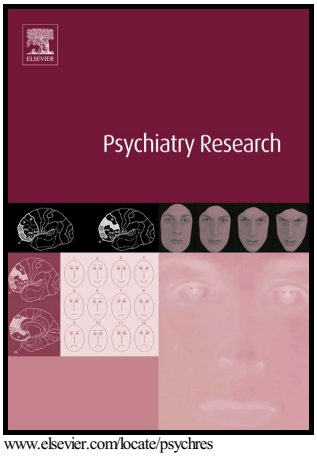

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Taxometric Analyses and Predictive Accuracy of Callous-Unemotional Traits Regarding Quality of Life and Behavior Problems in non-Conduct Disorder Diagnoses

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Abstract

Callous-unemotional (CU) traits have mainly been studied in relation to conduct disorder (CD), but can also occur in other disorder groups. However, it is unclear whether there is a clinically relevant cut-off value of levels of CU traits in predicting reduced quality of

life (QoL) and clinical symptoms, and whether CU traits better fit a categorical (taxonic) or dimensional model. Parents of 979 youths referred to a child and adolescent psychiatric clinic rated their child's CU traits on the Inventory of Callous-Unemotional traits (ICU), QoL on the Kidscreen-27, and clinical symptoms on the Child Behavior Checklist. Experienced clinicians conferred DSM-IV-TR diagnoses of ADHD, ASD, anxiety/mood disorders and DBD-NOS/ODD. The ICU was also used to score the DSM-5 specifier 'with limited prosocial emotions' (LPE) of Conduct Disorder. Receiver operating characteristic (ROC) analyses revealed that the predictive accuracy of the ICU and LPE regarding QoL and clinical symptoms was poor to fair, and similar across diagnoses. A clinical cut-off point could not be defined. Taxometric analyses suggested that callous-unemotional traits on the ICU best reflect a dimension rather than taxon. More research is needed on the impact of CU traits on the functional adaptation, course, and response to treatment of non-CD conditions.

Keywords:

callous-unemotional traits; ADHD; autism; oppositional-defiant disorder; conduct disorder; anxiety/mood disorders; taxon; quality of life

1. Introduction

Callous-unemotional (CU) traits are thought to represent a set of personality traits that constitute some of the core symptoms of psychopathy: lacking guilt and empathy; high egocentricity; showing callous use of others for one's own gain; and lacking normal

emotionality (Frick et al., 1994). Because of the relationship between CU traits in the presence of conduct problems and increased levels of antisocial behavior and a poor response to treatment (Frick et al., 2014; Hawes et al., 2014a), CU traits have gained much research attention. In contrast, little is known about the predictive value of CU traits outside CD (Herpers et al., 2012). Investigating CU traits outside CD may be relevant because recent evidence indicates that (a) at the population level most individuals with high CU traits do not meet criteria for CD (Rowe et al., 2010) and (b) high CU traits can be present in other disorders, and may have similar clinical implications as in CD (Dadds et al., 2012). More specifically, the relationship between CU traits and quality of life is unclear, while discussion remains whether CU traits should be seen dimensionally or taxonic (Docherty et al., 2016; Ray et al., 2016).

CU traits may have predictive value not only inside but also outside CD, for example in relation to quality of life (QoL). Whereas antisocial behavior is limited to a few DSM-diagnoses only, quality of life (QoL) is relevant for virtually every disorder (Bot et al., 2011). It is unclear however to which extent CU traits influence QoL outside CD. Previous research in community samples showed that high CU traits were associated with more global impairment inside (Waschbusch et al., 2004; Pardini et al., 2012; Ezpeleta et al., 2013; Horan et al., 2016), and outside CD (Pardini et al., 2012). In ADHD, impairment may be moderated by CU traits (Waschbusch and Willoughby, 2008; Brammer and Lee, 2012). For youths with non-CD disorders, we have shown that high CU traits compared to low CU traits were associated with significantly lower QoL (Herpers et al., 2016).

Recently, CU traits have been added as a four-item specifier, labeled ‘with limited prosocial emotions’ (LPE), to Conduct Disorder (CD) in the DSM-5 to identify a more severe form of the disorder (American Psychiatric Association; APA, 2013).

However, research applying the DSM-5 criteria for the specifier of CU traits is sparse and the value of using a cut-off of two out of four criteria to fulfill the LPE specifier CD has been debated. Several studies show that boys with CD and meeting criteria for the LPE specifier present more severe antisocial behavior and decreased prosocial behavior (McMahon et al., 2010; Kahn et al., 2012; Pardini et al., 2012; Colins and Andershed, 2015; Kimonis et al., 2015; Pechorro et al., 2015), with similar findings for girls (Pardini et al., 2012; Colins and Andershed, 2015). However, recent studies find limited usefulness of the cut-off score for the criteria of the LPE specifier in detained youths (Colins and Vermeiren, 2013; Colins, 2016; Colins et al., 2017), in former refugees (Latzman et al., 2016), and in conduct-disordered youths with substance abuse (Sakai et al., 2016). Only 4.5-7% of the variance in aggression was explained by the LPE specifier (Jambroes et al., 2016). In addition, research comparing the parent-reported versus self-reported LPE criteria yields inconclusive results (Van Damme et al., 2016; Colins et al., 2017). As such, findings regarding the incremental clinical value of the LPE specifier are inconclusive.

Although there is still debate about how to best assess either CU traits and psychopathy (Patrick and Drislane, 2015; Salekin, 2016), we were interested in an often used instrument to assess CU traits specifically and extensively: the Inventory of Callous-Unemotional traits (ICU; Frick, 2004). This makes the ICU an interesting instrument for use in subjects with CD as well as subjects with non-CD psychopathology. Although it has been recommended to use the ICU as a dimensional measure only (Ray et al., 2016), with the introduction of CU traits as a specifier to Conduct Disorder in the DSM-5 a categorical approach was introduced. For clinical purposes (i.e., decision making regarding treatment) a categorical perspective may be more helpful than a dimensional model (Coghill and Sonuga-Barke, 2012).

The clinical usefulness of the ICU could increase if it would be possible to define a clinically relevant optimal cut-off score based on the predictive value regarding QoL and/or co-occurring levels of psychopathology (Bruns et al., 2000). However, up until now, no widely accepted cut-off score for the ICU has been established. Methods that aim to set cutoffs based on clinical symptomatology are often based on receiver operating characteristic (ROC) analyses (Bruns et al., 2000). ROC analyses provide an index of accuracy, sensitivity and specificity (Zweig and Campbell, 1993). Previous studies that applied ROC analyses to set cut-off scores for the ICU in youths with conduct problems found AUCs varying between .48 and .67 (Feilhauer et al., 2012), and between .64 and .75 (Docherty et al., 2016). As such, predictive accuracy remained poor to fair.

A related issue is whether CU traits better fit a taxonic (i.e. categorical) or dimensional model. This can be examined by taxometric analyses (Ruscio and Ruscio, 2004). The first taxometric study on this topic found evidence for a discrete, discontinuous entity underlying antisocial behavior. However, findings for psychopathy were not described specifically (Skilling et al., 2001). A replication study did find support for a taxon consistent with psychopathy (Vasey et al., 2005). Support for a dimensional model was found in later studies (Murrie et al., 2007; Edens et al., 2011). One study (Walters and Kiehl, 2015) applied the comparison curve fit index (CCFI), which currently is seen as a more robust and valid way to identify taxa than the methods applied by previous studies. This study supports that antisocial behavior (including psychopathy; Haslam et al., 2012) as well as juvenile psychopathy should be viewed along a continuum (Walters and Kiehl, 2015). Up till now, no such study using the CCFI has been performed regarding CU traits.

Our study is the first to investigate the predictive accuracy of the ICU and the LPE specifier in non-CD disorders regarding reduced quality of life (QoL), and internalizing and externalizing behavior problems in the clinical range using ROC graphs and CCFI. We studied a sample of juveniles referred to a child and adolescent psychiatric clinic with ADHD, ASD, DBD-NOS/ODD, and anxiety and/or mood disorder. The overall question we aimed to answer was whether there is enough evidence to support a categorical perspective on CU traits. In our study, we focused on the following questions: 1) What is the accuracy of the ICU, and of the LPE specifier (based on four ICU items) to predict reduced quality of life (QoL) assessed using the Kidscreen-27 (Ravens-Sieberer and the European KIDSCREEN group, 2006), and clinically elevated behavior problems assessed by the Child Behavior Checklist (CBCL; Achenbach and Rescorla, 2001), and 2) Do CU traits better fit a taxonic or dimensional model?

2. Methods

2.1. Sample

Data were used of a sample of 1,833 juveniles (aged 6 and older) who were consecutively referred to Karakter, a child and adolescent psychiatric clinic in the Netherlands. We focused on data collected between July 2012 and May 2013. Services ranged from outpatient to high intensive mental healthcare, for patients with an estimated normal intelligence (IQ > 70). Estimated intelligence is based on either clinical functioning (e.g., in case of good functioning in school) or by administering an intelligence test (i.e., predominantly the Wechsler Intelligence Scale for Children (Wechsler, 1991). Clinical DSM-IV-TR (APA, 2000) diagnoses were established by a multidisciplinary team based on information gathered by a child psychiatrist

(developmental history, child observation and psychiatric assessment), by a child psychologist, and review of clinical and prior records, including information available from school or other professional institutions involved with the child. Thus, a consensus diagnosis is assigned, which is seen as most reliable, compared to structured interviews when broad diagnostic categories are investigated (Leckman et al., 1982). In The Netherlands, severe conduct problems are usually not treated within a psychiatric setting, but in juvenile welfare centers or juvenile penitentiary institutions. Hence, our clinic serves a specific population in which disruptive behavior disorders are only seen as a comorbid disorder and not as primary diagnosis.

Before the first appointment at the clinic parents completed a digital intake questionnaire which assessed a range of variables, including age, gender, country of birth, number of police contacts of the child, education level of parents, and also included validated questionnaires such as the Kidscreen-27 (Ravens-Sieberer and the European KIDSCREEN group, 2006) for measuring QoL. For this study, the Inventory of Callous-Unemotional traits (ICU; Frick, 2004) was added to the intake questionnaire. Global functioning was rated by experienced child and adolescent psychiatrists using the Global Assessment of Functioning Scale according the DSM-IV-TR criteria. Scores above 60 reflect no or minor functional impairment. This study was approved by the local Institutional Review Board.

Since the ICU was not part of the information collected in care as usual and added because of research reasons, participants gave informed consent to use the ICU for research purposes. Participants whose parents gave informed consent to use the data anonymously (n = 1,190) were included in this study. However, at the time of statistical analysis, data regarding DSM-IV-TR diagnosis was missing for n = 151. Furthermore, 8 juveniles were excluded because of invalid entry of Kidscreen-27 scores and 26 were

excluded because of invalid entry of CBCL scores. Youth who were aged below 8 (n = 15) or above 18 years (n = 6) were also excluded. Finally 5 juveniles were excluded because they were diagnosed having CD. This resulted in a sample of 979 youths.

2.2. Measures

Parents rated *callous-unemotional traits* of their child using the Dutch translation of the 24-item ICU, which assesses CU personality traits (Roose et al., 2010). Each item is rated on a 4-point Likert scale ranging from 0 = *not true at all* to 3 = *definitely true*. Previous studies (Mills-Koonce et al., 2014; Breeden et al., 2015) showed acceptable internal consistency (Cronbach's Alpha = .67-.70). In Dutch speaking adolescents, internal consistency was found to be good as well (Decuyper et al., 2009; Roose et al., 2010). In our study Cronbach's Alpha was found to be good (.89). Mean inter-item correlation for the ICU = .25 (min. = -.13; max. = .65), implying good internal consistency. Concurrent validity between the ICU and other psychopathy scales seems to be acceptable (r^2 = .45 – .68 between ICU and Antisocial Process Screening Device, and Childhood Psychopathy Scale; Kimonis et al., 2008; Roose et al., 2010).

In line with previous research (Kahn et al., 2012; Pardini et al., 2012) four items of the ICU were used to reflect the LPE specifier (Kimonis et al., 2015). These items are: item 3 ("I care about how well I do at school or work"), item 5 ("I feel bad or guilty when I do something wrong"), item 6 ("I do not show my emotions to others"), item 8 ("I am concerned about the feelings of others"). A dichotomous score was created, considering a symptom as present, when rated as "applies very well" for item 6, and "does not apply at all" for the other items. Internal consistency for the LPE specifier was low (.45). The mean inter-item correlation was .18 (min. = .10; max. = .30), implying low to moderate internal consistency.

Quality of life was measured by parent ratings on the Kidscreen-27 (Ravens-Sieberer et al., 2005). The Kidscreen-27 aims to assess general well-being and subjective health in youths. Previous studies showed the relationship between severity of mental health problems in youths and QoL, even when controlling for overlap (Dey et al., 2012; Weitkamp et al., 2013). The Kidscreen-27 contains 27 questions related to five dimensions (autonomy & parent relations, social support & peers, physical well-being, psychological well-being, school environment), as well as giving rise to a total QoL score. Each item is being rated on a 5-point Likert scale ranging from 1 = *not at all/never* to 5 = *totally/always*. Thus, low Kidscreen scores reflect lower QoL. Cut-off scores for clinically decreased functioning are based on the mean scores minus .5 standard deviation (SD; Ravens-Sieberer and the European KIDSCREEN group, 2006). A cut-off for the total score is not provided. The questionnaire is validated in Dutch, and internal consistencies (Cronbach's Alpha) were reported to be > 0.75 (Ravens-Sieberer and the European KIDSCREEN group, 2006). In our study Cronbach's Alpha for the total Kidscreen-27 was .90. Mean inter-item correlation for the Kidscreen-27 = .26 (min. = -.01; max. = .76), implying good internal consistency.

Psychopathology was measured by parents rating the Dutch translation of the CBCL. This is a widely used standardized questionnaire, containing 113 items that addresses psychopathological signs and symptoms. Parents describe the children in their current functioning and within the past two months. Most items are rated on a 3-point Likert scale ranging from 0 = *not true* to 2 = *definitely true*. For our analyses, we focused on three major scales of the CBCL, that relate to the scores for the total scale, externalizing behavior and internalizing behavior. Cut-off scores for clinically elevated symptoms are based on T-scores ≥ 68 (Achenbach and Rescorla, 2001). Internal consistencies (Cronbach's Alpha) for the Dutch version were reported to be > 0.90

(Verhulst and van der Ende, 2013). In our study Cronbach's Alpha for the total CBCL was .94. Mean inter-item correlation for the CBCL = .57 (min. = .02; max. = 1.50), implying acceptable internal consistency.

2.3. Analyses

IBM SPSS Statistics 21 was used for statistical analyses. Predictive accuracy was estimated by ROC analyses that plot assessment sensitivity against the inverse of its specificity (i.e., 1 – specificity). Thus an area under the curve (AUC) is generated which can be interpreted as the ability to discriminate between two subclasses of subjects (Zweig and Campbell, 1993). Interpretations of the AUC are based on the traditional academic point system, where .5-.6 classifies the test as a fail, .6-.7 as poor, .7-.8 as fair, .8-.9 as good and .9-1.0 as excellent (Obuchowski et al., 2004). AUCs were assessed for the ICU (test variable) in relation to Kidscreen-27 subscales (state variables; Ravens-Sieberer and the European KIDSCREEN group, 2006), and for the ICU (test variable) in relation to CBCL total scores, externalizing and internalizing scores (state variables). Analyses were conducted on the total sample and on five diagnostic categories: ADHD, ASD, anxiety/mood, DBD-NOS/ODD, and other diagnoses (see also Table S1, available online). Information on co-morbidity is given in Table S2 (available online). We repeated these analyses applying the LPE specifier. To control for comorbidity, we have also conducted ROC analyses applying the ICU on diagnostic groups without comorbidity.

In addition, we performed taxometric analyses to test whether CU traits, as assessed with the ICU, are taxonic or dimensional. These analyses were performed using the R code that is freely available from http://www.tcnj.edu/~ruscio/taxometrics.html. There are no *p*-values associated with taxometric analyses; rather, significance of a finding is established through replication of the result across multiple taxometric

procedures (Waller and Meehl, 1998). Each individual procedure matches the observed data up against 100 simulated datasets to best determine which model is more likely (taxonic or dimensional). In generating comparison datasets, a fit statistic, CCFI can be calculated (Ruscio and Walters, 2009), based on three different types of taxometric analyses, that is, (a) mean above minus below a sliding cut (MAMBAC), (b) maximum covariance (MAXCOV), (c) latent model (L-MODE). These three procedures were chosen owing to their complementary statistical properties. CCFI falls between 0 and 1; the closer the estimate falls to 1, the stronger the evidence of a taxon. CCFI closer to 0 supports a dimensional construct. If CCFI is between .4 and .6, the data probably are inadequate for distinguishing between taxonic and dimensional distributions. CCFI has previously been shown to be an accurate and sensitive method to differentiate between taxonic and categorical data (Haslam et al., 2012). CCFI's were run without a specified base rate, because findings regarding the prevalence of CU traits across disorders are still inconsistent (Kahn et al., 2012; Herpers et al., 2016). The command lines used in these analyses are the same as those recently reported elsewhere (Taylor et al., 2016).

For exploratory analyses regarding potential age effects, we performed hierarchical multiple linear regression analyses entering gender and mean centered age in step 1, mean centered ICU total scores in step 2, and an interaction term between the centered age and ICU variable in step 3. Continuous Kidscreen total and subscale scores, and continuous CBCL total, internalizing and internalizing scores were entered as dependent variables. Regression analyses were run for the total group as well as the diagnostic groups. Correction for multiple testing was done by running false discovery rate (FDR) analyses according to (Benjamini et al., 2006). For interpretation of age effects for the significant findings that remained after FDR analyses the sample was split in three age groups (each containing roughly a third of the sample), and then running

hierarchical multiple linear regression analyses entering gender in step 1, ICU total scores in step 2. Finally, because one item from the CBCL (i.e., item 26; "Does not seem to feel guilty after misbehaving") shows overlap with one ICU item (i.e., item 5; "Feels bad or guilty when he/she has done something wrong"), we have run additional analyses to investigate whether excluding this specific item from the raw scores from the CBCL would have a negative impact on zero-order correlations.

3. Results

3.1 Descriptives

Characteristics of the study sample are described in Table 1. Mean age of the sample was 12.05 years (*SD* = 2.80; range 8-18 years). Mean ICU score was 28.73 (SD = 11.27). Mean total CBCL score was 68.84 (SD = 27.74) and mean total Kidscreen-27 score was 95.77 (SD = 14.16). Bivariate correlations among the study measures are shown in Table S3 (available online), showing that CU traits correlate very modestly (ranging from .11 to .56) with the CBCL subscales, and thus seem to assess a rather separate domain of psychopathology.

3.2. Predictive accuracy of ICU for Kidscreen-27 and CBCL scores

AUCs for the ICU in relation to the Kidscreen-27 scales were found to vary from .498-.703 in the total sample and across disorders (see Table 2). AUCs were non-significant for the physical activities and health scale, and none were significant in the DBD-NOS/ODD group. As such, the value of the ICU predicting the Kidscreen-27 subscales seems at best moderate. Overall, AUCs were similar in relation to the different subscales of the Kidscreen-27 and the different disorder groups.

AUCs for the ICU in the total sample and for specific diagnoses varied from .646-.713 in relation to the CBCL total scale, from .686-.729 for the externalizing scale,

and .583-.623 for the internalizing scale. Across the different disorder groups, predictive accuracy was significantly greater for externalizing than internalizing scores for the total sample, ADHD, ASD and other diagnoses groups, as indicated by the non-overlapping confidence intervals for AUCs. An optimal cut-off score could not be defined. Except for the internalizing subscale of the CBCL in the DBD-NOS/ODD group, all AUCs were significant, and as such ICU total scores could be seen as predictors for clinically elevated CBCL scores, with poor (for CBCL internalizing behaviors) to moderate (for CBCL externalizing behaviors) predictive accuracy regardless of DSM-based classifications.

The predictive value of the LPE specifier in the prediction of quality of life and CBCL scores was found to be low or non-significant for the total group as well as the diagnostic groups, with AUCs ranging from .411 to .623 (Table 3). Especially, no significant predictive value was found in the BDB-NOS/ODD group. The highest score was found for predicting externalizing behavior in the DBD-NOS/ODD group (AUC = .623). However, this finding was non-significant.

3.3. Taxometric analyses

Performing taxometric analyses showed a mixed pattern of results (Figure 1). MAMBAC gives a CCFI of .62, suggesting there is a taxon. MAXCOV and L-MODE, on the other hand, give .19 and .33 respectively. The degree of confidence in the conclusions of taxometric analyses can be gleaned from testing whether a particular finding replicates across multiple taxometric analytic procedures. In instances where samples are slightly smaller, and thus less powered, it is possible for inconsistent results to emerge across procedures. Thus, the inconsistent results across the three procedures may have arisen from the relatively small sample used here. To determine whether the data generally support a dimensional or taxometric structure, one can average CCFI

estimates across multiple procedures. In the present study, this was .38, thus indicating that the analyses generally support a dimensional structure of the ICU.

3.4. Exploratory analyses

Repeating the ROC-curve analyses on diagnostic groups without comorbidity, showed that, overall, results stayed similar (see Table S4, available online). Nevertheless, results for the Anxiety/Mood disorders group mostly lost significance, except for the AUC of psychological well-being, CBCL total score, and CBCL externalizing score. Results for the DBD-NOS/ODD group all lost significance, which is likely due to the small number of participants (n = 13).

Results of the exploratory analyses regarding potential age effects for the total group are shown in Table S5 (available online). Additional analyses showed that after correction for multiple testing, only an age x ICU interaction effect remained significant (ΔR^2 = .148, β = .398, p = .048) for the Kidscreen-27 social support & peers subscale in the DBD-NOS/ODD group. Splitting the sample in three age groups revealed that, in the two younger groups (i.e., 8.0-10.1 and 10.2-13.3 years), total ICU scores had a significant negative predictive value (ΔR^2 = .222, β = -.480, p = .048; ΔR^2 = .195, β = -.452, p = .037; respectively), while the ICU did not show significant predictive value in the older group (13.3-17.9 years; ΔR^2 = .000, β = -.005, p = .979). Thus, ICU seems to be related to lower social support and peer-related QoL in DBD-NOS/ODD only at younger ages (below around age 13 years).

Results of the correlational analyses regarding the effect of excluding item 26 from the CBCL showed that zero-order correlations remained similar for correlations between ICU and CBCL total scores, and between ICU and CBCL externalizing scores. As such, the overlap of this item did not seem to impact our results regarding the ROC analyses.

4. Discussion

The usefulness of CU traits to inform clinical decision making in non-CD disorders is unclear. Our study aimed to investigate whether there is a clinically relevant cut-off on the ICU is in predicting QoL, and internalizing and externalizing behavior problems in a sample of 979 patients with non-CD disorders (i.e., ADHD, ASD, anxiety/mood disorder, DBD-NOS/ODD, and other diagnoses). The predictive accuracy of the ICU regarding QoL and clinical symptoms was poor to fair, and similar across disorders. As such, predictive accuracy of the ICU scores regarding QoL and clinical symptoms was not significantly better for the DBD-NOS/ODD group relative to other disorders. A significantly larger predictive accuracy of the ICU was found in relation to externalizing behavior compared to internalizing behavior, with similar accuracy across disorders. Overall, there was very little evidence for age effects. Hence, the ICU was predictive of QoL independent of age/developmental stage. In addition, taxometric analyses showed no evidence of a taxon underlying CU traits. Overall, our data suggest that there is no specific threshold on the ICU at which liability for clinical symptoms or poorer QoL drastically increases and this was similar for the different non-CD disorder groups, including the DBD-NOS/ODD group. Hence, the ICU seems to have limited clinical usefulness to predict QoL, internalizing and externalizing behavior scores in terms of a clear clinical cut-off, which is similar across non-CD disorders.

The accuracy of the ICU to predict QoL was found to be low, and in line with previous studies (Feilhauer et al., 2012; Docherty et al., 2016). As such, AUCs were too low to set cut-off scores that are clinically useful, even though we found that classification accuracy across disorders was statistically significant. In addition, the results of our taxometric analyses suggest a dimensional structure for CU traits, in a

similar manner to what has been shown for other traits, such as psychotic experiences in adolescence (Taylor et al., 2016). Therefore, our findings are supportive of the assumption that in general psychopathology does not exist in dichotomous entities (i.e., presence of absence of a disorder). As such, the dimensional perspective on CU traits seems to be more relevant than a categorical perspective. This view is supported by our taxometric analyses, and our results with the LPE specifier, and is in line with the ongoing discussion that current psychiatric classification is not well supported by research findings (Carragher et al., 2015). Therefore it may be more important to shift diagnostic thinking from a categorical perspective to a dimensional perspective, with a focus on combinations of symptoms and personality traits more than on 'overall' diagnoses (Krueger and Markon, 2011).

The accuracy of the ICU in predicting clinically elevated CBCL and decreased Kidscreen-27 scores in the DBD-NOS/ODD groups was found to be similar to the accuracy in other diagnostic groups. Thus, our findings suggest that high CU traits may not only be related to increased, and more pervasive antisocial behavior (Frick et al., 2014), but also to increased clinical symptoms and decreased QoL equally, regardless of diagnosis across non-CD disorders. This may be in line with previous research, suggesting that the ICU might reflect negative emotionality and global maladjustment (Berg et al., 2013). As correlations between internalizing and externalizing symptoms have been described as large, and comorbidity might result from common, underlying core psychopathological processes (Krueger, 1999), CU traits may be a symptom dimension that should be seen as a part of a general tendency towards psychopathology., in which CU traits may be part of more clinical DSM diagnoses than only CD. However, for better understanding of our findings, replication of our study, with inclusion of a CD group seems warranted.

Our finding that the ICU correlates stronger with the CBCL externalizing subscale than the internalizing subscale appears to be consistent with other studies on the ICU (Frick et al., 2014). Several recent studies challenged the ICU-PR from a psychometric point of view. Analyses indicated that factor models reported for the ICU-PR demonstrated a relatively poor fit to the data (Hawes et al., 2014b). Furthermore, the ICU-PR may be heavily saturated with items concerning negative emotionality and global maladjustment (Berg et al., 2013), and a need for item refinement and the use of a shortened ICU has been highlighted (Byrd et al., 2013; Hawes et al., 2014b; Waller et al., 2015). The ICU has been challenged from a conceptual point of view as well, as the unemotional subscale does not include items on un-emotionality as implied by the term callous unemotional traits (Lahey, 2014). However, further research on the psychometric properties of the ICU seems to be needed to elucidate this debate.

Notably, we found the predictive value of the LPE specifier to fail for the total group as well as the diagnostic groups. As such, these findings are in line with previous studies showing that the usefulness of the LPE specifier seems limited (Colins and Vermeiren, 2013; Colins, 2016; Latzman et al., 2016; Vanwoerden et al., 2016), even though the four ICU items that give rise to the LPE specifier may show good model fit (Kimonis et al., 2015). However, our findings might also be the result of the fact that we relied on single reported (i.e., parent-reported) LPE symptoms only (Van Damme et al., 2016). Our evidence that CU traits alone predict symptom and/or impairment beyond externalizing syndromes is still limited. Therefore, more research is needed on the impact of CU traits on the functional adaptation, course, and response to treatment of non-CD conditions.

Previous studies have used the CBCL items to compute a CU traits construct. These constructs were based either on the CBCL preschool forms (Willoughby et al.,

2011; Hyde et al., 2013) or previous versions of the CBCL we used (Pardini et al., 2006; Burke et al., 2007; Obradović et al., 2007). However, the current version of the CBCL only contains one item believed to assess CU traits ("Does not seem to feel guilty after misbehaving"). This implies that CU traits were thought not to have incremental value in assessing child and adolescent psychopathology beyond the other included items in the CBCL. However, bivariate correlations between ICU and CBCL subscales were mostly found to be positive and significant, though small to moderate at best. Only between the ICU uncaring subscale and the CBCL internalizing subscale we did not find a significant relationship. Therefore it seems that the ICU and CBCL capture rather separate domains of psychopathology. As such, CU traits may still be important in the prediction of other relevant clinical outcome measures, e.g., they may imply special challenges in the treatment of non-CD youths with high CU traits.

Although this study has its strengths, such as the sample size, and the fact that we investigated CU traits outside CD, this study has its weaknesses as well. A weakness of the ICU might be that it addresses only CU traits and no other dimensions of psychopathy, such as boldness and disinhibition (Patrick et al., 2009), while these may have incremental diagnostic value as well (Patrick and Drislane, 2015). Because it still is unclear which assessment scale captures the construct of psychopathy best (Vaughn et al., 2008), replication of our study using a psychopathy assessment scale instead of the ICU seems to be needed. Furthermore, we could not control for possible confounding variables, such as medication or previous treatment, even though both may moderate CU traits (e.g., Salekin et al., 2012; Blader et al., 2013). A final limitation we would like to mention is that we relied on parent reported-assessment of CU traits and of QoL only. This implies that these two variables may correlate due to shared method variance.

However, when examining the individual items on each questionnaire, there is virtually no overlap in item content.

ROC for the ICU in relation to QoL and clinically relevant problem scores and taxometric analyses of the ICU in a child and adolescent psychiatric sample had not been conducted before. The present findings provide more insight into the usefulness of the ICU in non-CD clinical populations. Our data suggest a continuous association between ICU scores and Kidscreen-27/CBCL, whereas the predictive accuracy of CU traits regarding QoL was found not to differ between DBD-NOS/ODD and other diagnoses. Further research is needed to develop a better understanding of how the presence of CU traits affect overall functional adaptation, course and response to treatment of non-CD diagnoses.

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Conflict of interest

In the past 3 years, Buitelaar has been a consultant to / member of advisory board of / and/or speaker for Janssen Cilag BV, Eli Lilly, Bristol-Myer Squibb, Shering Plough, UCB, Shire, Novartis and Servier. He is not an employee of any of these companies, and not a stock shareholder of any of these companies. He has no other financial or material support, including expert testimony, patents, royalties.

Drs. Herpers, Klip, Rommelse, Taylor and Greven have no biomedical financial interests or potential conflict of interest.

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Figure 1

Results of taxometric analyses with no base rate specified

Analysis	Plot	CCFI
(a) MAMBAC		.62
(b) MAXCOV		.19
(c) L-MODE		.33

MAMBAC: mean above minus below a sliding cut; MAXCOV: maximum covariance; L-MODE: latent model; CCFI: comparison curve fit index

In Fig. 1(a), 'cuts' on the X-axis represent the positions in which the sample was cut, based on ordered input variable scores. The Y-axis represents the mean difference in scores above and below each cut. A taxonic variable should yield a clear peak in the distribution, in that there exists a clear point at which a taxon can be distinguished from the rest of the sample. In Fig. 1(b), 'windows' represent the cuts in the sample, with covariance between indicators above each cut-off plotted on the Y-axis. If a taxon exists, then the distribution of the covariances should yield a clear peak in that there exists a point where indicators of the taxon cluster together more strongly. In Fig. 1(c), factor scores are shown on the X-axis, with the density of each score plotted along the Y-axis. A taxonic dataset would yield a bimodal distribution corresponding to a lower and higher scoring group.

The thick gray line represents the expected results for dimensional or categorical data for the middle 50% of the comparison datasets; the thinner gray lines either side of it represent the lower and upper bounds of the results. The results obtained from observed data are shown by the black lines.

Table 1
Characteristics of the study population (N = 979)

		n	%
Age	8 ≤ 11 years	492	50.3
	12 ≤ 18 years	487	49.7
Gender	Male	625	63.8
Education level of child	Primary education	388	41.9
	Special needs primary education	175	18.9
	Special needs secondary education	107	11.6
	Preparatory middle-level vocational education	137	14.8
	Higher vocational education / preparatory university education	119	12.9
Education level of parent	Lower	130	14.0
	Middle	403	43.3
	Higher	398	42.7
Previous treatment	Child and Adolescent Psychiatrist	403	41.2
	Child psychologist / Youth welfare	544	55.6
	Paediatrician	649	66.3
	Neurologist	127	13.0
Medication	Psycho-active medication	224	22.9
	Stimulants	146	14.9
	Antipsychotics	86	8
	Atomoxetine	5	.5
	Antidepressants	20	2

Table 2 *Predictive accuracy (AUC) of ICU for clinical scores on Kidscreen-27 and CBCL.*

Sc	Su	Total sample (*n* = 979)			ADHD (n = 431)			ASD (*n* = 414)			Anxiety / (*n* = 231)			DBD-NOS / (n = 72)			Other diagnos (n = 410)		
		AU	95 %		AU	95 %		AU	95 %		AU	95 %		AU	95 %		AU	95 %	
Kidscreen-27	autonomy & parent relation	.678***	.644	.712	.690***	.639	.740	.679***	.628	.731	.703***	.633	.773	.630	.500	.760	.691***	.639	.742
	social support & peer	.619***	.584	.654	.661***	.609	.713	.593***	.536	.650	.616***	.542	.689	.589	.455	.723	.621***	.566	.675
	physical well	.534	.498	.571	.549	.494	.605	.535	.479	.591	.498	.424	.573	.523	.388	.657	.525	.469	.581

	-being psychological	.619**	.583 - .656	.638**	.585 - .690	.575*	.514 - .636	.647**	.567 - .728	.619	.433 - .804	.637**	.582 - .693
	well-being school environment	.626**	.591 - .661	.635**	.582 - .687	.630**	.575 - .685	.613**	.538 - .688	.532	.365 - .699	.638**	.585 - .691
CBCL	total score	.691**	.657 - .724	.697**	.647 - .747	.658**	.601 - .715	.646**	.575 - .717	.713**	.586 - .840	.699**	.648 - .751
	Externalizing	.729**	.697 - .760	.722**	.674 - .769	.706**	.657 - .756	.722**	.655 - .789	.686*	.542 - .830	.720**	.671 - .769
	In	.6	.5 - .6	.6	.5 - .6	.5	.5 - .6	.5	.5 - .6	.6	.4 - .7	.6	.5 - .6

ternalizing	01***	66	37	11***	58	64	83***	25	42	96*	21	71	23	90	56	08***	53	63

* $p < .05$. ** $p < .01$. *** $p < .001$

Note.

ADHD attention-deficit/hyperactivity disorder, *ASD* autism spectrum disorder, *Anxiety/Mood* either anxiety or mood disorder, *AUC* area under the curve, *CBCL* Child Behavior Checklist, *CI* confidence interval, *DBD-NOS/ODD* either disruptive behavior disorder not otherwise specified or oppositional defiant disorder, *ICU* Inventory of Callous-Unemotional traits, *Other diagnoses* listed in Table S1.

Table 3 *Predictive accuracy (AUC) of DSM-5 'low prosocial emotions' (LPE) specifier for clinical scores on Kidscreen-27 and CBCL.*

Sc	Su	Total sample (*n* = 979)			ADHD[1] (n = 431)			ASD[1] (*n* = 414)			Anxiety / (*n* = 231)			DBD-NOS / (n = 72)			Other diagno (n = 410)		
		AU	95 %		AU	95 %		AU	95 %		AU	95 %		AU	95 %		AU	95 %	
Kidscreen-27	Autonomy & parent relationssocial support & peersphysical well-b	.588***	.551	- .624	.594**	.539	- .649	.599**	.543	- .654	.601*	.521	- .681	.579	.446	- .712	.562*	.505	- .619
		.552**	.516	- .588	.567*	.512	- .621	.569*	.513	- .625	.551	.475	- .626	.572	.437	- .706	.553	.498	- .609
		.529	.492	- .565	.530*	.473	- .587	.524	.469	- .580	.516	.441	- .591	.545	.411	- .679	.512	.456	- .568

	eing psychological well-being	.558**	.521	-	.595	.561*	.507	-	.616	.562*	.503	-	.620	.538	.453	-	.622	.411	.246	-	.576	.544	.486	-	.601
	school environment	.574***	.539	-	.610	.591**	.537	-	.645	.570*	.514	-	.625	.550	.474	-	.627	.497	.336	-	.658	.560*	.504	-	.615
CBCL	total score	.571***	.534	-	.607	.582**	.528	-	.636	.555	.496	-	.614	.543	.468	-	.617	.610	.459	-	.761	.542	.485	-	.600
	Externalizing	.591***	.555	-	.626	.596**	.542	-	.649	.583**	.529	-	.638	.594*	.514	-	.673	.623	.457	-	.790	.560*	.505	-	.616
	Inte	.533	.497	-	.570	.531	.477	-	.586	.548	.491	-	.606	.540	.464	-	.615	.489	.351	-	.626	.498	.442	-	.555

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* $p < .05$. ** $p < .01$. *** $p < .001$

[1] with comorbidity

Note.

ADHD attention-deficit/hyperactivity disorder, *ASD* autism spectrum disorder, *Anxiety/Mood* either anxiety or mood disorder, *AUC* area under the curve, *CBCL* Child Behavior Checklist, *CI* confidence interval, *DBD-NOS/ODD* either disruptive behavior disorder not otherwise specified or oppositional defiant disorder, *ICU* Inventory of Callous-Unemotional traits, *Other diagnoses* listed in Table S1.

Highlights

- Little is known regarding the clinical value of the ICU in non-Conduct Disorder populations.
- Predictive accuracy of the ICU regarding QoL and clinical symptoms was poor to fair.
- Predictive accuracy of the DSM-5 specifier 'with limited prosocial emotions' was poor.
- Taxometric analyses suggested a dimensional distribution to the ICU.
- Findings suggest a dimensional association between CU traits and Kidscreen-27/CBCL.