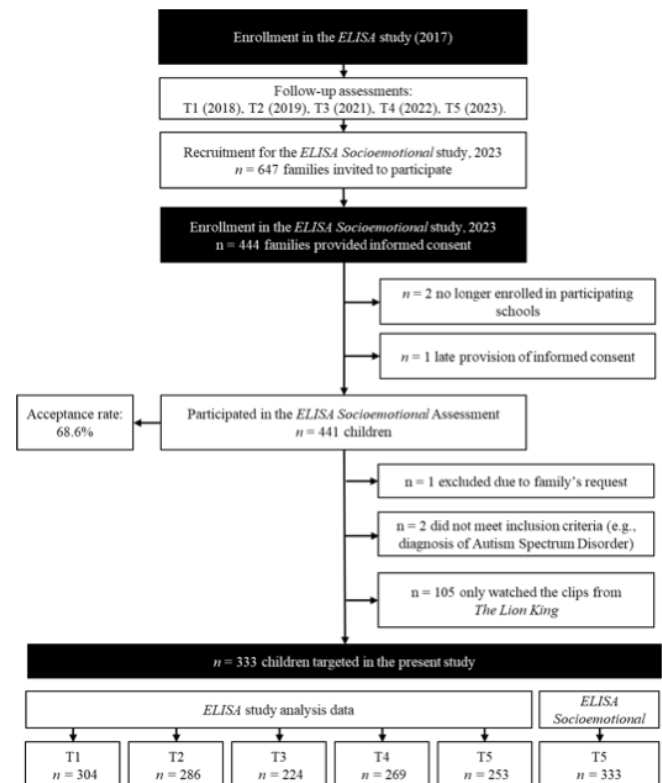
Materials

Information was collected through parent-reported questionnaires across five waves (T1–T5) and a child laboratory task (T5). All parent-report instruments have been previously used in the same ELISA cohort, showing adequate reliability, validity, and predictive utility (e.g., Álvarez-Voces et al., 2024; Fanti et al., 2024; López-Romero et al., 2021). The Cronbach's alpha coefficients reported in this study correspond to the values obtained in the current sample.

Fearlessness (T1)

Children's level of fearlessness was reported by families using a six-item scale (Colins et al., 2014; $\alpha = .86$; e.g., "He/she does not seem to be afraid of anything"), rated on a 4-point scale from 1 (strongly disagree) to 4 (strongly agree).

Figure 2. Participant Flow Diagram



Parental Variables (T2)

Parental warmth was assessed using a six-item scale based on the warmth subscale of the Child Rearing Scale (CRS; Patterson & Sanson, 1999; Zubrick et al., 2014; $\alpha = .82$; e.g., "You have warm, close times together with your child"), rated from 1 (never) to 5 (very often).

Parental inconsistency was assessed with a seven-item scale ($\alpha = .73$; e.g., "You let your child out of a punishment early") from the Spanish version of the Alabama Parenting Questionnaire (APQ; Frick, 1991), rated from 1 (never) to 5 (always).

CU Traits (T3)

CU traits were assessed using the parent version of the Child Problematic Traits Inventory (CPTI; Colins et al., 2014; López-Romero et al., 2019). Only the CU dimension was used in this study, consisting of 10 items ($\alpha = .87$; e.g., "Seldom express sympathy for others"), rated from 1 (does not apply at all) to 4 (applies well).

Empathy (T4)

Children's empathy was assessed using an adapted Griffith Empathy Measure (GEM; Dadds et al., 2008). Families reported on six adapted and translated items, rated from 0 (strongly disagree) to 3 (strongly agree). Three items assessed cognitive empathy ($\alpha = .76$; e.g., "He/she does not seem to understand why people get upset") and three assessed affective empathy ($\alpha = .70$; e.g., "He/she is happy when someone else is happy").

Conduct Problems (T5)

Conduct problems were assessed by families using a 10-item scale ($\alpha = .86$; e.g., "He/she has been very angry") from The Conduct Problems Scale (Colins et al., 2014), rated from 1 (never) to 5 (very often).

Emotional Processing (T5)

To assess emotional processing, a series of cartoon scenes from *The Lion King* and *Aladdin* were selected. Five 1-minute scenes of each movie were presented in a random order, and each of them was associated with one of the following emotions: fear, sadness, happiness, anger, and neutral. Electrodermal activity was recorded using the portable BIOPAC MP36R with the EDA SS3LA transducer and two reusable Ag/AgCl electrodes. The AcqKnowledge 5.0 software was used on a laptop, which was connected to the BIOPAC, and the scenes were presented on another laptop through the E-prime 3.0 software. The Chronos device was connected to the BIOPAC system, and to the laptop where the scenes were presented. For the present study, we extracted a measure of reactivity (i.e., peak-to-peak), which captures the peak levels of electrodermal response during each scene.

Procedure

The *ELISA Socioemotional* project was approved by the Bioethics Committee of the University of Santiago de Compostela (USC14/2024). First, the board of directors of 19 public schools involved in the ELISA study were contacted. Once the schools' principals and teachers accepted the conditions of the study and after having obtained their informed consent, families were contacted by telephone to provide them with detailed information about the *ELISA Socioemotional* project, which was also described in an informative document that was sent to the families via email. To formally authorize their participation, parents or guardians were required to provide informed consent through a link using their personal participation code, which had been assigned to them at the beginning of the ELISA project. The procedure of the ELISA project has been described in detail in previous studies (e.g., López-Romero et al., 2021).

The *ELISA Socioemotional* assessments lasted approximately 30–40 minutes, and were conducted individually at the schools, in a designated room during school hours, by the research team. The task used in the present study was the third task in the *ELISA Socioemotional* assessment protocol. Participants watched the scenes while physiological data were recorded. To measure their electrodermal response, two electrodes were attached to the index and middle fingers of the participant's left hand. The emotion elicitation procedure, as well as the participant's position during the task are represented in Figure 3. Prior to each session, the BIOPAC device was calibrated, and isotonic gel was applied to the electrodes. During the viewing, participants wore headphones to listen to the scenes and minimize external noise, and they were instructed to keep their hands on their lap. To control the potential influence of exogenous variables during the physiological recordings, a low pass filter was applied to the EDA records, in order to smooth the signal and preserve only low frequency data (<1 Hz, Posada-Quintero & Chon, 2020). Before applying smoothing and low pass filters to the raw signal, the EDA records were visually inspected in accordance with the observations noted by the researchers who had conducted the task, verifying that the movement artifacts did not fall within the 1-minute stimulus presentation period. After the assessment, all participants received a set of educational materials as a token of appreciation.

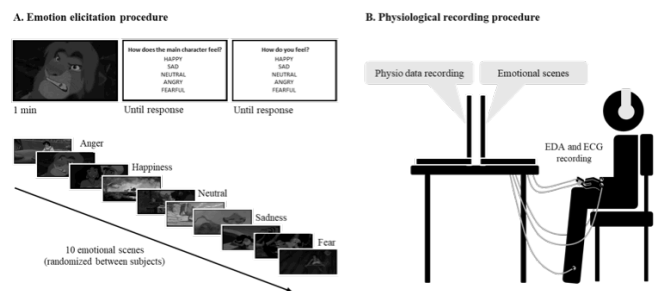
Statistical Analyses

First, descriptive statistics of the study variables were examined, followed by correlation analyses to explore the significance of the existing relationships between them, using IBM SPSS Statistics v. 29.01.

Subsequently, a path analysis with observed variables was conducted on Mplus 7.4 (Muthén & Muthén, 2011) to examine how fearlessness, parental inconsistency and warmth, CU traits, affective and cognitive empathy, and the emotional processing of anger, happiness, sadness, fear, and neutral emotions relate to CP. Potential mediation effects among the predictor variables were also examined. Specifically, indirect effects of parental inconsistency and warmth (as mediators between CU traits and fearlessness), CU traits (as mediators between empathy and parental variables), and affective and cognitive empathy (as mediators between CU traits and emotional processing), were calculated.

The model was estimated using maximum likelihood (Full Information Maximum Likelihood) for handling missing data. Model fit was assessed using the Root Mean Square Error of

Figure 3. Emotion Elicitation and Physiological Recording Procedures



Note. A. The complete procedure conducted during the *ELISA Socioemotional* passive viewing task is depicted, including two slides after each scene to assess (1) participants' recognition of the emotion represented in each scene, (2) participants' emotional state after each scene. They were asked to respond out loud to avoid movement artifacts in the physiological records. The data derived from that portion of the task was not analyzed in the present study. B. Both electrodermal activity and heart rate signals were recorded during the passive viewing task to assess emotional processing, but only data from the electrodermal activity records were used in the present study.

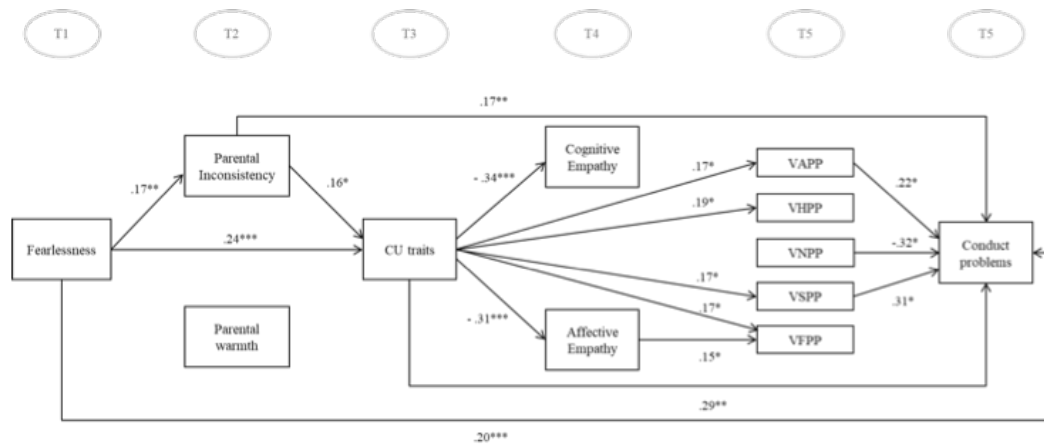
Approximation (RMSEA) and the Standardized Root Mean Square residual (SRMR), the Comparative Fit Index (CFI) and the Tucker-Lewis index (TLI). Specifically, it was considered that the value of the RMSEA should be below 0.05, the SRMR should be near zero (Browne & Cudeck, 1992), and the values of the comparative indices (i.e., CFI and TLI) should be close to .95 (Hu & Bentler, 1999).

Additionally, bootstrapping was used for the mediation analyses, with 95% confidence intervals for standardized indirect effects based on 10,000 bootstrap resamples.

Results

The descriptive statistics and the correlations among the study variables, which were calculated through the Pearson correlation to examine the potential associations between them, are presented in Tables 1 and 2, respectively.

Figure 4. Path Analysis Model for the Prediction of Conduct Problems



Note. *T* = Time; *** = $p < .001$; ** = $p < .01$; * = $p < .05$; CU = Callous-Unemotional traits; VAPP = Reactivity to anger; VHPP = Reactivity to happiness; VNPP = Reactivity to neutral scenes; VSPP = Reactivity to sadness; VFPP = Reactivity to fear.

Table 1. Descriptive Statistics of the Study Variables

	N	M	SD
Fearlessness (T1)	304	1.74	.70
Parental inconsistency (T2)	286	2.02	.57
Parental warmth (T2)	286	4.68	.38
CU traits (T3)	224	1.25	.39
Affective Empathy (T4)	268	2.37	.52
Cognitive Empathy (T4)	269	2.48	.60
VAPP (T5)	320	1.14	.79
VHPP (T5)	320	.10	.66
VNPP (T5)	318	1.08	.75
VSPP (T5)	319	1.03	.69
VFPP (T5)	320	1.07	.69
Conduct problems (T5)	253	1.39	.37

Note. *T* = Time of data collection; CU = Callous-Unemotional; VAPP = Reactivity to anger; VHPP = Reactivity to happiness; VNPP = Reactivity to neutral scenes; VSPP = Reactivity to sadness; VFPP = Reactivity to fear.

Fearlessness was significantly associated with parental inconsistency, CU traits, and CP, through positive correlations. Additionally, it was inversely associated with cognitive empathy. Significant inverse correlations were found between parental warmth and parental inconsistency. While parental warmth was only significantly associated with affective empathy, through a positive relationship, parental inconsistency was significantly and inversely related to cognitive empathy and directly associated with CP. Both types of empathy showed a significant inverse relationship with CU traits, which, in turn, were significantly and positively associated with CP. Regarding the emotional processing variables, they were significantly correlated with each other through positive relationships. However, no significant associations were found between them and the rest of study variables.

The model analyzed through a path analysis was just identified ($df = 0$), with global fit indices reported for completeness only ($RMSEA = 0$; $SRMR = 0$; $CFI = 1$; $TLI = 1$). The significant effects, along with the coefficients for each established relationship, are displayed in Figure 4.

Table 2. Correlations Between the Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Fearlessness (T1)	-											
2. Parental inconsistency (T2)	.16**	-										
3. Parental warmth (T2)	.01	-.22**	-									
4. CU traits (T3)	.29**	.22**	-.12	-								
5. Affective empathy (T4)	.04	-.11	.16*	-.32**	-							
6. Cognitive empathy (T4)	-.17**	-.22**	.09	-.36**	.06	-						
7. VAPP (T5)	-.03	.04	.03	.12	.02	.02	-					
8. VHPP (T5)	-.06	.01	.02	.09	-.01	.04	.75**	-				
9. VNPP (T5)	-.05	-.01	.04	.04	-.01	.06	-.76**	.84**	-			
10. VSPP (T5)	-.06	.02	.01	.08	.02	.02	.79**	.84**	.85**	-		
11. VFPP (T5)	-.06	.05	.06	.06	.04	.03	.80**	.83**	.84**	.83**	-	
12. Conduct problems (T5)	.24**	.24**	-.04	.33**	-.07	-.06	.12	.05	.01	.08	.04	-

Note. *T* = Time of data collection; ** = $p < .01$; * = $p < .05$; CU = Callous-Unemotional; VAPP = Reactivity to anger; VHPP = Reactivity to happiness; VNPP = Reactivity to neutral scenes; VSPP = Reactivity to sadness; VFPP = Reactivity to fear.

As observed in Figure 4, fearlessness (T1) had a significant direct effect on parental inconsistency (T2), CU traits (T3), and CP (T5). Additionally, parental inconsistency (T2) significantly predicted CP (T5). With respect to CU traits (T3), they significantly predicted cognitive and affective empathy (T4) through negative direct effects. Furthermore, CU traits had a significant direct effect on reactivity to anger, happiness, sadness, and fear scenes, as well as on CP, which were measured at T5. Regarding empathy, it was found that affective empathy (T4) had a significant direct effect on reactivity in the processing of fearful stimuli (T5). Among the variables collected at T5, reactivity in the emotional processing of anger and sadness scenes was positively associated with CP, whereas reactivity to neutral scenes was negatively associated with CP.

In addition to the direct effects, indirect effects were calculated. A significant total indirect effect of CU traits (T3) on reactivity in the processing of fear scenes (T5) was identified ($\beta = -.06$, $SD = .04$; $p < .05$). In this regard, a specific indirect effect through affective empathy (T4) was also identified, which was found to be marginally significant ($\beta = -.05$, $SD = .02$; $p < .06$).

The model was replicated controlling for gender and age, yielding no significant effects concerning these variables.

Discussion

The results regarding direct effects confirm different developmental pathways for CP, in which fearlessness, inconsistent parenting practices, and CU traits appear to play a key role. These findings are consistent with Fanti et al. (2023), where longitudinal associations between fearlessness and CU traits and later CP had been identified. This aligns with the *Interfear* model (Fanti et al., 2024), supporting fearlessness as an early precursor of CU traits (Waller et al., 2016).

Furthermore, the findings align with previous literature indicating that temperamental characteristics can predict specific parenting behaviors (Waller et al., 2016) and are congruent with studies suggesting that inconsistent parenting may particularly influence the development of externalizing behaviors in fearless children (Kiff et al., 2011), and changes in psychopathic traits (McDonald et al., 2011). This result emphasizes the importance of addressing parental inconsistency, which is already contemplated in well-established preventive programs of CP (e.g., EmPeCeMos; Romero et al., 2013). Concerning the predictive relationship between CU traits and empathy, results also align with prior literature where their relationship with both components of empathy had been evidenced (Demetriou et al., 2023; Waller et al., 2020).

The Role of Affective Empathy in the Emotional Processing of Fear

The total effect of CU traits on emotional reactivity suggested that higher levels of these traits are associated with greater levels of reactivity, being a result that is inconsistent with the proposed hypotheses and with the studies that tend to find lower levels of physiological arousal across different measures (Fanti, 2018). However, in the context of fear processing, the results suggest a marginal indirect effect of CU traits through affective empathy, in a way that lower levels of affective empathy appear to lead to a lower reactivity to fear.

This indirect effect, despite being marginal, facilitates our understanding of how the effect of CU traits on fear reactivity occurs, and is consistent with the proposed hypotheses and with previous studies that examined the development of CP in relation to fearlessness (Goffin et al., 2018), as the fearless temperament tends to be associated with reduced reactivity (Fanti, 2018). Thus, lower affective empathy may account for the reduced physiological reactivity to threat observed in children with CP and elevated CU traits (Georgiou & Fanti, 2021). In turn, this reduced activation could exacerbate their difficulties to share the emotional states of others (Georgiou et al., 2019). Given that children exhibiting CU traits tend to present deficits in affective empathy (Demetriou et al., 2023), interventions targeting these difficulties could promote more adaptive emotional processing of fear.

The Relationship between Emotional Reactivity and Conduct Problems

In this study, higher emotional reactivity to anger and sadness was found to be associated with CP. Nevertheless, when comparing the present findings with those reported in the existing literature, it is important to acknowledge the challenges that methodological heterogeneity poses for consistency across studies, as well as the differences in the measures and tasks employed. In studies examining physiological arousal, some studies have relied on indices of sympathetic activity other than electrodermal activity (e.g., Oldenhof et al., 2022), or on tasks that included emotional stimuli limited to static images (e.g., Sharp et al., 2008), although the use of videos or scenes (Dadds et al., 2016) may be more appropriate, as these may provide findings with greater ecological validity.

Regarding the effect of temperament on reactivity, fearlessness was not associated with limited reactivity to aversive stimuli (Fanti, 2018). Instead, physiological reactivity appeared to be linked to other variables, suggesting that the influence of temperament on emotional reactivity may vary depending on the developmental context (Rothbarth & Bates, 1998). Therefore, although these results suggest that children with CP exhibit elevated levels of emotional reactivity that may not be adaptive, they are not consistent with literature indicating that fearlessness and CU traits are associated with reduced sympathetic activity (Colasante et al., 2021; van Zonneveld et al., 2017). While the association between high emotional reactivity and CP is well established (Murray-Close et al., 2024), it is theoretically challenging to reconcile such levels of reactivity with trajectories characterized by fearlessness and CU traits.

Regardless, it should also be noted that there are very few comparable longitudinal studies, as existing studies are generally correlational and include only some of the variables considered in the proposed model. For this reason, the results could also be due to a cascade effect of different variables throughout development (Masten & Cicchetti, 2010), some of which may not be operationalized in the model, such as anxiety (Payot et al., 2023), aggression (Schoorl et al., 2016), and emotional recognition (Colasante et al., 2021) or regulation skills (Tonnaci et al., 2019), which could be useful to attain a more accurate interpretation and explanation of the observed results regarding emotional reactivity, in addition to a series of methodological limitations that will be addressed in the fol-

lowing section. Although the mechanisms underlying higher physiological reactivity in the context of the fearless temperament and CU traits remain unclear, the results point out that higher reactivity to anger and sadness is significantly associated with CP. Thus, turning to the practical implications of the results, children who have not benefited from early interventions and who have followed trajectories that have led to maladaptive emotional processing, could receive interventions targeting arousal regulation (Malti et al., 2016) to prevent future CP. Self-regulation techniques are already targeted as part of standard interventions and have led to improvements in CP in children (Pandey et al., 2018), and biofeedback techniques are yielding promising effects, achieving a similar effectiveness than standard cognitive-behavioral interventions in the reduction of aggressive behaviors when using skin conductance levels (Aggensteiner et al., 2024). The results of the present study suggest that physiological signals in the context of emotional processing should be examined in assessment settings, in order to improve the identification of CP and adjust available interventions. Building upon current interventions that incorporate physiological signals to improve emotional regulation skills through gamified interventions (e.g., Ducharme et al., 2021), assessment protocols in the field of CP should incorporate both psychological and physiological methods in order to understand the mechanisms underlying their development and incorporate interactive elements to increase children's engagement during the assessment procedures.

Strengths and Limitations

The present study advances the understanding of the mechanisms underlying the development of CP, strengthened by its longitudinal and multi-method design, despite certain limitations. Although the data from ELISA project comes from a large sample, it was reduced in the ELISA Socioemotional phase, limiting the generalizability and interpretation of the results. Regarding the emotional processing variables, the expected results on reactivity may not have been obtained due to the characteristics of the selected scenes, which had been previously used with younger samples (Kimonis et al., 2023). Given that this was a community-based sample, this may also contribute to the inconsistency with findings reported in studies involving clinical populations or samples characterized by higher psychosocial risk. The results might have also been influenced by an informant effect, since all variables, except those concerning emotional processing, were parent-reported, possibly affecting method variance and leading to relationships in the expected directions (Izquierdo-Sotorri o et al., 2016). In addition to addressing these constraints through larger sample sizes, studying the effect of additional variables of interest, and employing a multi-informant perspective, there are several considerations that could be useful in guiding future research along the lines of the present study. Although no gender effect was observed in the present study, given the differences that tend to be found in the development of CP between boys and girls ( lvarez-Voces et al., 2024) they should continue to be explored in relation to physiological reactivity (Georgiou & Fanti, 2021). Regarding the instruments used to assess emotional processing variables, it would be interesting to incorporate virtual or augmented reality into assessment protocols

(Blanco et al., 2024). Moreover, it could be useful to study how deficits in physiological arousal relate to deficits in emotional recognition, which are manifested in the presence of psychopathic traits in both childhood and adolescence (D  az-V  zquez et al., 2024).

Conclusions

The results of the present study suggest early developmental trajectories of CP based on fearlessness, parental inconsistency and CU traits. They also propose that affective empathy could affect the emotional processing of fear, which is particularly interesting given that empathy could be addressed through preventive interventions. Considering the controversies surrounding the role of emotional processing and its underlying mechanisms, more longitudinal studies are needed to examine it not only as a consequence of the interaction of a series of variables throughout development, but also to study its predictive value and stability, and thus contribute to the characterization of CP from a dimensional perspective, facilitating changes through interventions toward more adaptive trajectories.

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Conflict of interest

The authors declare no conflict of interests.

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