Callous-Unemotional Traits and Co-occurring Anxiety in Preschool and School-age Children: Investigation of Associations with Family's Socioeconomic Status and Home Chaos.

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Data, Materials and Code availability The study materials, analysis code and output are available by emailing the corresponding author.

Abstract

While contemporary literature has traditionally viewed youth with Callous-Unemotional (CU) traits as a homogeneous group, there is a growing interest in delineating two variants of CU traits based on high or low levels of anxiety. Extensive attention has been brought in the CU traits literature to the study of relational factors such as maltreatment and parenting practices. However, very few studies have looked at other environmental contexts in which the children within these two variants evolve, such as home chaos or socioeconomic status (SES). In a community sample of children aged 4 to 9, divided into a preschool sample (N= 107; M_{age} = 4.95, SD = .62) and a school-age sample (N= 153; M_{age} = 7.49, SD = 1.11), the current study investigated whether anxiety moderates the associations of CU traits with SES and home chaos. Hierarchical regression analyses revealed that CU traits were positively associated with home chaos, regardless of anxiety levels. CU traits were negatively associated with SES, but this effect emerged only at high levels of anxiety. Notably, these findings were observed solely in the school-age subsample. Implications for understanding the two variants of CU traits (i.e., primary and secondary) and hypotheses regarding their developmental trajectories are discussed.

Keywords: callous-unemotional traits, variants, SES, home chaos, childhood

Callous-Unemotional Traits and Co-occurring Anxiety in Preschool and School-age Children: Investigation of Associations with Family's Socioeconomic Status and Home Chaos.

Callous-Unemotional (CU) *traits*, closely corresponding to the affective dimension of psychopathy (Hare & Neumann, 2008), appear to be a concept of great interest in the identification of a distinct subgroup among children and adolescents with conduct problems. Indeed, youths with conduct problems and high levels of CU traits exhibit specific cognitive, emotional, biological, and social characteristics that set them apart from youths with conduct problems alone (Frick et al., 2014b). This specific subgroup is also at heightened risk of developing psychopathy (Burke et al., 2007; Lynam et al., 2007) and severe antisocial outcomes later in life (Frick et al., 2014a). Due to the valuable insights CU traits offer in understanding the heterogeneity of youth with conduct problems, the construct has been integrated into the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V; American Psychiatric Association, 2013) as a specifier named "with limited prosocial emotions" (LPE) within the diagnostic criteria for Conduct Disorder (CD). This specifier is defined by four criteria: lack of remorse or guilt; callous/ lack of empathy; unconcern about performance; shallow or deficient affects. While contemporary research has traditionally viewed youth with CU traits as a homogeneous group, a growing body of literature now supports the possibility of dividing CU traits into two variants (i.e., primary and secondary). These variants are thought to stem from two distinct etiological pathways and exhibit different characteristics (Ezpeleta et al., 2017; Kahn et al., 2013; Kimonis et al., 2012). However, the current literature focusing on these two variants remains limited, particularly within preschool and school-aged samples. The present study aimed to further enhance the understanding of these two variants, specifically in relation to the family's socioeconomic status (SES) and the level of home chaos.

Assuming the existence of two distinct variants of CU traits is directly derived from literature concerning adult psychopathy, in which Karpman (1941) distinguished two variants of psychopathy. The primary variant is believed to stem from an innate or temperamental deficit in emotional processing, while the secondary variant is considered as an adaptive mechanism developed to cope with adverse environments such as maltreatment, or chronic traumatic experiences (Karpman, 1941; Porter, 1996). Current studies on CU traits in children have supported this theoretical framework, the two variants of CU traits being most of the time distinguished based on low (primary variant) or high (secondary variant) levels of anxiety in addition to high levels of CU traits (Craig et al., 2020). Indeed, high levels of CU traits and anxiety have been constantly associated with maltreatment or trauma (Craig et al., 2020; Dadds et al., 2018; Kahn et al., 2013; Kimonis et al., 2011).

Research indicates that children within the primary variant exhibit hypoarousal of affect, as evidenced by lower physiological activity, reduced responsiveness to distressing stimuli and lower behavioral and emotional dysregulation. Conversely, children in the secondary variant are characterized by hyperarousal of affect reflected in biological markers of dysregulation, affect dysregulation and suppression and hypersensitivity to distress stimuli (Craig & Moretti, 2019; Ezpeleta et al., 2017; Fanti et al., 2018; Goulter et al., 2017; Kimonis et al., 2012, 2017).

In the existing literature, a variety of methods are employed to investigate the two variants. The first approach utilizes clustering models such as clustering analyses, latent class analysis and growth mixture models. These methods are employed to identify natural groupings of individuals in the data based on their levels of CU traits and anxiety (e.g., Craig & Moretti, 2019; Ezpeleta et al., 2017; Fanti et al., 2018; Kimonis et al., 2017). The second approach involves cut-off methods that define groups by setting predetermined threshold scores (e.g., 1 SD above the mean) for CU traits and anxiety (e.g., Cecil et al., 2018; Flexon, 2016; Kimonis et al., 2012). A third type of analysis adopts a dimensional approach, in which CU traits and

anxiety are treated as continuous variables within moderated regression analyses, to examine whether anxiety levels moderate the associations between CU traits and various outcomes (Dadds et al., 2018; Kahn et al., 2017; Kimonis et al., 2008).

Among the studies that have examined the two variants of CU traits, limited attention has been directed towards the environmental contexts in which children with these variants develop. Generally, these studies suggest that the secondary variant is associated with greater environmental adversity, including parental psychopathology (Meehan et al., 2017), the frequency of challenging life events (Ezpeleta et al., 2017), and inappropriate parenting practices (Craig et al., 2021; Flexon, 2015; Goulter et al., 2017). However, other variables like socioeconomic status or home chaos have received less consideration. It is crucial to recognize that a child's development is interwoven with the broader contexts in which they grow. These specific contextual factors could potentially serve as environmental risks for the emergence of CU traits or a specific variant. On the other hand, it is also worth considering that the characteristics of CU traits or a specific variant might exert a reciprocal influence on their environment. Therefore, there is a need for further studies to precisely delineate the environmental contexts in which children of the two variants develop.

To the best of our knowledge, only one study has investigated the association between the socioeconomic context and the two variants. Specifically, Ezpeleta et al. (2017) used growth mixture models to identify the two variants in preschoolers and discovered that the secondary variant included a higher proportion of families with a low socioeconomic status (SES) than the primary variant. However, more studies have explored the associations between SES and broad CU traits. For instance, a meta-analysis synthetized findings from five studies conducted across samples aged 0 to 18, revealing a noteworthy negative correlation between SES and

broad CU traits[1] (mean r = -.24, p = .00; Piotrowska et al., 2015). The notable findings from these studies underscore the relevance of considering both variants when investigating the connection between SES and CU traits.

Within the construct of home environment, the concept of "home chaos" emerges as a pertinent area of investigation in relation to the variants of CU traits. Home chaos is characterized by high levels of confusion and agitation in the home, a sense of rush, a lack of predictability or routine, disorganization and crowding. This facet of family dynamics holds significant relevance, exerting an influence on the developmental trajectories of children, particularly with regard to internalizing and externalizing behaviors (Dumas et al., 2005; Fiese & Winter, 2010; Matheny et al., 1995). This influence may manifest either directly or indirectly through its potential to disrupt optimal parenting practices (Barnes et al., 2014; Pike et al., 2016; Zvara et al., 2020).

As of the present, no research has investigated the association between home chaos and the two variants of CU traits. Nevertheless, some studies investigated this association in the context of broad CU traits and showed home chaos to be a predictor of broad CU traits (Fontaine et al., 2011; Mills-Koonce et al., 2016). Fontaine et al. (2011) discovered that children who exhibited a developmental trajectory marked by stable and elevated levels of both CU traits and conduct problems between the ages of 7 and 12 demonstrated higher levels of home chaos at age 4 compared to other children. Mills-Koonce et al. (2016) found a direct effect of home chaos assessed during the first three years of life on CU traits assessed in first grade, as well as indirect associations through the effects of home chaos on sensitive and harsh parenting. The significant results of these studies support the relevance of investigating home chaos and CU traits by considering both variants.

[1] The term "broad CU traits" is used to talk about CU traits without making a distinction between the two variants.

Lastly, an important variable to consider when investigating the associations between CU traits (with high or low levels of anxiety) and environmental variables such as SES or home chaos is the levels of externalizing behaviors (EB). While CU traits were initially integrated in the CD diagnosis, evidence indicates that they could also be associated with Oppositional Defiant Disorder (ODD; Ezpeleta et al., 2017) or with subclinical EB (Rowe et al., 2010). Specifically, the findings of a meta-analysis (Longman et al., 2016) revealed a moderate effect size association (r= .39, p<.001) between broad CU traits and EB. Furthermore, EB have been extensively associated to SES (Letourneau et al., 2013; Mills-Koonce et al., 2016; Piotrowska et al., 2015) and home chaos (Dumas et al., 2005; Fiese & Winter, 2010; Matheny et al., 1995) in the existing literature. Therefore, it seems essential to account for this variable to ensure that the associations between CU traits and the outcomes are not influenced by a confounding effect due to shared variance with EB.

In conclusion, an increasing body of research underscores the heterogeneity of CU traits, dividing them into two variants with distinct developmental trajectories and characteristics. However, only a limited number of studies have examined other characteristics of the environmental context in the two variants, including factors such as SES and home chaos. Existing studies support the existence of a significant link between these environmental variables and CU traits levels. Enhancing our comprehension of the associations between CU trait variants and these variables could potentially pave the way for tailored prevention and intervention strategies aimed at addressing the distinctive characteristics and needs of children within each variant.

Present study

In this context, the objective of the present study was to contribute to the existing knowledge regarding the environmental variables associated with the two variants of CU traits within a community sample of children aged 4 to 9. Specifically, our aim was to enhance

comprehension of the associations between the primary and secondary variants of CU traits on one hand, and two environmental variables, namely socioeconomic status (SES) and home chaos, on the other hand.

Anxiety was employed to differentiate between the two variants, as it is the variable the most frequently used in current literature. In the present study, a dimensional approach using moderated regression analyses was used. This decision was motivated by the fact that elevated CU traits are relatively uncommon in the general population (Colins et al., 2020; Herpers et al., 2012), rendering both clustering and categorical analyses potentially less relevant due to the need of extensive community samples to ensure sufficient representation in each group for meaningful group comparisons. Additionally, the cut-off scores for CU traits, as established in a previous study (Kemp et al., 2023), are based on older children than those in the current sample, making the application of a categorical approach challenging. Conversely, the dimensional approach holds particular value within community samples as CU traits and anxiety are treated as continuous variables. This methodology enables the examination of the combination of high levels of CU traits and anxiety as a proxy for secondary CU traits, and the combination of high levels of CU traits and low levels of anxiety as a proxy for primary CU traits (Craig et al., 2020).

We hypothesized, in line with results from the study of Ezpeleta et al. (2017), that anxiety would moderate the relationship between CU traits and SES, such that CU traits would show greater associations with SES at high levels of anxiety (i.e., secondary variant) than at low levels of anxiety (i.e., primary variant). Admittedly, it may seem more logical to designate SES as a dependent variable, given its role as a risk factor in child development rather than an outcome. However, the choice to consider CU traits and anxiety as independent variables arises from the necessity of exploring the interaction between these specific variables and to offering

insights into the two variants. It is important to note that this interpretation does not imply a causal sequence but rather underscores the intricate relationships between these variables.

Regarding home chaos, we hypothesized that CU traits would exhibit a stronger association with levels of home chaos under conditions of high anxiety compared to low anxiety levels. This hypothesis is grounded in the existing literature, which indicates greater environmental adversity for the secondary variant (Ezpeleta et al., 2017; Meehan et al., 2017).

To explore whether differences between variants are already discernible during the preschool and school-age period, separate analyses were conducted for preschoolers (4 – 5 years old) and school-age children (6 – 9 years old). Indeed, the emergence of the secondary variant is not clearly understood, as it might require many years of repeated maltreatment or exposure to traumatic experiences for a child to develop CU traits as a coping mechanism (Craig et al., 2020; Porter, 1996). Consequently, it is plausible that the results for this variant will vary based on age. Conversely, the characteristics of the primary variant may manifest at an early age due to substantial genetic influences (Humayun et al., 2014).

Method

Procedure

Parents of children aged 4 to 9 from the French-speaking region of Belgium were recruited via social media and schools to answer an online questionnaire about their child. The survey collected demographic information and encompassed assessments of callous-unemotional traits, externalizing/internalizing behaviors and home chaos.

Children with autism, developmental delay or intellectual disability were excluded from the study. The study was approved by the Ethical Committee of Psychology of the University of Liege and participants' consent was obtained at the start of the online questionnaire.

Participants

The 260 participants were aged 4 to 9 (M_{age} = 6.44; *SD* = 1.56), including 107 preschoolers aged 4 to 5 (M_{age} = 4.95, *SD* = .62) and 153 school-age children aged 6 to 9 (M_{age} = 7.49, *SD* = 1.11). Boys accounted for 54.6% of the total sample (54.2% within preschoolers; 54.9% within schoolers). The parents were aged 23 to 52 (M_{age} = 36.02, *SD* = 5.18), were principally mothers (94.6% of the sample) and 93.1% of them had, at least, completed secondary school education. Around 82% of the respondents were living with the other parent of the child.

Measures

CU traits The Inventory of Callous Unemotional traits (ICU; Frick, 2004) was used to assess CU traits. In this study, the parent-report preschool and school-age French versions (translation by de Chantérac, A., Gignac, M., Seguin, J.) provided by Frick were used. A previous study (Payot et al., 2022) in a Belgian community sample of children aged 3 to 9 validated an 18-item second order model with three first order factors based on the LPE specifier criteria (Lack of conscience, encompassing the criteria lack of guilt and callousness/lack of empathy, Unconcern about performance, Lack of emotional expression), a second order latent factor (General dimension of CU traits) and a methodological factor encompassing negatively worded items. As this model demonstrated a good fit indices, external validity and measurement invariance across age and gender, the total score was used in the current study. The internal consistency was good in the preschool (α =.84) and in the school-age (α = .87) subsamples.

Anxiety symptoms and externalizing behaviors The preschool and school-age versions of the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2000, 2001) were completed by parents. For this study, the DSM-V Anxiety and DSM-V Oppositional Defiant Problems (ODP) subscales were used for the analyses, to respectively assess anxiety and externalizing

behaviors. It should be noted that the preschool and school-age versions of the questionnaire do not include the same number of items across subscales. Thus, raw scores cannot be compared between the two subsamples. The internal consistency was acceptable for the DSM-V Anxiety scale (α = .70 for the preschool sample; α = .79 for the school-age subsample), and varied between acceptable and good for the DSM-V ODP scale (α = .83 for the preschool sample; α = .74 for the school-age subsample).

Socioeconomic status A social and economic index was derived from three questions: (i) the parent's highest degree, (ii) the highest degree of the parent's partner (if applicable) (iii) the combined family incomes. The highest education level ranged from 0 (no diploma) to 8 (PhD degree). The income variable was recoded into an ordinal variable spanning from 1 (less than 750 euros per month) to 8 (more than 6000 euros per month). In order to accommodate missing data and incomplete test designs, the data were scaled using the Item Response Theory (IRT) model. Unlike Classical Test Theory, IRT allows for reporting on a single scale even when dealing with incomplete or missing data. This adaptability is crucial for socioeconomic status (SES) assessments, where the second variable might be missing if the child's mother or father does not live with a partner. Among the various IRT models, we employed the one-parameter logistic model tailored for ordinal variables, commonly referred to as the partial credit model. This model, implemented using ConQuest software (Wu et al., 1997), functions as a Confirmatory Factor Analysis applied to dichotomous or ordinal observed variables. By jointly estimating individual ability and item difficulty through logistic regression, this model provides both ability and difficulty estimates on a unified scale. Once both estimates are obtained, the logistic function is employed to compute the probability of an individual providing a particular response, based on their ability and the item parameters. For person estimates, we utilized the Weighted Maximum Likelihood Estimate (Warm estimate).

Home chaos The Confusion, Hubbub, and Order Scale (CHAOS; Matheny et al., 1995) assessed the level of environmental confusion in the home (high levels of noise, crowding, home traffic pattern). This questionnaire consisted of 15 true or false items. This scale correlated accurately with observed home environment conditions (Matheny et al., 1995), with parenting and with children's behavior (Dumas et al., 2005). Internal consistency was acceptable (α = .77) in our sample.

Statistical Analyses

All analyses were performed using SPSS, version 28.0. First, a comparison was made between the preschool and school-age samples in terms of child gender, informant gender, informant level of education, family SES, level of home chaos level of CU traits. The Chi-Square Test of Independence was used for categorical variables while Welch's ANOVA was conducted for continuous variables. These analyses aimed to ensure group comparability and to identify potential sampling biases. Subsequently, associations between study variables – child gender and age, CU traits, anxiety, ODP symptoms, SES, and home chaos (considered as continuous variables, except for gender) – were examined using bivariate correlations in both preschool and school-age subsamples.

The associations between CU traits and SES, as well as home chaos, along with the hypothesized moderating role of anxiety in these associations, were examined using hierarchical multiple regression analyses. All continuous predictors were centered by subtracting the sample mean from each participant's score. Centering is necessary to reduce the multicollinearity between predictors (CU traits and anxiety) and the interaction term derived from them. Gender and ODP symptoms were included as control variables in the first step of the multiple regression analyses. The inclusion of ODP symptoms as a control variable aimed to ensure that the associations between CU traits and the outcomes were not influenced by shared variance with EB. Given the non-significant correlations between SES and home chaos

in the current samples, SES was not employed as a control variable in regressions where home chaos serves as the dependent variable. CU traits and anxiety were introduced in the second step of the multiple regression analyses. Finally, the interaction term, composed of the predictor variables (CU traits and anxiety), was introduced in a third step. The amount of incremental variance explained by the addition of the interaction term was tested for significance. Any significant interaction was further investigated by analyzing simple slopes and marginal effects at -1 SD, -0.5 SD, the mean, +1SD, +2SD of anxiety using the *interActive* application (McCabe et al., 2018).

Results

The preschool and the school-age subsamples exhibited no significant differences based on the gender of the child ($\chi^2(1) = .12$, $p = .91$), gender of the informant ($\chi^2(1) = 2.38$, $p = .12$), informant's education level ($\chi^2(5) = 8.28$, $p = .14$), SES (F_w (1, 233.18) = .95, p =.33), level of home chaos (F_w (1, 241.44) = .01, p =.93) and level of CU traits (F_w (1, 249.08) = 1.99, p = .16). However, the two samples significantly differed in terms of the proportion of children with clinical levels of anxiety ($\chi^2(1) = 12.65$, $p < .001$) and aggressive behaviour ($\chi^2(1) = 6.53$, $p = .01$), with more school-age than preschool children having clinical levels on these two subscales.

Descriptive statistics and correlations among the study variables for the preschool and school-age samples are provided in Table 1. Results regarding correlations and regression analyses are reported separately for each sample (i.e., preschool and school-age).

Preschool sample

First, consistent with prior research, CU traits were significantly correlated with ODP symptoms ($r = .46$, $p < .001$) and gender ($r = -.24$, $p = .01$) in preschoolers. This latter result indicates that boys displayed higher levels of CU traits than girls. In addition, SES was

Table 1. Descriptive Statistics and correlations of main study variables in the preschool and the school-age samples.

Variables	Preschool sample								School-aged sample							
	1	2	3	4	5	6	Mean /%	SD/N	1	2	3	4	5	6	Mean /%	SD/N
Gender	-						54.2	58	-						54.9	84
Age	-.17	-					4.95	.62	.02	-					7.49	1.11
SES	-.04	.02	-				.06	.80	.19*	-.10	-				-.04	.82
CU traits	-.24*	-.05	-.19	-			11.62	7.03	-.21**	.16*	-.10	-			12.97	8.34
Anxiety	.13	-.17	-.18	.11	-		4.66	3.25	-.12	-.02	-.08	.17*	-		5.50	3.75
ODP	.06	-.08	-.32**	.46**	.44**	-	3.70	2.86	-.18*	-.00	-.11	.57**	.40**	-	3.12	2.42
Home chaos	.05	-.00	-.06	.13	.15	.38**	4.31	2.95	-.14†	.06	.02	.40**	.32**	.50**	4.34	3.25

Note. Gender: 0 = boy, 1 = girl; ODP, Oppositional Defiant Problems symptoms. In the preschool sample, scores ranged from 0 to 29 for CU traits, 0 to 14 for anxiety, and 0 to 11 for ODP symptoms. In the school-age sample, scores ranged from 0 to 50 for CU traits, 0 to 17 for anxiety, and 0 to 10 for ODP symptoms. ** = $p<.01$, * = $p<.05$.

negatively associated with ODP symptoms (r = -.32, p < .001). Contrary to previous results, CU traits were not significantly associated with SES or home chaos, and home chaos was not significantly associated with SES. However, home chaos was positively associated with ODP symptoms (r = .38, p <.01).

The results of the hierarchical regression analyses for SES and home chaos in the preschool sample are reported in Table 2. Regarding SES, the interaction between CU traits and anxiety was not significant. Only a main effect of ODP symptoms was observed (β = -.26, p = .03).

Regarding home chaos, the interaction between CU traits and anxiety was not significant either. The only significant main effect was for ODP symptoms (β = .39, p < .001).

Table 2. Hierarchical regression analyses in the preschool sample.

Preschool	SES				Home Chaos			
	β	R^2	ΔR^2	*Partial r*	*β*	R^2	ΔR^2	*Partial r*
Stage 1								
Gender	-.02			-.02	.03			.03
ODP	-.32**			-.32	.38**			.38
		.10	.10**			.14	.14**	
Stage 2								
Gender	-.04			-.04	.02			.01
ODP	-.26*			-.20	.41**			.33
CU	-.07			-.06	-.05			-.03
Anxiety	-.06			-.05	-.03			-.04
		.11	.01			.15	.00	
Stage 3								
Gender	-.04			-.04	.01			.01
ODP	-.26*			-.21	.39**			.31
CU	-.08			-.07	-.07			-.06
Anxiety	-.06			-.05	-.03			-.04
CU x Anxiety	.04			.04	.13			.13
		.11	.00			.16	.00	

Note. Gender : 0 = boy, 1 = girl, CU = score of CU traits; ODP = Oppositional Defiant Problems symptoms; β = standardized beta; Partial r = partial correlation. ** = p<.01, * = p<.05.

School-age sample

Regarding the school-age sample, as expected based on previous research, CU traits were significantly correlated with ODP symptoms (r = .57, p < .001), age (r = .16, p = .04), and gender (r = -.21, p < .01), indicating that boys exhibited higher levels of CU traits compared to girls. Contrary to expectations, SES was not significantly associated with CU traits (r = -.10, p = .22), ODP symptoms (r = -.11, p = .18) or anxiety (r = -.08, p = .31) in this sample. Home chaos was significantly and positively associated with CU traits (r = .40, p < .001), ODP symptoms (r = .50, p<.001) and anxiety (r = .32, p < .001).

The results of hierarchical regression analyses for SES and home chaos in the school-age sample are reported in Table 3. Regarding SES, the interaction between CU traits and anxiety was significant (β = -.21, p = .007), although there was no significant main effect for

Table 3. Hierarchical regression analyses in the school-age sample.

School	SES				Home Chaos			
	β	R^2	ΔR^2	*Partial r*	*β*	R^2	ΔR^2	*Partial r*
Stage 1								
Gender	.17*			.17	-.05			-.05
ODP	-.08			-.07	.49**			.48
		.04	.04*			.25	.25**	
Stage 2								
Gender	.17*			.16	-.03			-.02
ODP	-.04			-.03	.33**			.25
CU	-.03			-.03	.18*			.15
Anxiety	-.04			-.04	.16*			.14
		.04	.00			.29	.04*	
Stage 3								
Gender	.18*			.18	-.02			-.02
ODP	-.04			-.03	.33**			.25
CU	-.05			-.04	.17*			.14
Anxiety	.00			.00	.16*			.15
CU x Anxiety	-.22**			-.21	-.04			-.04
		.09	.05**			.29	.00	

Note. Gender : 0 = boy, 1 = girl, CU = score of CU traits; ODP = Oppositional Defiant Problems symptoms; β = standardized beta; Partial r = partial correlation. ** = p<.01, * = p<.05.

CU traits nor for anxiety. When the interaction term was added in the model, there was a significant .05 change in R^2. The interaction was displayed using *interActive* (McCabe et al., 2018). Results of the significance test for simple slopes showed that the association between CU traits and SES was significantly different from zero at 2 SD above the mean (β = -.05, 95% CI = -0.09, -.01; see Fig. 1). Specifically, the slope of the effect of CU traits on SES was significant and negative when anxiety was 0.95 SD above the mean or further (see Fig. 2). At high levels of anxiety, a pattern emerged where lower SES corresponded to heightened levels of CU traits.

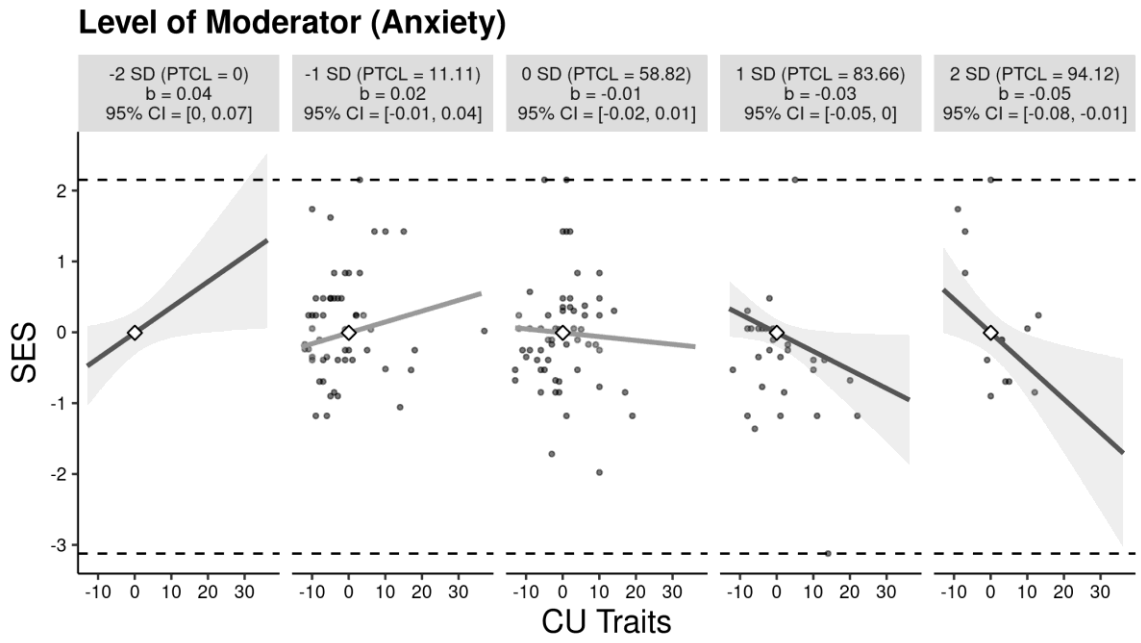
Regarding home chaos in the school-age sample, the interaction between CU traits and anxiety was not significant. However, there were significant main effects for CU traits (β = .17, p = .04), anxiety (β = .16, p = .03) and ODP symptoms (β = .33, p < .001). These results indicated that heightened levels of CU traits, ODP symptoms, and anxiety corresponded to increased levels of home chaos.[2]

Discussion

The present study has enriched the existing research landscape in the realm of childhood variants of CU traits, expanding the comprehension of environmental contextual factors linked with each variant. Precisely, the objective of this study was to explore the moderating impact of anxiety on the associations between CU traits and socioeconomic status (SES), as well as between CU traits and home chaos in preschool and school-age children. Notably, the combination of high CU traits with low or high levels of anxiety can be used as a proxy for the

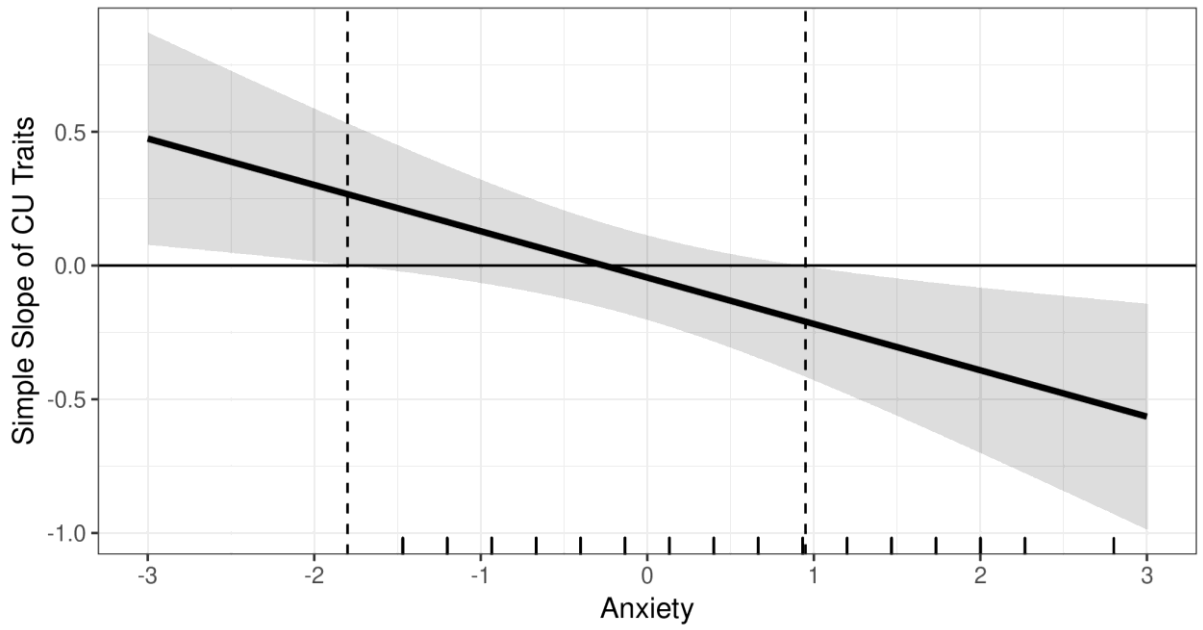
[2] To address potential biases resulting from non-normally distributed residuals, robust regression analyses were performed using bootstrapping to compute confidence intervals and p-values. This approach allowed for the avoidance of normality assumptions and the acquisition of precise estimates of the population value of coefficient b for each predictor. In the preschool sample, ODP symptoms were significantly associated with home chaos (b = .41 [.15, .60], p = .00). In the school-age sample, the findings revealed significant associations with SES for the child's gender (b = .30 [.07, .53], p = .02), as well as a significant interaction between CU traits and anxiety (b = -.01 [-.01, -.002], p = .01). These results closely align with non-robust regression analyses.

Fig. 1 Simple Slopes Between CU Traits and SES at Levels of the Moderator (Anxiety)



Note. Black slope lines indicate significance; SD Standard Deviation; PTCL Percentile, CI Confidence Interval.

Fig. 2 Marginal-effects Plot of the Association Between CU traits and SES.



Note. The plot shows the marginal effect of CU traits on SES (i.e., the simple slope of CU traits) across a range of the moderator variable (anxiety); the shaded area indicates the 95% confidence region for the marginal effect; the vertical dashed lines indicate the levels of moderator at which CU traits become significantly associated with SES; a marginal rug showing the frequency of different levels of anxiety is included.

primary and secondary variants (Craig et al., 2020).

Two primary findings emerged from this study. First, consistent with our hypothesis, a moderating effect of anxiety was identified in the association between CU traits and SES among school-age children. Specifically, CU traits were negatively associated with SES exclusively at high levels of anxiety. Conversely, at lower levels of anxiety, CU traits were not associated with SES. When extrapolating these results and framing them in the context of the two variants (located at the end of the continuum of CU traits), it can be inferred that solely the secondary variant is associated with a low SES, while the primary variant was not significantly associated with SES. These findings are consistent with those of Ezpeleta et al. (2017), who identified a greater proportion of families with low SES within the secondary variant compared to the primary variant in their preschool sample. Moreover, these findings align with existing evidence that highlights the presence of more unfavorable environmental characteristics associated with the secondary variant relative to the primary variant (Docherty et al., 2016; Ezpeleta et al., 2017; Meehan et al., 2017).

Secondly, the results of this study indicated that CU traits were significantly associated with home chaos in the school-age sample, irrespective of the anxiety levels. Thus, the higher the levels of CU traits, the higher the level of home chaos. This result aligns with previous studies on broad CU traits (Fontaine et al., 2011; Mills-Koonce et al., 2016). Nevertheless, we anticipated a stronger association between CU traits and home chaos when levels of anxiety were elevated, given that this variant is believed to be more influenced by environmental factors, as opposed to the primary variant which might be more greatly influenced by genetic factors.

On the contrary, the current results suggested an association between the two variants and home chaos. This result concurs with previous studies that have demonstrated associations between the two variants and parental harshness (Bégin et al., 2021; Humayun et al., 2014;

Meehan et al., 2017), which is also associated with home chaos (Dumas et al., 2005; Zvara et al., 2020). Furthermore, this unexpected result does not dismiss the possibility that high levels of home chaos could act as a risk factor of CU traits. Instead, it introduces an alternative hypothesis that had not been previously considered: high levels of home chaos might ensue as a consequence of high levels of CU traits. Consequently, the absence of a moderating effect of anxiety in the association between CU traits and home chaos could concealing a potential divergence in the direction of the associations between these two variables, contingent upon the variant.

To elaborate, in the case of the secondary variant, elevated home chaos might contribute to the development or reinforcement of features characteristic to this variant, alongside experiences of maltreatment or trauma. These features (such as emotional numbing and hyperarousal) could serve as adaptive mechanisms employed to cope with the high levels of disorganization and overstimulation within their chaotic environment (Fisher & Brown, 2018; Mills-Koonce et al., 2016) and/or with parental harshness or insensitivity that might partially stem from home chaos (Mills-Koonce et al., 2016; Zvara et al., 2020).

In the case of the primary variant, assumed to be predominantly influenced by genetic factors, the characteristics associated with this variant – such as affect hypoarousal, aggressive behaviors, fearless temperament, and insensitivity to punishment (see Frick et al., 2014a, Craig et al., 2020 for reviews) – would manifest early in the course of development. These characteristics might increase home chaos, either directly or indirectly by gradually impacting parenting practices and, consequently, parental organization and the home environment. Indeed, a prior study discovered that broad CU traits exert an influence on parenting practices over time (Hawes et al., 2011). Alternatively, another hypothesis posits that home chaos might interact with suboptimal parenting practices and genetic influences, thereby increasing or leading to the characteristics of the primary variant. Notably, Kahn et al. (2016) revealed that

broad CU traits in parents indirectly influenced broad CU traits in children through hostile parenting practices, albeit only within chaotic homes. Thus, transmission of CU traits from parents to children within the primary variant – even though the study of Kahn et al. (2016) did not distinguish between the two variants – could be facilitated inside family contexts that lack structure and predictability.

Nevertheless, reciprocal influences between the child's behavior, parenting practices and home chaos within the context of the two variants cannot be ruled out. CU traits and home chaos can mutually influence each other, either directly or indirectly through their impact on parenting practices (Dumas et al., 2005; Jaffee et al., 2012; Waller et al., 2014). Further research is required to elucidate the connection between variants of CU traits and home chaos, particularly given that the cross-sectional design of our study does not allow for the assumption of temporal relationships in these associations.

The primary findings of the current study, i.e., the association between CU traits and SES exclusively at high anxiety levels and the association between CU traits and home chaos irrespective of anxiety level, were found only in the school-age sample (encompassing children aged 6 to 9). In contrast, results were somewhat different in the preschool sample. Among this younger cohort, externalizing behaviors were significantly associated with SES, while CU traits were not. One possible explanation for this result may be a lower sensitivity of the questionnaire used in the present study to detect CU traits in preschool children. However, literature in this domain provides ample evidence of the validity of CU trait assessment in preschoolers and its usefulness in understanding other psychological issues in this age group (Longman et al., 2016). Previous studies have also demonstrated that CU traits can be observable via the Inventory of Callous-Unemotional Traits (Frick, 2004) as early as three years old (Bansal et al., 2020; Kimonis et al., 2016). Furthermore, Payot et al. (2022) observed the invariance of the structure of the ICU between the preschool and school-age period, along with similar average levels of

CU traits across these periods. Those results suggest the suitability of the ICU for capturing CU traits across ages. Thus, the discrepancy in results suggests the need to explore alternative explanations.

Another plausible explanation for this divergence lies in the differing developmental trajectories of the two variant of CU traits. For the secondary variant, associations with SES and home chaos might only manifest at school-age as it may require several years of maltreatment or exposure to an adverse environment for a child to develop the secondary variant as a coping mechanism (Craig et al., 2020; Porter, 1996). Regarding the primary variant and its associations with home chaos solely in the school-age sample, two explanations are considered. First, CU traits within the primary variant might potentially amplify home chaos over time, with this association becoming more pronounced during the school-age period. Alternatively, high levels of home chaos might gradually impact the child's development, progressively amplifying the characteristics of the primary variant.

Consequently, the current findings suggest that the school-age period may serve as a pivotal developmental stage in which the broader environment's influence on CU traits, irrespective of the variant, is particularly discernible. Preceding this period, it seems that externalizing behaviors might be a more pertinent variable to examine in association with environmental contexts. This observation aligns with existing meta-analyses, which suggest that the link between SES and externalizing behaviors weakens as children grow older (Letourneau et al., 2013; Piotrowska et al., 2015).

This study paves the way for future research perspectives. Longitudinal studies would be valuable to identify the processes underlying the associations between home chaos and the variants throughout childhood and adolescence, and to determine whether home chaos is a risk factor, an outcome, or both, for the two variants. Including a measure of parenting in these upcoming studies could also improve the understanding of the associations between CU traits

(with low or high levels of anxiety) and home chaos. Indeed, current literature suggests that both variants might be associated with parental practices, especially parental harshness (Bégin et al., 2021; Humayun et al., 2014; Meehan et al., 2017), which is also associated with home chaos (Dumas et al., 2005; Mills-Koonce et al., 2016; Zvara et al., 2020). In addition, studies on broad CU traits have shown that parenting might be a mediator (Mills-Koonce et al., 2016) or a moderator (Kahn et al., 2016) in the associations between home chaos and CU traits. Finally, including a measure of maltreatment would further enable future research to better understand the association between, on the one hand, SES and home chaos, and on the other hand, the two variants of CU traits. Indeed, a low SES constitutes a risk factor for child neglect (Schumacher et al., 2001) and maltreatment (Berger, 2004), these two latter variables being associated with the secondary variant. Therefore, a low SES might constitute a particular risk for the development of the secondary variant in comparison to the primary variant, which is thought to be predominantly under the influence of genetics. In the same way, one could think that chaotic environments characterized by high levels of home chaos might enhance the risks associated with negative environments including maltreatment (Kahn et al., 2016) and, therefore, increase the risk of developing the secondary variant.

Strengths and Limitations

The current study is characterized by some strengths. First, it was conducted within a mixed-gender community sample, encompassing children aged 4 to 9. This serves to supplement the existing literature, as a substantial portion of prior studies has predominantly focused on male adolescents engaged with the justice system (Craig et al., 2020). Secondly, the methodological approach employed in this study, which involves moderation analyses, allowed for the examination of the entire continuum of CU traits. Thirdly, the analyses incorporated externalizing behaviors as a control variable, recognizing the associations between this variable and both CU traits and environmental factors.

Nonetheless, the current results need to be interpreted in light of several limitations. First, the cross-sectional design of this study precludes any causal interpretations about the direction of the associations between home chaos and SES and the two variants. Although we made hypotheses about the temporality, our results did not imply that one precedes or causes the other. Secondly, all the measurements in this study were questionnaires answered by parents, potentially leading to an increase in shared variance due to common reporter bias. To further enhance the validity and comprehensiveness of future research, adopting a multi-method and multi-informant perspective would be valuable. For instance, supplementing the parental reports with observational measures of home chaos could provide a more comprehensive understanding of the environmental context. Thirdly, the levels of CU traits, particularly within the preschool sample, may not have represented the continuum, with relatively lower scores prevailing. Replication in samples encompassing a wider range of CU trait levels could further increase our understanding of the two variants, for example with the inclusion of children with clinical levels of externalizing behaviors in addition to children drawn from the general population. Lastly, our dataset primarily stemmed from maternal responses. Future investigations should encompass data collection from both mothers and fathers, in order to ascertain that the parent's gender does not exert any influence on their assessment of their child.

Conclusion

Considering these limitations, the current study has added understanding regarding the environmental context associated with the two variants of CU traits for two different age periods – namely the preschool and school periods – in a mixed-gender community sample. Our findings showed that, while solely externalizing behaviors such as aggression and opposition were associated with a lower SES and higher levels of home chaos among preschoolers, results were markedly different in the school-age sample. In this age period, CU traits, externalizing behaviors and anxiety were associated with home chaos. Regarding the SES, a significant

interaction between CU traits and anxiety was observed: CU traits were associated with a low SES solely in the presence of high levels of anxiety.

By extending these results from school-age children to the context of the two variants, they suggest that the primary variant (CU traits at the end of the continuum and low levels of anxiety) might be associated with high levels of home chaos while the secondary variant (CU traits at the end of the continuum and high levels of anxiety) might be associated with a low SES in addition to high levels of home chaos. These outcomes substantiate theoretical propositions and prior research indicating that the secondary variant is characterised by more adverse environmental conditions compared to the primary variant (Ezpeleta et al., 2017). However, it is important to note that this latter variant is also associated with negative environmental contexts, as shown by the current results and by previous studies (Humayun et al., 2014; Meehan et al., 2017).

Unveiling the environmental characteristics associated with each variant is important for tailored interventions that account for the specificities of each variant. Specifically, gaining insights into the developmental trajectories of the variants appears imperative for early intervention targeting environmental risk factors. The current findings suggest that while strategies like assisting parents in establishing routines, maintaining predictable and serene home environments can benefit children from both variants, interventions grounded in trauma treatment or abuse prevention may hold particular promise for the secondary variant, particularly within low-income families.

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