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ORIGINAL ARTICLE

Primary and Secondary Variants of Callous–Unemotional Traits in Early and Middle Childhood: Distinction, Evaluation and Empathic Differences

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Abstract
Current literature demonstrates the relevance of considering two variants of CU traits based on high or low levels of anxiety. However, there is limited information about these variants in young community samples. The current study used cluster analyses to investigate the primary and the secondary variants of CU traits in two samples of children: preschool ($N=107$; $M_{age}=4.95$, $SD=0.62$) and school-age ($N=153$; $M_{age}=7.49$, $SD=1.11$). The identified clusters were compared on empathic dimensions, aggressive behavior and criteria from the "with limited prosocial emotions" specifier from the DSM-V. The primary variant was identified as early as preschool age while the secondary variant was only identified in the school-age sample. In this latter sample, the two variants did not differ on assessed variables, except for aggressive behavior. Despite the similarities between the two variants, these results suggest distinct developmental trajectories.

Keywords Callous–unemotional · Variants · Cluster analysis · ICU subscales · Empathy

Introduction

Callous–Unemotional (CU) *traits*—corresponding to the affective features of adult psychopathy—enable the identification of a specific subgroup among children with conduct problems. This subgroup is particularly at risk of developing adult psychopathy [1]. As a consequence, CU traits have been included in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders [2] as a specifier of Conduct Disorder. This specifier, named "with Limited Prosocial Emotions" (LPE), encompasses four criteria: lack of remorse or guilt; callous/lack of empathy; unconcern about performance; shallow or deficient affects.

While contemporary research has considered CU traits as a homogeneous construct, a growing body of literature shows that CU traits may result from two distinct etiological pathways (e.g., Ezpeleta et al. [3]; Kimonis et al. [4]). This conception is directly derived from the adult literature, in which Karpman [5] and Porter [6] distinguished two variants of psychopathy. These authors postulated that a primary variant would result from an innate or temperamental deficit in emotional processing, while the secondary variant would be an adaptive mechanism to cope with an adverse environment characterized by maltreatment or chronic traumatic experiences.

Current studies on CU traits in youth support this theory [7–10], the two variants being predominantly distinguished based on low (primary variant) or high (secondary variant) levels of anxiety (for a systematic review, see Craig et al. [7]). Indeed, high levels of CU traits and anxiety are consistently associated with abuse, maltreatment or trauma [7, 11–13].

At a methodological level, person-centered clustering analyses have been invaluable in this field. They demonstrate that youth naturally cluster into two variants of CU traits, based on their levels of CU traits and anxiety [8, 12, 14]. However, only a limited number of studies have used this methodology in preschool and school-age samples [15, 16].

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Using this methodology in such samples is relevant to investigate early differences between the two variants and examine if they are already detectable and distinguishable at such a young age. 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 [6, 7]. In contrast, the characteristics of the primary variant may develop at an early age due to significant genetic influences that contribute to its manifestation [17].

Among the studies carried out on childhood samples, results have suggested that the two variants could already be detected from 3 years-old [15]. Similarly to older samples, young children within the primary variant are characterized by hypoarousal of affect including lower physiological activity, by lower engagement towards distressing stimuli and by emotional dysregulation. In contrast, children within the secondary variant are characterized by hyperarousal of affect including biological markers of dysregulation, by affect dysregulation, and by hypersensitivity to distress stimuli [3, 9, 18]. At a behavioural level, results from the current literature are mixed. Some studies have found higher levels of externalizing behaviors, including aggression [15, 16], in children within the secondary variant in comparison to those within the primary variant. In contrast, longitudinal studies have found no difference between the two variants at baseline, at 3 [3], 4 [17] or 8 years old [19]. However, these studies indicated higher levels for the secondary variant in later stages of development, specifically at 7 years old [3, 17] and during adolescence [19]. These conflicting results suggest the need for further studies to clarify the behavioural differences between the two variants in childhood.

Although a majority of studies support the existence of two variants of CU traits in childhood, the LPE specifier from the DSM-V does not consider this distinction. This lack of consideration might complicate the understanding of the phenomenon and the development of efficient interventions. In addition, some criteria might not correspond to the two variants. For example, the secondary variant, characterized by hyperarousal, might not present "shallow or deficient affects", contrary to the primary variant. Indeed, the results of Kimonis et al. [20] in incarcerated boys showed higher scores on the items representing the "shallow or deficient affects" criteria in the LPE specifier for the primary, in comparison to the secondary variant. Clarifying the associations between the variants and the criteria is a major issue. If the criteria do not capture the similarities of the two variants, they might need refinement.

Among the criteria of the LPE specifier, a lack of empathy is thought to be a central concept in the understanding of CU traits [21], but has been poorly studied in relation to the variants. Empathy is a complex construct that encompasses two distinct but related components. First, affective empathy refers to a resonant emotional experience that is congruent in valence with another's emotional state [22]. Affective empathy begins to develop during infancy [23]. Second, cognitive empathy refers to the ability to accurately recognize and identify another's emotions (i.e., emotion recognition), and to understand another's perspective (i.e., perspective-taking) [24]. The cognitive component of empathy starts to develop after the affective component, typically during the preschool period, and can be measured by the age of 4 [23].

Among literature about broad CU traits[1], studies have consistently found a negative association between CU traits and affective empathy in various samples of children and adolescents, with different types of measures such as self-report questionnaires [25, 26], other-report questionnaires [27, 28] or through laboratory tasks [29]. Regarding cognitive empathy, results are mixed in the current literature. While some studies have found an absence of association between broad CU traits and cognitive empathy [29–31], others have found a significant negative association [27, 32, 33]. The distinction between the two variants of CU traits could shed light on these mixed results. Indeed, the results of studies on broad CU traits can be influenced by the proportion of youth with primary and secondary variants within the sample. On the one hand, youth with the secondary variant may exhibit deficits in cognitive empathy as the result of maltreatment and abuse. Indeed, a meta-analysis [34] found that maltreated children had lower levels of emotion understanding and perspective-taking skills compared to non-maltreated children. On the other hand, the primary variant may not be characterized by deficits in cognitive empathy. This hypothesis would be consistent with theories and studies showing that adults or youths with primary psychopathy possess the ability to perceive vulnerability in others and use these abilities to fulfill their own needs [6] (Salekin et al. 2010; Skeem et al. 2003). However, only one study has investigated associations between the two variants of CU traits and empathy. In their sample of detained male adolescents, Kahn et al. [35] found deficits in cognitive empathy solely for the secondary variant, while no deficits were observed for the primary variant. Interestingly, this study also revealed a negative association between both variants and affective empathy, which could explain the consistent associations found between this latter component and broad CU traits. More research is needed to replicate these results in more diverse samples, especially in childhood, in order to gain a better understanding of the central processes of these phenomena.

In conclusion, the current literature supports the existence of two variants of CU traits. Given their distinct etiologies

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

and characteristics, accounting for this distinction is crucial for a comprehensive understanding of these phenomena and the development of targeted interventions. However, this distinction has only recently been investigated in studies and limited data are available for preschool and school-age samples. The majority of existing studies have focused on samples of boys involved in the justice system (for a systematic review, see Craig et al. [7], which restricts the generalizability of the findings to other populations. Consequently, there is an urgent need for additional research to provide further evidence that the two variants of CU traits can be identified and distinguished in childhood, and to explore differences between these variants in relation to the LPE specifier criteria, empathy components and externalizing behaviors.

Present Study

In this context, the present study aimed to contribute to the current understanding of the two variants of CU traits in a community sample of children aged 4 to 9. The first objective was to investigate whether the primary and the secondary variants of CU traits could be identified based on levels of both CU traits and anxiety in two mixed-gender samples: (1) preschool children and (2) school-age children from the general population. By exploring these variants in two distinct age groups, the present study sought to determine if the two variants are already detectable and distinguishable during the preschool and school-age periods and to shed light on potential early differences between these two variants. According to previous studies, we expected four clusters to emerge in each sample: one cluster low on CU traits and low anxiety (control group), one cluster with low or moderate levels of CU traits and with high levels of anxiety (anxious group), one cluster with high CU traits and low anxiety (primary variant) and finally, one cluster with high CU traits and high levels of anxiety (secondary variant).

The second objective of this study was to examine whether the identified clusters differed on LPE specifier criteria, investigating the relevance of these criteria in the diagnosis of the two variants. Based on previous findings [20], it was expected that children within the primary variant would obtain higher scores on items representing shallow or deficient affects compared to those within the secondary variant. The third objective involved investigating levels of affective and cognitive empathy within the two variants. It was hypothesized that the two variants would display similar levels of affective empathy, but the secondary variant would exhibit lower scores on cognitive empathy compared to the primary variant [35]. Lastly, the fourth objective was to examine levels of externalizing behavior within the two variants, given the conflicting results in the current literature.

Method

Procedure

Data was collected from a sample of 260 children aged 4 to 9 residing in the French-speaking region of Belgium. Parents were recruited through social media platforms and schools. One parent per child was asked to answer an online questionnaire. The survey collected demographic information and encompassed assessments of CU traits, externalizing/internalizing behaviors and empathy. Children diagnosed with autism, developmental delay or intellectual disability were excluded from the study. The study was approved by the Ethical Committee of Psychology at the University of Liege, and informed consent was obtained from all participants.

Participants

The 260 participants were aged 4 to 9, including 107 preschoolers aged 3 to 5 (M_{age} = 4.95, $SD = 0.62$) 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. 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. The preschool and the school-age subsamples did not differ based on gender of the child ($\chi^2(1) = 0.12$, $p = 0.91$), gender of the informant ($\chi^2(1) = 2.38$, $p = 0.12$), parent education ($\chi^2(5) = 8.28$, $p = 0.14$) and socioeconomic status of the family (F_w (1, 233) = 0.95, $p = 0.33$).

Measures

CU Traits

The Inventory of Callous–Unemotional traits [36] was used to assess CU traits. In this study, the parent-report preschool and school-age French versions were used. A previous study [37] in a Belgian community sample 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 and Lack of emotional expression representing the shallow or deficient affects criteria), a second order latent factor (General dimension of CU traits) and a methodological factor encompassing negatively worded items. This structure demonstrated good fit indices ($\chi^2 = 227.430$, $df = 125$, $p = 0.00$; $\chi^2/df = 1.82$; CFI = 0.95; TLI = 0.94; RMSEA = 0.043; SRMR = 0.044). External validity was supported through expected correlations

with measures of aggressive behavior, attention problems, internalizing behaviors and empathy. Finally, this factorial structure showed measurement invariance across age and gender. Therefore, this structure was used for this present study. The internal consistency, assessed by Cronbach α, was between good and acceptable for the total score, the Lack of Conscience and the Unconcern about performance subscales ($\alpha = 0.74$–0.87), but lower than optimal for the Lack of emotional expression subscale (preschool sample: $\alpha = 0.55$; school-age sample: $\alpha = 0.67$), probably due to the limited number of items included in this subscale (3 items).

Anxiety Symptoms and Externalizing Behaviors

The preschool and the school-age versions of the Child Behavior Checklist [38, 39] were answered by the parents. For the current study, the anxiety-problems DSM5-oriented and the aggressive behavior scales were used for the analyses. 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 of 0.70 and 0.91 for the preschool sample, and 0.79 and 0.88 for the school-age sample for the anxiety and the aggressive behavior scales, respectively.

Empathy

The Griffith Empathy Measure [27] was used to assess empathy. The GEM is an established measure of affective and cognitive empathy. Items from the affective scale primarily appear to measure emotional contagion, the tendency to feel the same emotions that another is feeling. This questionnaire showed good reliability and validity [27]. Internal consistency for the affective scale was 0.70 and 0.82 (9 items) and 0.50 and 0.54 for the cognitive scale (6 items) for the preschool and the school-age samples, respectively. This low internal consistency for the cognitive scale is a limitation that has already been found in previous studies [27, 40].

Statistical Analyses

All analyses were performed using SPSS, version 28.0. First, the preschool and school-age samples were compared regarding the variables used in this study, i.e. levels of total CU traits and scores at the subscales of the ICU, the subscales of the GEM, and the anxiety and aggressive behavior subscales of the CBCL. Regarding these two latter subscales, the raw scores of the two samples could not be compared due to the different number of items between the preschool and the school-age versions. However, we compared the proportions of children exhibiting clinical or non-clinical levels of anxiety and aggressive behaviors using the cut-off scores provided by the CBCL [38, 39]. The Chi-Square Test of Independence was used for categorical variables and Welch's ANOVA was conducted for continuous variables.

Subsequently, the TwoStep cluster analysis (CA) procedure was used to identify clusters. This two-step method is an auto-cluster procedure that combines both Bayesian information criterion (BIC) and ratio of distance between clusters in order to determine the optimal number of clusters. Analyses were conducted separately in the preschool and the school-age samples. The total ICU score and the anxiety-problems DSM5-oriented scale of the CBCL were used as continuous clustering variables. Chi-square analyses were used to test gender distribution across clusters. Thereafter, Welch's ANOVAs were conducted to compare resulting clusters regarding ICU, empathy, externalizing and internalizing subscales. Finally, Games-Howell post hoc tests were used.

Results

Preliminary Analyses

The preschool and the school-age subsamples did not differ based on the total score of CU traits (F_w (1, 249) = 1.99, $p = 0.16$) and the Lack of conscience factor of ICU (F_w (1, 244) = 0.08, $p = 0.77$), in contrast to the Unconcern about performance (F_w (1, 228) = 0.3.95, $p = 0.048$) and Lack of emotional expression (F_w (1, 257) = 14.1, $p < 0.001$) factors. Children from the school-age sample had higher scores on these two latter factors than preschool children. The two groups did not differ based on empathy subscales of the GEM. The two samples significantly differed regarding the proportion of children with clinical levels of anxiety ($\chi^2(1) = 12.65$, $p < 0.001$) and aggressive behaviour ($\chi^2(1) = 6.53$, $p = 0.01$), with more school-age than preschool children having clinical levels on these two subscales.

Results for the Preschool Sample

In the preschool sample the two-step cluster procedure indicated a three-cluster solution (Cluster 1, $N = 64$, 59.8% of the total sample; Cluster 2, $N = 24$, 22.42%; Cluster 3, $N = 19$, 17.75%). The algorithm judged the three-cluster solution to be the best fit for our data, with a BIC change of − 12.07 between the two and the three-cluster solutions, and a ratio of distance measure of 2.65. The three-cluster solution represented a better fit than the four-cluster solution, with a BIC change of 7.06 between the three and four-cluster solution, and a ratio of distance measure of 1.10.

Table 1 Mean and standard deviations for study variables and test of cluster differences in the preschool sample

Variable	Total sample	Control	Primary	Anxious/ secondary	Welch's test
ICU					
Total score	11.62 (7)	7.59 (3.8)$_a$	20.29 (3.2)$_c$	14.21 (7.8)$_b$	$F(2, 37) = 119.2$***
Lack of conscience	6.89 (4.7)	4.42 (2.9)$_a$	11.92 (3.2)$_b$	8.84 (5.2)$_b$	$F(2, 35) = 51.6$***
Unconcern about performance	3.21 (2.8)	1.98 (1.9)$_a$	6.21 (2.2)$_b$	3.58 (3.4)$_a$	$F(2, 34) = 34.3$***
Lack of emotional expression	1.51 (1.5)	1.19 (1.3)$_a$	2.17 (1.6)$_b$	1.79 (1.5)$_{a,b}$	$F(2, 37) = 3.9$**
GEM					
Affective empathy	11.38 (8.2)	12.31 (8.7)$_a$	6.50 (10)$_b$	14.42 (8.8)$_a$	$F(2, 39) = 4.2$**
Cognitive empathy	8.17 (7)	9.30 (7.1)$_a$	5.29 (7.1)$_b$	8.00 (5.7)$_{a,b}$	$F(2, 43) = 2.7$*
CBCL					
Anxiety problems	4.66 (3.2)	3.38 (1.9)$_a$	3.63 (1.6)$_a$	10.32 (2.1)$_b$	$F(2, 40) = 84.9$***
Aggressive behavior	10.84 (7.2)	8.19 (5.4)$_a$	13.25 (8.3)$_b$	16.74 (6.7)$_b$	$F(2, 35) = 14.8$***

Control = control group, Primary = primary variant, Anxious/secondary = anxious/secondary variant group

ICU Inventory of Callous–Unemotional Traits, *CBCL* Child Behavior Checklist, *GEM* Griffith Empathy Measure

***$p < 0.01$, **$p < 0.05$, *$p < 0.10$

Means with different subscripts within the same row differ significantly in post-hoc tests

Description of Clusters

There was no significant difference between clusters regarding the gender of the child (χ^2 (2) = 2.04, $p = 0.36$). Table 1 displays the mean scores for clustering and other study variables for each cluster, and lists results of mean difference tests and post-hoc group comparisons. Clusters differed significantly on the ICU total score ($\eta^2 = 0.58$) and on anxiety level ($\eta^2 = 0.42$). Post-hoc comparisons revealed significant differences for all between-cluster comparisons on the ICU total score and anxiety-problems scale, except between Cluster 1 and Cluster 2 for the anxiety-problems scale. The first and largest cluster had significantly lower levels on the ICU total score than the two other clusters. Moreover, its level of anxiety did not differ from the second cluster but was lower than the third cluster, and the mean level of anxiety of this cluster was far below the clinical cut-off score from the CBCL [38]. Therefore, Cluster 1 was labelled "control group". The second cluster was named "primary variant" because it showed significantly higher ICU levels than the control group and the third cluster, and scored lower on the anxiety dimension than the third cluster but did not differ from the control group. Finally, the third cluster presented higher levels of anxiety than the primary variant and the control group, and had higher scores of CU traits than the control group, although lower than the primary variant. The levels of CU traits of this cluster varied between 3 and 29. It was therefore named "anxious/secondary variant" as it included some children presenting only high levels of anxiety, and others showing high levels of anxiety and high levels of CU traits.

Comparing Identified Variants

Figure 1 displays the z-scores of each cluster regarding clustering and external variables in the preschool sample. Concerning the ICU, clusters differed significantly for the three subfactors, namely Lack of conscience ($\eta^2 = 0.46$), Unconcern about performance ($\eta^2 = 0.37$) and Lack of emotional expression ($\eta^2 = 0.08$). In comparison to the control group, the primary variant had higher scores on the three subfactors, while the anxious/secondary group only presented higher scores on the Lack of conscience factor. In comparison to the anxious/secondary group, the primary variant had higher scores on the Unconcern about performance and at a trend for significance on the Lack of Conscience ($p = 0.08$) factors. However, these two groups did not differ for the Lack of emotional expression factor.

Regarding the GEM subscales, clusters significantly differed for the affective scale ($\eta^2 = 0.08$) but differed only at a trend for significance for the cognitive scale ($p = 0.08$, $\eta^2 = 0.05$). In comparison to the control group, the primary variant scored significantly higher on the affective scale and at a trend for significance for the cognitive scale (at $p = 0.06$). The anxious/secondary group did not differ from the control group for these two scales, scored lower than the primary variant on the affective scale but had similar scores on the cognitive scale.

Clusters differed on the aggressive behavior scale ($\eta^2 = 0.23$). The primary variant and the anxious/secondary group had higher scores than the control group. However, they did not differ in comparison with each other.

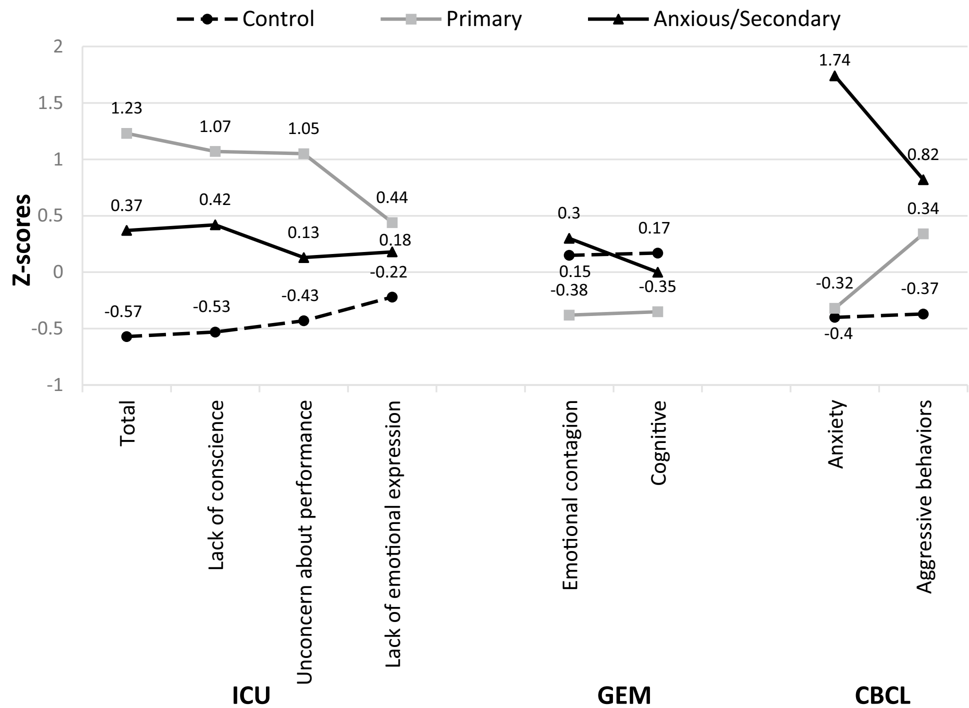

Fig. 1 Mean Z-scores on clustering and external variables for identified variants in the preschool sample. *ICU* Inventory of Callous–Unemotional Traits, *GEM* Griffith Empathy Measure, *CBCL* Child Behavior Checklist

Table 2 Mean and standard deviations for study variables and test of cluster differences in the school-age sample

Variables	Total sample	Control	Anxious	Primary	Secondary	Welch's test
ICU						
Total score	12.97 (8.34)	7.21 (4.18)$_a$	11.10 (4.10)$_b$	23.54 (7.00)$_c$	23.00 (6.22)$_c$	$F(3, 46)=63.68$***
Lack of conscience	6.71 (5.31)	3.69 (3.03)$_a$	5.14 (3.29)$_a$	12.50 (4.90)$_b$	13.33 (4.55)$_b$	$F(3, 46)=40.23$***
Unconcern about performance	3.93 (2.85)	2.23 (1.77)$_a$	3.77 (2.31)$_b$	6.96 (2.49)$_c$	5.80 (3.12)$_{b,c}$	$F(3, 46)=30.76$***
Lack of emotional expression	2.33 (2.02)	1.23 (1.18)$_a$	2.19 (1.86)$_b$	4.07 (2.05)$_c$	3.87 (2.26)$_{b,c}$	$F(3, 45)=19.50$***
GEM						
Affective empathy	10.03 (11.47)	9.21 (11.05)	13.02 (9.45)	7.96 (14.16)	7.67 (12.72)	$F(3, 48)=1.91$
Cognitive empathy	7.82 (8.07)	11.43 (6.44)$_a$	8.15 (7.95)$_{a,b}$	4.07 (6.29)$_{b,c}$	−1.13 (8.16)$_c$	$F(3, 49)=15.36$***
CBCL						
Anxiety problems	5.50 (3.75)	2.76 (1.60)$_a$	8.06 (2.34)$_b$	3.64 (1.83)$_a$	12.13 (2.60)$_c$	$F(3, 47)=104.4$***
Aggressive behavior	8.88 (6.46)	4.56 (2.98)$_a$	10.10 (4.88)$_b$	11.46 (7.60)$_b$	17.67 (6.27)$_c$	$F(3, 44)=36.53$***

Control = control group, Primary = primary variant, Anxious/secondary = anxious/secondary group

ICU Inventory of Callous-Unemotional Traits, *CBCL* Child Behavior Checklist, *GEM* Griffith Empathy Measure

***$p < 0.01$

Means with different subscripts within the same row differ significantly in post-hoc tests

Results for the School-Age Sample

For the school-age sample, the two-step cluster procedure indicated a four-cluster solution (Cluster 1, $N=62$, 40.5% of the total sample; Cluster 2, $N=48$, 31.4%; Cluster 3, $N=28$, 18.3%; Cluster 4, $N=15$, 9.8%) as the best fit. The BIC change between the three- and the four-cluster solution was −5.56, combined with a ratio of distance measure of 1.76. The algorithm judged this four-cluster solution to be superior to a five-cluster solution, which had a BIC change of 5.53 and a ratio of distance measure of 1.66.

Description of Clusters

There was no significant difference between clusters in terms of gender (χ^2 (3) = 4.44, $p=0.22$) of the child. Table 2 displays the mean scores for clustering and study variables for each cluster, and lists results of post-hoc

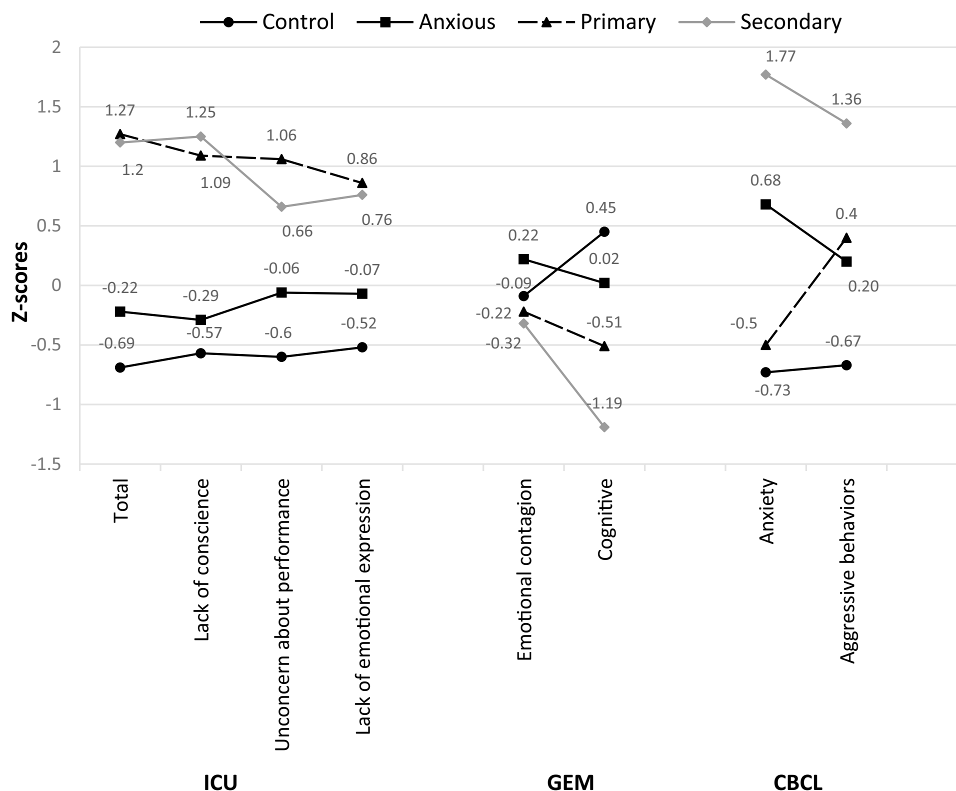

Fig. 2 Mean Z-scores on clustering and external variables for identified variants in the school-age sample. *ICU* Inventory of Callous–Unemotional Traits, *GEM* Griffith Empathy Measure, *CBCL* Child Behavior Checklist

group comparisons. Clusters differed significantly on the ICU total score ($\eta^2 = 0.65$) and on anxiety ($\eta^2 = 0.72$). Post-hoc comparisons determined which clusters differed from each other. The first and largest cluster was labelled "control group", because it displayed the significantly lowest level of CU traits compared to the other clusters, and had lower scores on the anxiety-problems scale than all the other clusters with the exception of the third cluster, the mean score being far below the clinical cut-off scores from the CBCL [39]. The second cluster showed higher levels of anxiety than the control group and the third group but lower than the fourth group, the mean score of the cluster being above the clinical cut-off score from the CBCL. Regarding the total score of the ICU, this second cluster was higher than the control group but lower than the third and the fourth cluster, and was therefore named the "anxious group". The third cluster was labelled "primary variant" and had significantly higher levels of CU traits than the control and the anxious groups but did not differ from the fourth group. Moreover, it scored lower on the anxiety dimension than the fourth group and the anxious group, but did not differ from the control group. Finally, the fourth cluster was labelled "secondary variant" due to higher levels of CU traits than the anxious group and the control group, and the highest level of anxiety, which was above the cut-off scores of the CBCL.

Comparing Identified Variants

Figure 2 shows the z-scores on clustering and external variables for identified clusters in the school sample. Regarding the ICU scores, the school-age clusters differed for each scale, namely Lack of conscience ($\eta^2 = 0.53$), Unconcern about performance ($\eta^2 = 0.40$) and Lack of emotional expression ($\eta^2 = 0.30$). Post-hoc comparisons revealed that the two variants had higher scores than the control group but did not differ from each other for the three ICU scales. In comparison to the anxious group, the secondary variant scored significantly higher on the Lack of conscience scale, and at a trend for significance ($p = 0.07$ for both) for the Unconcern about performance and the Lack of emotional expression scales.

Regarding the GEM subscales, clusters did not differ on the affective scale ($p = 0.17$, $\eta^2 = 0.03$). However, they significantly differed on the cognitive scale ($\eta^2 = 0.24$). The two variants scored significantly lower on this scale than the control group, but did not differ from each other.

Clusters differed on the aggressive behavior scale from the CBCL ($\eta^2 = 0.41$). The two variants had higher scores than the control group. The secondary variant had significantly higher scores on the aggressive behavior scale than the primary variant and the anxious group.

Discussion

The aim of the present study was to improve the understanding of the primary and the secondary variants of CU traits in preschool and school-age children from a community sample.

Distinguishing the Two Variants in Childhood

The first objective of this study was to investigate whether the two variants of CU traits could be distinguished in a community sample of children, either during the preschool or the school period. Using cluster analyses based on levels of CU traits and anxiety, our results demonstrated that the two variants, along with an anxious and a control group, could be distinguished during the school period. These findings are consistent with previous studies conducted on community samples [3, 16]. However, only three groups were identified in the preschool sample of the current study: a control group, a primary variant group, and a third group labeled as "anxious/secondary variant" due to its high levels of anxiety and varying levels of CU traits. These results showed that, in the preschool sample, children within the secondary variant were indistinguishable from anxious children. Several hypotheses could explain this result. First, making the distinction between these two groups of children might be difficult at preschool age based on parent ratings, given their shared characteristics such as hyperarousal and aggressive behaviour [41, 42]. Additionally, processes such as cognitive empathy and the development of prosocial behaviors are rapidly evolving during this period, which may complicate the identification of distinct atypical patterns. The developmental trajectories of these two groups could diverge later on in development. Indeed, it may take several years of exposure to an adverse environment for a child to progressively develop characteristics of secondary CU traits as an adaptive mechanism [7, 17]. Additionally, the exposure to an adverse environment could occur later in the development of certain children. As a result, it is possible that the development of the secondary variant predominantly occurs later in the developmental process. Consequently, the number of children who already exhibit characteristics of secondary CU traits at the preschool age may be too insignificant for them to be clustered into a distinct group within this study.

Nevertheless, these hypotheses should be approached with caution as our study design is cross-sectional, limiting our ability to test them. In contrast to our findings, Fanti and Kimonis [15] demonstrated in their community sample of 3 year-olds that a secondary group and an anxiety group were already distinguishable. Moreover, two studies have emphasized the stability of the variants in childhood [3, 9]. However, several differences exist between these studies and ours, including the inclusion or exclusion of externalizing behaviors as clustering variables, sample sizes, the assessment of CU traits (APSD, items of CBCL or ICU), and the statistical analyses employed. Additionally, various factors might influence the likelihood and timing of the development of the secondary variant, such as the onset, the frequency and the severity of the exposure to deleterious environments, the perpetrator and/or the type of events (maltreatment, trauma, parental neglect). However, these variables remain poorly studied. Regarding maltreatment type, Kimonis et al. [20] found in incarcerated male adolescents that the secondary variant was characterized by higher rates of sexual but not emotional or physical abuse, while the primary variant was associated with higher rates of emotional and physical neglect. Cecil et al. [14] observed in their sample of youths that the secondary variant was associated with higher levels of emotional, physical and sexual abuse, as well as physical neglect, and with a trend towards significance for emotional neglect, compared to the primary variant. Thus, determining when, how, and why children develop secondary CU traits and investigating the differences between anxious children and those within the secondary variant are crucial in order to clarify the developmental trajectories and characteristics of these phenomena.

Differences Between Variants in the School-Age Sample

The results of the current study are discussed primarily for the school-age sample due to the absence of a secondary variant group distinctly separate from an anxious group in preschoolers.

The second objective of the current study was to compare and contrast the two variants in relation to the DSM-V LPE specifier criteria. A previous study [37] validated a theoretical factorial structure of the ICU with three subscales based on the LPE criteria: Lack of conscience, which includes criteria related to lack of guilt and lack of empathy; Unconcern about performance; Lack of emotional expression. In the school-age sample, there were no significant differences between the two variants on the ICU subscales. Both variants exhibited higher scores on the three subscales compared to the control group. These results suggest that distinguishing between the two variants based on the LPE specifier criteria or the ICU may not be feasible during this age period. However, it appears that these criteria capture the shared characteristics of both variants, namely a lack of guilt and empathy, a lack of concern about performance, and a lack of emotional expression. These results contradict the

findings of [20] who observed higher scores on the Unemotional dimension of the ICU (similar to the Lack of emotional expression factor) for the primary variant compared to the secondary variant in incarcerated male adolescents. The distinction between the two variants based on this factor may be less obvious in younger samples, similar to the findings of Ezpeleta et al. [3], considering the ongoing development of emotional responsiveness, expression and regulation in childhood [43, 44]. Differences in this factor between the variants might emerge at a later age, as affect dysregulation becomes more pronounced in the secondary variant [45]. Alternatively, these differences may only manifest in clinical or justice-involved samples [20]. Future studies should investigate whether the DSM-V criteria adequately capture the characteristics of both variants in other samples.

The third objective of our study aimed to specifically investigate the components of empathy in children within the two variants, since it had not previously been carried out on this age period. Surprisingly, no significant differences were observed in affective empathy, specifically emotional contagion, between the two variants in the school-age sample. This result was unexpected considering the numerous studies that have reported deficits in affective empathy among children with broad CU traits (for a systematic review, see Waller et al. [46]. Additionally, it contrasts with the findings of Kahn et al. [35] who observed deficits in affective empathy for both variants in a sample of detained adolescents.

Several hypotheses could be proposed to explain these results. First, items of the GEM [27] might be misunderstood by parents, leading them to assess emotional distress or low emotional regulation instead of emotional contagion. Indeed, some items in this questionnaire (e.g., "my child becomes sad when other children are sad") may overlap with indicators of low emotional regulation in preschool children. At this age, children not only feel the distress of others but may also display this distress (e.g., when a baby/a child cries because another baby/child is crying) due to limited regulation skills. As children grow older, they continue to experience the emotions of others, but with improving emotional regulation skills [47], these emotions may become less visible and therefore less easily assessed by parents. This hypothesis may explain why the current study found differences in emotional contagion between groups in the preschool sample but not in the school-age sample, and why the primary variant had lower scores of emotional contagion compared to the other groups in the preschool sample. Indeed, current literature suggests that the primary variant is characterized by lower levels of affect dysregulation [45]. Secondly, Dadds and colleagues [48, 49] found a non-linear relationship between the affective scale of the GEM and psychopathy in males. Specifically, clear deficits on this scale were observed only at the highest levels of psychopathy and, presumably, CU traits. Since the current study was conducted on a community sample, the levels of CU traits might be not sufficiently high to make such deficits of affective empathy visible. Future studies could employ alternative measures in different samples to further clarify the link between affective empathy and the two variants.

Regarding cognitive empathy, both variants in the present study had lower scores than the control group in the school period, but did not differ from each other. With reference to the secondary variant, these results align with previous research by Kahn et al. [35] and studies demonstrating lower levels of cognitive empathy in children exposed to abuse and maltreatment [34]. These children might develop hypervigilance towards threatening stimuli as a means to predict potential threats from the environment (Heleniak et al. 2016; Pollak and Tolley-Schell 2003). However, this mechanism can impair their ability to attend to other aspects of the environment (Camras et al. 1983, 1990; During and McMahon 1991), thereby impacting their emotion understanding and perspective-taking skills [34]. In contrast, our results regarding the primary variant are inconsistent with those of Kahn et al. [35], who found a non-significant association between cognitive empathy and the primary variant. Cognitive deficits in children within the primary variant might be present as early as the preschool period, as indicated by our current findings, and gradually decrease during adolescence as youth within the primary variant learn to "talk the talk" [49]. At a young age, children within the primary variant might lack the affective motivation underlying the development of the understanding of other's emotions due to hyperarousal [3, 4]. Nevertheless, these children might compensate for their deficits in adolescence through intact cognitive abilities, such as perspective-taking. They might do so without truly having an affective understanding of others' emotions [46, 49]. Therefore, we hypothesize that the difference in cognitive empathy between the variants, as demonstrated by Kahn et al. [35], may emerge later on in the child's development, specifically during adolescence.

The fourth objective of the current study was to examine levels of externalizing behaviors in the two variants. Both variants exhibited higher levels of aggressive and oppositional behaviors compared to the control group. Additionally, children within the secondary variant demonstrated even higher levels of aggressive behaviors compared to those within the primary variant. This finding further supports previous research indicating that children with the secondary variant exhibit a more severe clinical picture [3, 12].

The Two Variants: Two Distinct Developmental Trajectories

The results of the current study suggest potential differences in the developmental timing between the two variants. The primary variant emerged as a particularly stable and

detrimental profile as early as preschool age, characterized by high scores on the ICU subscales, low levels of emotional contagion and cognitive empathy, as well as elevated levels of aggressive and oppositional behaviors. This aligns with theories proposing that the primary variant predominantly results from genetic influences, with the characteristics of this variant emerging at an early stage of development [5, 6]. In contrast, the secondary variant was not distinguishable from the anxious group in the preschool sample and only manifested in the school-age sample. This finding might suggest a later development of the secondary variant's characteristics compared to the primary variant, with the exception of a few children potentially exhibiting high levels of secondary CU traits by preschool age. These children may experience particularly abusive or traumatic environments.

In the school-age sample, the two variants exhibited similar characteristics, including high levels of CU traits, high scores on the ICU subscales, low cognitive empathy and high levels of externalizing behaviors. However, the secondary variant demonstrated a higher incidence of externalizing behaviors compared to the primary variant. The differences between the two variants may diminish throughout childhood, while the secondary variant could continue on a detrimental developmental trajectory, eventually presenting as a more severe profile than the primary variant in early adolescence. Indeed, longitudinal studies have shown that children from both variants did not initially differ at a behavioral level but later displayed divergent patterns, with the secondary variant showing a more severe behavioral profile [3, 17, 19].

Strengths and Limitations

The present study demonstrated several strengths, including a person-centered approach, a gender-mixed community sample of children aged 4 to 9, and separate analyses conducted on preschool and school samples However, some limitations must be considered when interpreting the results of this study. First, the cross-sectional design of the study prevented the investigation of differences regarding the developmental trajectories of the two variants. Second, only parent-reported questionnaires were used in this study. Including multiple informants or using alternative measures would enhance the validity of the assessment. For example, laboratory tasks could be particularly useful for assessing affective empathy, as it can be challenging for parents to accurately perceive their child's emotions. Moreover, parents might not be objective in assessing CU traits, especially in the case of the primary variant, as they themselves could present CU traits. Third, the sample did not include many children with high levels of CU traits, and there were large standard deviations for CU traits within the clusters. This may have limited the detection of significant differences between the variants in the school-age sample. However, given that the sample was drawn from the general population, it was expected that only a small proportion of children would fall into these two variants and exhibit high levels of CU traits. Lastly, although the ICU used in the study is an extensively validated questionnaire, the cut-off scores have not yet been well-established. This fact prevented us from distinguishing whether the clusters had clinical or non-clinical levels of CU traits. One way to address this lack of cut-off scores, and the small sample size of the variant groups in a community sample, would be to focus on approaches that consider variables, especially CU traits, as continuous. For example, moderated regressions could be used, as they allow an examination of the combination of high levels of CU traits and anxiety as a proxy for secondary CU traits [45].

Implications

The findings of this study give rise to several implications. First, the current results highlight the need for longitudinal studies to clarify the developmental trajectories of CU traits and anxiety from early childhood through middle childhood and adolescence. It is necessary to examine the specific characteristics of each variant and determine when differences disappear or emerge between the two variants. Additionally, since the statistical analyses did not reveal a distinct preschool anxious group that could be differentiated from the secondary variant, further research is needed to understand the developmental trajectories of these two groups. This could be achieved by considering variables such as trauma symptoms, the perpetrator of abuse, age of onset, frequency and severity of maltreatment, external resources of the child, and the family context. Currently, there is a lack of investigation into these variables. Understanding their impact is crucial for gaining a more precise understanding of the phenomenon of secondary CU traits in childhood, although assessing them remains a challenge that must be addressed, especially as parents are the most frequent informants for children. Secondly, the current criteria from the LPE specifier in the DSM-V might capture the commonalities of the two constructs, at least in the school-age period and in a community sample, although further investigation is needed regarding the "lack of emotional expression" factor. However, it would be useful to include a distinction between the two variants within the specifier in DSM-V, considering their distinct etiological and developmental trajectories. This distinction is crucial for researchers to enhance their understanding of the phenomena and for clinicians to guide appropriate interventions. For example, both variants were characterized at school age by deficits in cognitive empathy in our study, yet the etiology of these deficits may differ. The empathy deficit in the primary variant could be due to emotional hypoarousal, while in the secondary variant, it

may be related to trauma and abuse-induced hyperarousal [3, 4]. Thus, future interventions should take these specificities into account. Interventions focused on addressing the effects of trauma might be particularly important for children with the secondary variant, while interventions focused on motivating changes in their behavior might be more valuable for youth with the primary variant [35].

Summary

Contemporary research has traditionally considered Callous–Unemotional (CU) traits as a homogeneous construct. However, there is a growing interest in delineating two distinct variants of CU traits based on levels of anxiety: a primary variant with low levels of anxiety and a secondary variant with high levels of anxiety. These two variants may arise from distinct etiological pathways and display different characteristics. Nevertheless, this distinction has only recently been investigated in studies and limited data are available for preschool and school-age samples. To address this gap, the present study employed cluster analyses to examine levels of CU traits and anxiety in two samples of children: preschool (N = 107; Mage = 4.95, SD = .62) and school-age (N = 153; Mage = 7.49, SD = 1.11). The identified clusters were compared on empathic dimensions, aggressive behaviour and criteria from the "with limited prosocial emotions" (LPE) specifier from the DSM-V. The primary variant was identified as early as preschool age while the secondary variant was only identified in the school-age sample. Interestingly, in the school-age sample, the two variants did not significantly differ across assessed variables, except for levels of aggressive behavior, which were higher in children with the secondary variant compared to those with the primary variant. Despite the similarities between the two variants in this sample, the results of this study suggest distinct developmental trajectories. The study indicates that the LPE criteria effectively capture the shared characteristics of both variants in the school-age sample.

Author Contributions MP and MS contributed to the study conception and design. Material preparation, data collection and analysis were performed by MP, CM and MS. The first draft of the manuscript was written by MP and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data Availability The study materials, analysis code and output are available on request by contacting the corresponding author.

Declarations

Competing interest The authors declare no competing interests.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Ethical Committee of Psychology of Liege University.

Consent to Participate Informed consent was obtained from all participants included in the study.

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