

Post-print de: Ezpeleta, L., Granero, R., Osa, N. de la, & Domènech, J.M. (2017). Developmental trajectories of callous-unemotional traits, anxiety and oppositional defiant disorder in 3 - 7 year-old children in the general population. *Personality and Individual Differences*, 111, 124-133. doi: 10.1016/j.paid.2017.02.005. Versió de l'editor consultable a: <http://www.sciencedirect.com/science/article/pii/S0191886917300739>

Developmental Trajectories of Callous-unemotional traits, Anxiety and Oppositionality in 3 - 7 year-old Children in the General Population

Lourdes Ezpeleta^{1,2,4}

Roser Granero^{1,3,4}

Núria de la Osa^{1,2,4}

Josep Maria Domènech^{1,3,4}

¹Unitat d'Epidemiologia i de Diagnòstic en Psicopatologia del Desenvolupament

²Departament de Psicologia Clínica i de la Salut

³Departament de Psicobiologia i Metodologia de les Ciències de la Salut

⁴Universitat Autònoma de Barcelona (Spain)

Abstract

There is increasing interest in describing different variants and subtypes that characterize the heterogeneity of behavior problems with the aim of supporting early detection and prevention, as well as facilitating research into etiological differences. This work examines the course of co-occurrence of callous-unemotional traits (CU), anxiety (ANX) and oppositionality (ODD-s) levels in a longitudinal community sample. A sample of 622 3-year-old preschoolers, followed up until age 7, was assessed annually with dimensional measures of callous-unemotional traits, oppositional defiant disorder and anxiety and related psychological constructs answered by parents, teachers and performed by children. Growth-Mixture-Modeling yielded six trajectories (null 58.9%, ANX-increasing 4.9%, CU+ANX+ODD 2.4%, CU+ODD-decreasing 8.1%, ODD-increasing 16.4%, and ANX-decreasing 9.2%) that represent the variants previously described with older subjects. The specifier ODD “with limited prosocial emotion” (CU+ODD decreasing and increasing) showed deficits in executive functioning, attention, aggressive behavior and social cognition in comparison with null trajectory. The secondary variant showed a more severe clinical picture and presented more difficulties in executive functioning, worse environmental characteristics, and worse outcomes at age 7. It is possible to identify the heterogeneity of disruptive behavior problems from preschool age. The identification of homogeneous groups in this category of disorders may help to design more suitable treatments with specific components for specific difficulties, and to progress in the etiological research of each class.

KEYWORDS: anxiety; callous-unemotional traits; developmental trajectories; oppositionality; preschool; primary/secondary psychopathy.

1. Introduction

Disruptive behavior disorders (oppositional defiant disorder –ODD- and conduct disorder –CD) identify a heterogeneous group of children with different characteristics and etiologies. From preschool age, ODD is a highly prevalent condition (Bufferd, Dougherty, Carlson, Rose, & Klein, 2012; Ezpeleta, Granero, et al., 2014) that tends to co-occur with CD during development (Rowe, Maughan, Pickles, Costello, & Angold, 2002). Current research proposes that ODD should be studied separately from CD, as the two disorders have different developmental trajectories and are associated with different risk processes (Lahey & Waldman, 2012). In recent years there has been increasing interest in describing different subtypes (homogeneous discrete categories) and variants (heterogeneous and non-discrete categories that identify representative members -prototypes- in each class) of behavior problems with the aim that this description may help early detection and prevention as well as facilitate research into etiological differences. An example of such an inquiry is the inclusion in DSM-5 (American Psychiatric Association, 2013) of the specifier “with limited prosocial emotions” for CD, which permits the identification of a more homogeneous subgroup of youth with CD who share a callous-unemotional (CU) pattern of interpersonal and emotional functioning. CU traits depict the affective facet of psychopathy and are developmental precursors of adult psychopathy (Patrick, 2010).

A recent meta-analysis including 10 studies with samples of children below 5 years of age has reported that CU traits are just as strongly associated with a more severe presentation of conduct problems in early childhood as they are in adolescence (Longman, Hawes, & Kohlhoff, in press). Studies have shown that from preschool age, CU traits distinguish a group of children with more severe ODD symptoms that were less fearful, recovered more easily after an upset, and showed less negative reactivity, lower heart period reactivity and

higher levels of general arousal than those with ODD only (Hawes, Dadds, Brennan, Rhodes, & Cauchi, 2013; Scholte & van der Ploeg, 2007; Willoughby, Waschbusch, Moore, & Propper, 2011). The early severity of this combination together with the poor treatment outcomes (Hawes, Price, & Dadds, 2014) recommend the study of their joint evolution from early ages to know better how they manifest and to provide developmentally adequate care to the affected.

Further heterogeneity has been suggested based on psychopathy and anxiety, *primary* and *secondary* psychopathy, which reflect some differences in the phenomenology and in the etiological pathways (Hicks, Markon, Patrick, Krueger, & Newman, 2004). Primary psychopathy refers to the presence of CU traits and secondary psychopathy refers to the presence of CU traits plus anxiety. Thus, while the primary variant is characterized by stable difficulties in emotional responding to the distress of others and low stress reaction, probably resulting from a constitutional deficit in conscience development, the secondary variant is characterized by negative emotionality, impulsivity and more aggressive behavior aroused by environmental adversity (abuse, traumatic experiences) that, as an adaptive mechanism, would interfere with the social behavior of children with normative development of conscience (Kimonis, Frick, Cauffman, Goldweber, & Skeem, 2012).

There is some support for primary and secondary variants in adolescents. Studies using cluster analytic methodologies with 11 to 18 year-old clinic-referred and juvenile offenders have found two separate groups: one for CU only (primary psychopathy), which was the most prevalent, and another for CU plus anxiety (secondary psychopathy) (Kimonis et al., 2012; Kimonis, Skeem, Cauffman, & Dmitrieva, 2011; Vaughn, Edens, Howard, & Smith, 2009). When CU only (primary) was compared with CU plus anxiety (secondary), the latter presented a more frequent history of abuse and trauma experiences, together with higher impulsivity, externalizing behaviors, aggression, behavioral activation, physiological anxiety,

worry and social concerns, negative emotionality, depression, attention problems, anger, hostility, violence, and suicide ideation (Kimonis et al., 2012; Kimonis et al., 2011; Vaughn et al., 2009). The CU only group showed lower behavioral inhibition and underreported their level of behavioral disturbance (Kahn et al., 2013). The two groups did not differ in the degree of CU traits and their stability (Kimonis et al., 2012; Kimonis et al., 2011). Therefore, in juvenile offenders, who also present a high prevalence of conduct disorder, the concurrence of CU traits plus anxiety designates a more severely affected group. However, this is not borne out by all studies. Lee, Salekin, and Iselin (2010), for example, did not find support for these subtypes in young male offenders.

Variants of CU conduct problems have also been confirmed in a large community sample of 15 to 18 year-old Cypriot adolescents (Fanti, Demetriou, & Kimonis, 2013). Using latent profile analysis, four groups emerged: primary CU, secondary CU, anxious, and low risk. Secondary CU had lower self-esteem, and higher reactive aggression, susceptibility to peer pressure and popularity striving than primary CU. Primary CU and secondary CU were similar in the proportion of boys and the levels of impulsivity and sensation seeking. The anxious group had similar CU and conduct problems to the low risk group but higher anxiety. Therefore, in the general population it has also proved useful to subtype CU traits according to conduct problems and anxiety as more homogeneous groups with specific needs are identified.

Regarding statistical procedures, the heterogeneity among children with psychological problems has mostly been studied through variable-level approaches (such as General Linear Models), which are centered on the description of the association between variables and consider potential risk factors as predictors of a subject's clinical features and competences. This approach isolates psychologically meaningful behavioral characteristics in which children reliably differ, and analyzes their potential correlational structure, stability over time,

and predictive validity for children's outcomes. Therefore, variable-level approaches do not provide information about the person-specific intra-individual psychological behavior or about the person-specific intra-individual dynamics/development (von Eye & Bergman, 2003; West, Ryu, Kwok, & Cham, 2011). In contrast, person-centered approaches (such as mixed growth modeling) start from the grouping of individuals according to their responses/scores on different features, and focus attention on the intra-individual structure of variables, with the advantage of conceiving of children as a whole and not as the sum of isolated features. Psychological profiles obtained with these methodologies are well suited for addressing questions that concern group differences in patterns of clinical profiles. Some person-centered approaches have been used for behavioral problems and the combination with CU traits in early ages. Person-centered approaches have been used for studying the developmental trajectories of CU traits and the combination with behavioral problems. For CU traits Fontaine, Rijdsdijk, McCrory, and Viding (2010) identified four trajectories from ages 7 to 12 in a sample of 9462 twins: stable high (3.4%), increasing (9.6%), decreasing (16.9%) and stable low (70.2%). Similarly, in a sample of 503 at-risk boys from ages 7 to 15 Byrd, Hawes, Loeber, and Pardini (2016) found five trajectories of CU: early-onset chronic (10.3%), childhood-limited (10.1%), adolescent-onset (11.8%), moderate (17.4%) and low (50.4%). These studies indicate that elevated, even unstable levels of CU, are associated with highest risk and worse adjustment outcomes: behavioral difficulties, negative family background, fearlessness and emotional abuse/neglect. Person-centered approaches have been used also to model the joint evolution of CU traits and conduct problems in childhood. In the 7-12 year-old twin sample, Fontaine, McCrory, Boivin, Moffitt, and Viding (2011) identified four trajectories of combined CU and conduct problems: stable high (4.7%), increasing (7.3%), decreasing (13.4%) and stable low (74.6%). Recently, Klingzell et al. (2016) found five latent classes of combined CU traits and conduct problems (CP) in a sample of 2031 in-school

children at three age points (3-5, 4-6, 5-7): high CP+CU (6.8%), increasing CP+CU (13.8%), decreasing CP+CU (7.2%), high CP+lowCU (5.4%) and low CP+CU (66.8%). These studies also observed that belonging to trajectories with high levels of both conduct problems and CU traits has more risks and the most negative outcomes (hyperactivity, peer problems, emotional problems, negative parental feelings, fearlessness and psychopathic traits other than CU). Furthermore, studies of trajectories have reported the percentages of children chronically affected by these problems (between 3 and 10%) and have shown that there are distinct developmental pathways with distinct targets for prevention and intervention. However, no previous study has analyzed the joint development of the conduct problems and CU subtypes/variants.

Considering the importance of CU traits in distinguishing more severe conduct problems, and within the CU subtype the importance of differentiating levels of anxiety and trauma history as an indicator of divergent developmental pathways to the phenotypic presentation of CU traits (primary/secondary), we aimed to investigate whether it is possible to identify the heterogeneity of behavior problems based on CU traits, anxiety and ODD levels from preschool age. This study examines the course of co-occurring CU traits, anxiety and ODD levels in a longitudinal community sample of children assessed annually between ages 3 and 7, through developmental trajectories estimated with growth mixture modeling. This is the first study to combine the two subtyping approaches, and to generally investigate CU primary-secondary subtypes in a preschool aged sample. Also, prior primary/secondary subtyping relies on a single static time-points to identify variants, whereas this study examines stable variants across multiple measurement points from ages 3 to 7. Among the resulting trajectories, we expected to find the different variants of behavior problems reported in the literature (with limited prosocial emotions -primary-, and secondary variants of psychopathy) presenting different external and individual characteristics at the baseline and

with different outcomes consistent with previous research. We were specifically interested in testing if primary and secondary variants emerged and if they were different, as no studies have yet been focused specifically on ODD in preschoolers and in the general population. We would expect the secondary variant, in comparison with the primary variant, to show more difficulties in emotional regulation, aggressive behavior, life events, and a higher degree of conduct problems at follow-up. The identification of such groups may have important preventive implications from age 3.

2. Materials and Methods

The longitudinal project was approved by the ethics review committee of the authors' institution (Comissió d'Ètica en l'Experimentació Animal I Humana; CEEAH 1385).

Informed written consent was obtained from parents of the children participating in the study, as approved by the ethics committee.

2.1. Participants

The sample comes from a longitudinal study of behavioral problems starting at age 3, described in (Ezpeleta, Osa, & Doménech, 2014). The initial sample consisted of 2,283 children randomly selected from early childhood schools in Barcelona (Spain). A two-phase design was employed. In the first phase of sampling, 1,341 families (58.7%) agreed to participate (33.6% high socioeconomic status, 43.1% middle, and 23.3% low; 50.9% boys). To ensure the participation of children with possible behavioral problems (and specifically with ODD), the parent-rated Strengths and Difficulties Questionnaire (SDQ³⁻⁴) conduct problems scale (Goodman, 2001) plus four ODD DSM-IV-TR symptoms not included in the SDQ questions were used for screening. Two groups were potentially considered: screen-positive, which includes all children with SDQ³⁻⁴ scores ≥ 4 , percentile 90, or with a positive

response for any of the 8 DSM-IV ODD symptoms ($N = 205$; 51.2% boys), and screen-negative, a random group comprising 28% of children who did not reach the positive threshold ($N = 417$; 49% boys). Refusals in this phase ($n=135$; 10.6%) did not differ in sex ($p=.815$) or type of school (public or semi-public) ($p=.850$) from those children who did agree to participate (the only difference was in SES, with a higher participation ratio for high socioeconomic levels, 86.2% vs. 73.6%; $p=.007$).

The final sample for the follow-up (second phase of sampling design) included 622 children first assessed at age 3. Mean age for the full sample was 3.77 years ($SD=0.33$), and 96.9% were born in Spain. Demographic characteristics are shown in the first column of Table 1.

At age 4, 604 (97.1%) children remained in the follow-up (303 boys), at age 5 there were 574 (93.3%; 290 boys), at age 6 there were 511 (82.2%; 256 boys) and at age 7 the number of completers was 496 (79.7%; 243 boys). No differences in sex ($\chi^2=0.70$, $df=1$, $p=.40$), SES ($\chi^2=2.95$, $df=2$, $p=.23$) or type of school ($\chi^2=0.02$, $df=1$, $p=.90$) were found when comparing completers and drop-outs. The presence of any DSM5 disorder at baseline did not predict the risk of drop-out during the follow-up ($\chi^2=2.49$, $df=1$, $p=.11$), nor the baseline levels in any of the three scales used for generating the developmental trajectories (CU trait: $\chi^2=2.00$, $df=1$, $p=.16$; anxiety: $\chi^2=0.22$, $df=1$, $p=.64$; ODD: $\chi^2=1.09$, $df=1$, $p=.30$).

2.2. Measures

2.2.1. Trajectory measures

Callous-Unemotional Traits. The *Inventory of Callous-Unemotional Traits* (ICU) (Frick, 2004) includes 24 items coded on a 4-point Likert-type scale (0: *not at all true* to 3: *definitely true*) structured in three dimensions: Callousness, Uncaring and Unemotional. The total score, which is the sum of raw scores as reported annually by teachers, was used to

obtain the developmental trajectories of CU traits since it has been suggested that the total score provides a reliable and valid continuous measure of CU traits (Ray, Frick, Thornton, Steinberg, & Cauffman, 2016). Cronbach's alpha ranged from .79 to .90.

Oppositionality (ODD-s). The level of ODD-symptoms was measured by the conduct scale of the *Strengths and Difficulties Questionnaire* (SDQ) (Goodman, 2001) (temper tantrums, disobedient, argumentative and spiteful), plus four additional items at ages 3-4 and five at ages 5-7 required to complete the DSM-5 ODD symptomatology (annoys, blames, touchy, angry, plus argumentative at ages 5-7, which is not included in the SDQ⁵⁻¹⁶) (see Table S1). The same 8 symptoms were used at all the ages. The sum of the eight symptoms, coded on a 3-point Likert-type scale (0: *not true*; 1: *somewhat true*; 2: *certainly true*) reported by teachers each year, was used to obtain the developmental trajectories of ODD-s. Cronbach's alpha ranged from .68 to .73.

Anxiety. The anxiety-problems DSM5-oriented scale of the *Child Behavior Checklist* (Achenbach, 2013), as reported by parents, was used for the developmental trajectories of anxiety. Items are coded on an ordinal scale with three options (0: *not true*; 1: *somewhat/sometimes true*; 2: *very true/often true*). Since the anxiety scale used at ages 3-4-5 is not the exactly the same as that used for ages 6-7, the analyses were conducted for standardized T-scores rather than for raw scores. Cronbach's alpha ranged from .65 to .78

Table S1 contains the list with the ODD-s and anxiety items considered in this study.

2.2.2. Measures at baseline and outcomes

Table S2 contains a detailed description of each measure, as well as the Cronbach's alpha (α) in the sample for the scales analyzed in this study. Table S3 shows the descriptive statistics of the measures.

The *Children's Behavior Questionnaire Short Form (age 3) and Very Short Form (age 7)* (Putnam & Rothbart, 2006) measure reactive and self-regulative temperament, with 94 items on a 7-point Likert-type scale, ranging from 1 (*extremely untrue*) to 7 (*extremely true*). It was answered by parents when children were 3 and 7 year-old. The 3 broad dimensions of temperament: negative affectivity, effortful control, and surgency were analyzed.

The *Kiddie-Continuous Performance Test (K-CPT; Conners, 2006)* is a performance-based measure of attention function and response inhibition administered at aged 4. The software present stimuli consisting in familiar pictures for very young children, and response/no response are to be made depending on the picture that appears. *Omission* scores (means lack of a required response) and *commission* (a response after a stimulus that requires none) were used.

The *Behavior Rating Inventory of Executive Function preschool version (BRIEF-P; Gioia, Espy, & Isquith, 2003)* assesses behaviors reflecting the executive functions in daily life in preschool children. The instrument consists of 63 items on a 3-point ordered scale (1: *Never*, 2: *Sometimes*, 3: *Often*). Two dimensions of executive functioning, Inhibit (I) and Emotional Control (EM) were used. Teachers answered the questionnaire when children were 3 year-old.

The *Child Behavior Checklist (CBCL/1½-5 and CBCL/6-18; Achenbach & Rescorla, 2000; 2001)* measure behavioral and emotional problems as reported by parents through 100 and 112 items respectively, with 3 response options (0: *not true*, 1: *somewhat/sometimes true*, 2: *very true/often true*). Attention problems syndrome scale at age 3 and DSM-5 oriented scales at age 7 were used for the analyses.

The *Children's Aggression Scale* (CAS; Halperin & McKay, 2008) assesses aggressive behavior with 22 items (0: *never* to 4: *many days*). Provoked and initiated physical aggression and total score responded by teachers was used when children were 3 years-old.

The Social and Communication Disorders Checklist (Skuse et al., 1997) assesses child's social cognition deficit. It is a 12-item questionnaire (0: *not true*, 1: *quite true*, 2: *very true*) that was completed by the teacher when children were 5 year-old.

Schedule for Risk Factors (SRF; Unitat d'Epidemiologia i de Diagnòstic en Psicopatologia del Desenvolupament, 2009) is a computerized structured interview conceived as a compendium of potential areas of risk of psychopathology that should be evaluated in children. Life events section reported by parents at age 3 were used for this analysis.

The *Alabama Parenting Questionnaire-Preschool* (Frick, 1991; Osa, Granero, Penelo, Doménech, & Ezpeleta, 2014) measures parental practices. It consists in 42-item (1: *Never*; 2: *Almost never*; 3: *Sometimes*; 4: *Often*; 5: *Always*). The dimensions positive discipline techniques, inconsistent parenting and punitive parenting involvement with children, poor supervision, consistency in the use of discipline, and the use of corporal punishment. Two additional scales, limits (6 items) and autonomy (3 items) were added to the instrument with the same response format. It was applied at age 3.

Adult Self-Report (ASR; Achenbach & Rescorla, 2003) assesses dimensional psychopathology in adults between ages 18 and 59. It contains 126 items (0: *not true*, 1: *somewhat/sometimes true*, 2: *very true/often true*). Mothers and fathers answered separately the questionnaire when children were 3 year-old and rule breaking and aggressive behavior were analyzed.

Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997) assesses children's ability to regulate their emotions as reported by parents. It has 24 items (1: *never* to 4: *always*

true). The negativity/lability and the emotion regulation subscales were applied when children were 7 year-old.

Affective Reactivity Index (ARI; Stringaris et al., 2012) is a 6 item scale (0: *not true* to 2: *certainly true*) to assess irritability. It was answered by the teachers when children were 7 year-old.

The *Sensitivity to Punishment and Sensitivity to Reward Questionnaire for Children* (SPSRQ-C; Colder and O'Connor, 2004) contains 33 items (0: *strongly disagree* to 4: *strongly agree*) to assess sensitivity to reinforcement according to Gray's model. It contains four scales (sensitivity to punishment, impulsivity/fun-seeking, drive and reward responsivity) that were answered by the parents when children were 6 years-old.

The *Diagnostic Interview for Children and Adolescents for Parents of Preschool and Young Children* (DICA-PPYC; Ezpeleta, Osa, Granero, Doménech, & Reich, 2011) is a computerized semi-structured diagnostic interview for assessing the most common psychological disorders at ages 3-7 as reported by parents, following the DSM-5 criteria (American Psychiatric Association, 2013). Diagnoses at age 7 were used as covariates.

The *Children's Global Assessment Scale* (CGAS; Shaffer et al., 1983) is a global measure of functional impairment rated by the interviewer based on information from the diagnostic interview with the parents when children were 7 year-old.

2.3. Procedure

Families were recruited at the schools and gave their written consent. All families of children in grade P3 (3-year-olds) in the participating schools were invited to answer the screening questionnaire. Families who agreed were interviewed with a semi-structured diagnostic interview and other psychological assessment instruments at the school for each assessment. The interview team was specifically trained in the use of the assessment

instruments, and all interviewers were blind to the screening group. After the interview, the parents answered the questionnaires, the interviewer completed the impairment instrument considering the information of the diagnostic interview, the teachers were given the questionnaires for completion before the end of the academic year, and the child performed the attention task. The data were collected once a year between November 2009 and July 2013, with an average interval of 11.01 months between the first and second assessments (SD=1.15), 12.45 months (SD=1.19) between the second and third assessments, and 10.81 months (SD=1.55) between the third and fourth assessments. The average interval between the parent-family assessment and teacher's report in the follow-ups was between 2.5 months (SD=5.22) for the first assessment and 3.3 months (SD=3.09) for the fourth assessment. The average time that teachers knew the children ranged from 7.6 months (SD=2.19) in the first assessment to 12.7 months (SD=6.23) in the last assessment.

2.4. Statistical Analysis

The trajectories were obtained in MPlus7, through Growth-Mixture-Modeling (GMM), a procedure that permits the identification of clusters of individuals who follow different individual trajectories. The model defines the shape (i.e. increasing, decreasing, etc.) of each trajectory and the proportion of children belonging to each one. The Robust-Maximum-Likelihood (MLR), a full-information method which can handle missing data was used to estimate the parameters (Enders & Bandalos, 2001; Graham, 2009). The repeated measures for the three behaviors of the study (CU, anxiety and ODD-s) were simultaneously entered into the model. The selection of the number of trajectories for each model was based on: a) the lowest Bayesian information criterion (BIC) (lower values indicate a more parsimonious model); b) entropy > .80 (values closer to 1 indicate greater accuracy of the classification); c) high on-diagonal average values (around .80) in the matrix containing the

probabilities of membership; and d) the best clinical interpretability. Due to the two-stage sampling design, a sampling weight variable in Mplus was defined in the GMM procedure, assigning to each subject a weighting equal to the inverse probability of selection after the sampling screening phase (WEIGH command in Mplus syntax).

The other analyses were carried out in SPSS20 with Complex Samples (CS, due to the multi-stage sampling), and each subject was also weighted by the inverse proportion to the probability of selection in the second phase of the sampling. The comparison between trajectories was measured with logistic regression (binary outcomes) and General Linear Models (GLM, quantitative criteria). Comparisons were adjusted to the covariates family social status and presence of comorbidities in the child different to ODD and anxiety at baseline (ADHD, conduct disorder, and mood disorders) to obtain the specific discriminative capacity of trajectories. Pairwise comparisons (odds ratio -OR- in logistics and mean differences -MD- in GLM) estimated differences between trajectories.

Inflation in Type-I error due to multiple statistical comparisons was controlled with Bonferroni's method. Since it is more relevant to measure and interpret the effect sizes than to draw conclusions based on statistical significance tests (Garamszegi, 2006), Cohen's-*d* coefficients measured the effect size for each pairwise comparison (effect size was considered moderate for $|d| > 0.5$ and good for $|d| > 0.8$ (Kelley & Preacher, 2012)). In this study, interpreting results as relevant required at least moderate effect size.

3. Results

3.1. Empirical trajectories of CU+ANX+ODD-s

GMM estimated candidate models with a number of trajectories ranging from 3 to 6 (solutions for a higher number of classes were not considered due to very small groups with lack of clinical interpretation). The modeling was done with $n=620$ children (two subjects

were excluded due an unsuitable missing-pattern: only one measure was available for them during the follow-up). Table S4 shows goodness-of-fit indices for the set of 3 to 6 candidate group solutions.

The model finally selected identified six trajectories of the co-occurring CU+ANX+ODD-s (Fig 1), and yielded the lowest BIC (58205.431), good entropy (.837), high on-diagonal values in the matrix with the average latent class probabilities (between .84 for T6 and .91 for T1), and clinical interpretability (Table S5 shows the model results corresponding to the means of the intercepts, slopes and quadratic terms of the final solution).

Trajectory 1 (T1:null; $n=337$, 58.9% weighted) represented those children with persistently low levels of CU, anxiety and ODD-s from ages 3 to 7. Trajectory 2 (T2:ANX-increasing; $n=42$, 4.9% weighted) represented those children with anxiety levels increasing during the follow-up, and low levels of CU and ODD-s. Trajectory 3 (T3:CU+ANX+ODD; $n=17$, 2.4% weighted) identified children with high levels of CU, anxiety and ODD-s. Trajectory 4 (T4:CU+ODD-decreasing; $n=54$, 8.1% weighted) included children with CU scores persistently above the mean, high but decreasing ODD symptoms, and low anxiety levels. Trajectory 5 (T5:CU+ODD-increasing; $n=105$, 16.4% weighted) clustered children with high increasing levels of ODD-s, CU scores persistently above the mean, and low anxiety. Finally, Trajectory 6 (T6:ANX-decreasing; $n=65$, 9.2% weighted) represented children with decreasing anxiety levels from ages 3 to 7, and low levels of CU and ODD-s.

No differences between developmental classes were related to children's sex and ethnic group (Table 1), but T3 (CU+ANX+ODD) included a higher proportion of families of low socioeconomic status than the other trajectories.

3.2. Comparison between trajectories at baseline

Table 2 presents the distribution for the measures of the study at baseline, adjusted by family SES and other comorbid disorders different to ODD and anxiety, and the resultant significant comparisons of each trajectory in relation to T1:null (considered as the reference/control group). Specific post-hoc comparisons were made for trajectories T3:CU+ANX+ODD versus T4:CU+ODD-decreasing, and T3:CU+ANX+ODD versus T5:CU+ODD-increasing (last columns of Table 2), as this was one of the main interests of the study (Table S6 contains the value of each contrast and their specific effect size calculated with Cohen's-*d* coefficient).

Several pairwise comparisons achieved relevant effect-size ($|d| > 0.50$) in relation to T1:null. Children in T2:ANX-increasing presented higher anxiety, negative affectivity, attention problems and difficulties in social cognition. Children in T3:CU+ANX+ODD displayed higher uncaring and total CU traits, ODD-s, anxiety, difficulties in executive functioning (inhibition and emotional control), attention problems, aggression behavior, difficulties in social cognition, inconsistent parenting, few limits, higher number of life events, and both father and mother scored higher in aggressive behavior and rule breaking. Children in T4:CU+ODD-decreasing exhibited higher callousness, uncaring, total CU traits, ODD-s, surgency, difficulties in inhibition and emotional control, attention problems, aggression behavior, difficulties in social cognition, and had fathers with a higher aggressive behavior score. Children in T5:CU+ODD-increasing scored higher in callousness, uncaring, total CU traits, ODD-s, inhibition problems, aggression behavior, difficulties in social cognition, and their fathers had higher aggressive behavior scores. Children in T6:ANX-decreasing scored higher in anxiety and negative affectivity.

The comparison of T3:CU+ANX+ODD and T4:CU+ODD-decreasing indicated that the former scored higher in anxiety, negative affectivity, emotional control difficulties, made more errors in commissions and fewer in omissions, had more life events, inconsistent

parenting, few limits, and the mother scored higher in aggressive behavior and rule breaking while the father did so in rule-breaking. These two trajectories did not differ in sex or ethnic group but there were more children of low and middle SES in T3:CU+ANX+ODD (80%) than in T4:CU+ODD-decreasing (27.4%) ($\chi^2 = 13.7$; $df = 2$; $p = .001$).

The comparison of T3:CU+ANX+ODD and T5:CU+ODD-increasing indicated that the former scored higher in anxiety, emotional control difficulties, and life events, and the mother scored higher in aggressive behavior and rule breaking. These two trajectories did not differ in sex or ethnic group but there were more children of low and middle SES in T3:CU+ANX+ODD (80%) than in T5:CU+ODD-increasing (35.3%) ($\chi^2 = 11.3$; $df = 2$; $p = .004$).

3.3. Predictive capacity of the trajectories for outcomes at age 7

Table 3 presents the mean values obtained by each trajectory in the studied variables (first column) and the resultant significant comparisons of each in relation to T1:null (defined as the reference-control group). Again, a specific comparison was made for trajectories T3:CU+ANX+ODD versus T4:CU+ODD-decreasing and T3:CU+ANX+ODD versus T5:CU+ODD-increasing. Table S7 contains the value of each contrast and their specific effect size calculated with Cohen's *d* coefficient).

The following pairwise comparisons in relation to T1:null achieved moderate to high effect size ($|d| > 0.5$). Children in T2:ANX-increasing at final follow-up were characterized by negative affectivity, difficulties in emotional regulation, more marked sensitivity to reinforcement, higher scores in all psychopathology scales and more functional impairment. Children in T3:CU+ANX+ODD had the same difficulties as T2:ANX-increasing, plus higher aggression and anger scores. Children in T4:CU+ODD-decreasing were distinguished by high aggression scores (provoked and total), anger, externalizing disorders (ADHD, ODD and

conduct scores), and worse functioning. Children in T5:CU+ODD-increasing were identified by difficulties in aggression, emotional lability, anger, high scores in externalizing disorders and worse functioning. Children in T6:ANX-decreasing showed negative affectivity, high aggression scores, emotional lability, anger, higher sensitivity to punishment, high scores in internalizing disorders (affective and anxiety), conduct and low functioning.

The comparison of T3:CU+ANX+ODD and T4:CU+ODD-decreasing indicated that at age 7, children in the former scored higher in all the variables except surgency, effortful control and emotion regulation. The comparison of T3:CU+ANX+ODD and T5:CU+ODD-increasing indicated that at age 7, children in the former scored higher in all the variables except surgency, effortful control and emotion regulation, anger, and somatic complains.

4. Discussion

GMM captured different developmental trajectories from age 3 to 7 for pure anxiety, ODD-s plus CU traits, and ODD-s plus CU traits plus anxiety, which reflect the heterogeneity of presentation of behavior problems. Each trajectory presented different characteristics at baseline coherent with current knowledge and had a distinctive outcome. Not only did a control group (T1:null) and pure groups (T2:ANX-increasing, T6:ANX-decreasing) emerge as expected, but so did well-recognized specifiers such as T4:CU+ODD-decreasing and T5:CU+ODD-increasing, which may be analogous to CD with limited prosocial emotions and to the primary psychopathy variant, or T3:CU+ANX+ODD, which corresponds to the secondary psychopathy variant. The recognition of these empirically derived latent classes have important implications for: a) the early detection of affected children, as we have shown that it is possible to identify these manifestations clustered early in life; b) designing treatments for the affected children, with specific components for the specific difficulties; and c) advancing our knowledge of the etiology of the specific classes.

One of the main interests was to test if the primary and secondary variants of psychopathy as assessed through CU traits could be identified early in life in relation to ODD symptoms. Three trajectories emerged that exhibited the constructs implicated in these two variants: T4:CU+ODD-decreasing and T5:CU+ODD-increasing, which represent the primary psychopathy variant, and T3:CU+ANX+ODD, which is less prevalent, representing the secondary variant. Comparing both, the secondary variant emerged as a more severe clinical picture and presented higher difficulties in executive functioning (emotional control and impulsive behavior), worse environmental characteristics (lower SES, more life events, worse parental practices and higher parental psychopathology), and worse outcomes at age 7 in terms of negative affectivity and emotional lability, aggression behavior, more marked sensitivity to reinforcement, higher psychopathological symptoms, and worse global functioning. These results are in line with the previous literature on adolescents, in which the secondary variant was more severely affected (Kahn et al., 2013; Kimonis et al., 2012; Kimonis et al., 2011; Fanti et al., 2013) and was the least prevalent (Kimonis et al., 2012; Kimonis et al., 2011). The ratio range of primary to secondary was 3.2:1 (for T4:CU+ODD-decreasing) to 6.2:1 (for T5:CU+ODD-decreasing), which is somewhat higher than the ratio reported in other community studies with adolescents such as that of Fanti et al. (2013), who found a 2.8:1 ratio. Although CU traits have shown a certain stability from early childhood to adolescence (Obradović, Pardini, Long, & Loeber, 2007; Willoughby et al., 2011), they tend to decrease over time (Klingzell et al., 2016) and we were evaluating a very young cohort, which had less time for the development of sound prosociality and less environmental influence, and this may explain the different ratios. This notwithstanding, we found some support in data relating to very young children for the proposal of Kimonis et al. (2012) regarding the etiological pathways of the primary and secondary variants. These authors suggested that one of the roots of the differences in emotional processing in both variants

might be temperament, in the sense that the levels of emotional reactivity (too low in primary, or too high in secondary) may interfere with adequate conscience development (guilt, empathy) (Kochanska, 1993). At baseline, we found that CBQ-Negative affectivity significantly differentiated the trajectories T4:CU+ODD-decreasing (primary) and T3:CU+ANX+ODD (secondary), with T3 presenting higher emotional negativity characteristics. This difference was maintained at age 7, and also held for T5:CU+ODD-increasing. Another etiological base for the differences proposed by Kimonis et al. (2012) was environmental experiences, in the sense that having been exposed to negative experiences, such as maltreatment, might alter the hypothalamus-pituitary-adrenocortical system and the regulation of emotional response of children exposed. In our study, at baseline, several environmental adversities such as low SES, the number of life events, parental practices and parental psychopathology significantly differentiated the trajectories T4:CU+ODD-decreasing and T5:CU+ODD-increasing (primary) from T3:CU+ANX+ODD (secondary), with children in T3 having suffered more adverse environmental experiences. Both trajectories had similar levels of CU traits as found in the study of Kimonis et al. (2012), and there were no sex or ethnic differences.

The specifier ODD “with limited prosocial emotion” also emerged in two trajectories differentiated by the development of the ODD symptoms (T4:CU+ODD-decreasing and T5:CU+ODD-increasing) and showed, in line with theory, deficits in executive functioning, attention, aggression behavior, social cognition and worse outcomes at age 7 in comparison with the control group. Finally, two “pure” anxiety groups emerged. These were T2:ANX-increasing and T6:ANX-decreasing, both with stable negative affectivity and difficulties in emotional lability, high sensitivity to punishment, and high affective and anxiety DSM symptoms at the age 7 follow-up, but this differed in the worse global outcomes for T2:ANX-increasing. Therefore, we could conclude that the trajectories identified show criterion

validity, as is demonstrated by its precursors (baseline characteristics) and outcomes in line with the phenomenology of the disorders.

The length of the study (5 years) covering the preschool period in a large general population sample, the varied reporters used for the study of the baseline and outcome characteristics, which included parents, teachers and children, and the application of strong analytic techniques are strengths of the study. However, some limitations must be considered in interpreting the results. Some of the classes consist of a small number of children. This is especially true for T3:CU+ANX-ODD, with 17 cases. Small sample size group can affect statistical power. Although, in our study, we have used significance tests but also size effects through Cohen's- d , estimations of the d when the sample is small have more variability and, consequently, should be interpreted cautiously. However, this trajectory is characterized by the worst outcome and it is not expected that many children in the general population would present such a sustained negative development. Also, this trajectory has been the least prevalent in previous studies with older children (Fanti et al., 2013; Lee et al., 2010).

Although varied reporters (teachers, parents) were used for deriving the trajectories, it was not possible to include observational or laboratory measures. Furthermore, although maltreatment was evaluated in the life events interview with parents, no other published reports of abuse were available. Also, the reliability of the anxiety measure used to define the trajectories (CBCL/1^{1/2}-5 DSM5-anxiety) was within the moderate-low range for the youngest children ($\alpha=.65$ for age 3-4-5). It should be noted however that previous studies have highlighted the difficulties of parents in assessing internalizing symptoms in their young children (De los Reyes & Kazdin, 2005). Regarding other measures, such as the CBQ, concerns have arisen in relation with its validity. Recent research has shown divergent higher and lower factorial structure (Kotelnikova, Olino, Klein, Kryski, & Hayden, 2015), and this may imply that important temperamental constructs could not be well represented using the original structure

of the questionnaire. Given the high heritability reported for some of the components of the trajectories (such as for CU) (Viding & McCrory, 2012), future genetic and genetic x early environment studies could contribute to improving knowledge of the etiological pathway of each class. Also, intervention studies should test the most effective components of treatment programs for each class.

The results imply that children in the different trajectories may have different risk processes and may need different treatment approaches. Thus, although both children in T3:CU+ANX-ODD, T4:CU+ODD-decreasing and T5:CU+ODD-increasing present high ODD-s, the components of the treatment package each needs to receive may differ. All would probably benefit from parenting training based on social learning (Battagliese et al., 2015). Also, as CU traits have been associated with insensitivity to punishment, and hence, children with CU are less responsive to discipline, but they respond to praise, support of others or to maintaining a positive relationship with teacher (Allen, Morris, & Chhoa, 2016; Hawes & Dadds, 2005). Therefore, for all the previously mentioned groups reducing the punishment component and strengthening positive reinforcement parenting to increase prosocial behaviors, or training in focusing attention on the eye region, a novel intervention that facilitates emotional engagement between the child and its parents, may prove effective (Hawes et al., 2014). Support for T5:CU+ODD-increasing or T3:CU+ANX-ODD may need to include strengthening effective discipline practices (Dadds et al., 2012; Dadds et al., 2014; Hawes & Dadds, 2005). Children of T3:CU+ANX-ODD may require cognitive-behavioral treatment for the internalizing problems or trauma-focused CBT, as suggested by Sharf, Kimonis, and Howard (2014). Furthermore, the results have important preventive implications. If it is possible to identify these trajectories very early in life, then, given the outcomes associated with them, the early detection of children with these characteristics should be a priority.

From the developmental psychopathology perspective, the different developmental trajectories show the distinct dynamic processes that CU, ODD-s and anxiety present for different children from ages 3 to 7. In most of the trajectories, the developmental pathway of ODD and CU followed a similar shape (although distances on the y axis varied), which may be interpreted as a certain co-stability in the development of both characteristics. There were also discontinuities across development. Decreasing discontinuities may be more consistent with the expected increases with age in behavioral and emotional control as well as in empathy and prosocial behavior. The increasing trajectories (i.e. T2:ANX-increasing, T5: CU+ODD-increasing) may be showing cases of early onset psychopathology. To better understand behavior problems, future causal model studies should trace the developmental stability of the outcome (each trajectory) and the developmental mechanisms, which according to our results may focus on negative affectivity, inhibition, social cognition, emotion regulation, inconsistent parenting and limit setting, stressful environment, or the genetics of aggressive behavior. Longer assessment periods may help to understand the evolution of the different trajectories through puberty and adolescence.

Acknowledgements

We would like to thank the participating schools and families.

Funding sources

This work was supported by the Spanish Ministry of Economy and Competitiveness [grants PSI2012-32695 and PSI2015-63965-R (MINECO/FEDER)] and the Secretaria d'Universitats i Recerca, Departament d'Economia i Coneixement de la Generalitat de Catalunya [grant 2014 SGR 312].

References

- Achenbach, T. M. (2013). *DSM Guide for the ASEBA*. Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families.
- Achenbach, T. M., & Rescorla, L. A. (2000). *Manual for the ASEBA preschool-age forms & Profiles*. Burlington, VT: University of Vermont, Research Center for Children, Youth & Families.
- Achenbach, T. M., & Rescorla, L. A. (2001). *Manual for the ASEBA school-age forms & Profiles*. Burlington, VT: University of Vermont, Research Center for Children, Youth & Families.
- Achenbach, T. M., & Rescorla, L. A. (2003). *Manual for the ASEBA adult forms & profiles*. Burlington, VT: University of Vermont, Research Center for Children, Youth & Families
- Allen, J. L., Morris, A., & Chhoa, C. Y. (2016). Callous-unemotional (CU) traits in adolescent boys and response to teacher reward and discipline strategies. *Emotional and Behavioural Difficulties*, 21(3), 329-342. doi:10.1080/13632752.2016.1165968
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Association.
- Battagliese, G., Caccetta, M., Luppino, O. I., Baglioni, C., Cardi, V., Mancini, F., & Buonanno, C. (2015). Cognitive-behavioral therapy for externalizing disorders: A meta-analysis of treatment effectiveness. *Behaviour Research and Therapy*, 75, 60-71. doi: 10.1016/j.brat.2015.10.008
- Bufferd, S. J., Dougherty, L. R., Carlson, G. A., Rose, S., & Klein, D. N. (2012). Psychiatric Disorders in Preschoolers: Continuity From Ages 3 to 6. *American Journal of Psychiatry*, 169(11), 1157-1164. doi: 10.1176/appi.ajp.2012.12020268

- Byrd, A. L., Hawes, S. W., Loeber, R., & Pardini, D. A. (2016). Interpersonal callousness from childhood to adolescence: Developmental trajectories and early risk factors. *Journal of Clinical Child & Adolescent Psychology*. doi: 10.1080/15374416.2016.1144190
- Colder, C. R., & O'Connor, R. M. (2004). Gray's reinforcement sensitivity model and child psychopathology: Laboratory and questionnaire assessment of the BAS and BIS. *Journal of Abnormal Child Psychology*, 32, 435-451.
- Conners, C. K. (2006). *Kiddie Conner's Continuous Performance Test technical guide and software manual*. Toronto: Multi-Health Systems.
- Dadds, M. R., Allen, J. L., McGregor, K., Woolgar, M., Viding, E., & Scott, S. (2014). Callous-unemotional traits in children and mechanisms of impaired eye contact during expressions of love: a treatment target? *Journal of Child Psychology and Psychiatry*, 55, 771-780. doi: 10.1111/jcpp.12155
- Dadds, M. R., Allen, J. L., Oliver, B. R., Faulkner, N., Legge, K., Moul, C., . . . Scott, S. (2012). Love, eye contact and the developmental origins of empathy v. psychopathy. *British Journal of Psychiatry*, 200(3), 191-196. doi: 10.1192/bjp.bp.110.085720
- De los Reyes, A., & Kazdin, A. E. (2005). Informant discrepancies in the assessment of childhood psychopathology: a critical review, theoretical framework, and recommendations for further study. *Psychological Bulletin*, 131, 483-509. doi: 10.1037/0033-2909.131.4.483
- Enders, C. K., & Bandalos, D. L. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling*, 8, 430-457. doi: 10.1207/S15328007SEM0803_5

- Ezpeleta, L., Granero, R., de la Osa, N., Blas Navarro, J., Penelo, E., & Domenech, J. M. (2014). Tracing Developmental Trajectories of Oppositional Defiant Behaviors in Preschool Children. *PloS One*, 9(6). doi: 10.1371/journal.pone.0101089
- Ezpeleta, L., Osa, N. d. l., & Doménech, J. M. (2014). Prevalence of DSM-IV disorders, comorbidity and impairment in 3-year-old Spanish preschoolers. *Social Psychiatry and Psychiatric Epidemiology*, 49(1), 145-155. doi: 10.1007/s00127-013-0683-1
- Ezpeleta, L., Osa, N. d. l., Granero, R., Doménech, J. M., & Reich, W. (2011). The Diagnostic Interview for Children and Adolescents for Parents of Preschool and Young Children: Psychometric Properties in the general Population. *Psychiatry Research*, 190, 137-144. doi:10.1016/j.psychres.2011.04.034
- Fanti, K. A., Demetriou, C. A., & Kimonis, E. R. (2013). Variants of Callous-Unemotional Conduct Problems in a Community Sample of Adolescents. *Journal of Youth and Adolescence*, 42(7), 964-979. doi: 10.1007/s10964-013-9958-9
- Fontaine, N. M. G., McCrory, E. J. P., Boivin, M., Moffitt, T. E., & Viding, E. (2011). Predictors and Outcomes of Joint Trajectories of Callous-Unemotional Traits and Conduct Problems in Childhood. *Journal of Abnormal Psychology*, 120(3), 730-742. doi: 10.1037/a0022620
- Fontaine, N. M. G., Rijdsdijk, F. V., McCrory, E. J. P., & Viding, E. (2010). Etiology of Different Developmental Trajectories of Callous-Unemotional Traits. *Journal of the American Academy of Child and Adolescent Psychiatry*, 49(7), 656-664. doi: 10.1016/j.jaac.2010.03.014
- Frick, P. J. (1991). *Alabama Parenting Questionnaire*. Unpublished rating scale. University of Alabama.
- Frick, P. J. (2004). The Inventory of Callous-Unemotional traits. from <http://psyc.uno.edu/Frick%20Lab/ICU.html>

- Frick, P. J., Ray, J. V., Thornton, L. C., & Kahn, R. E. (2014). A developmental psychopathology approach to understanding callous-unemotional traits in children and adolescents with serious conduct problems. *Journal of Child Psychology & Psychiatry*, *55*, 532-548. doi: 10.1111/jcpp.12152
- Garamszegi, L. Z. (2006). Comparing effect sizes across variables: generalization without the need for Bonferroni correction. *Behavioral Ecology*, *14*(4), 682-687. doi: 10.1093/beheco/ark005
- Gioia, G. A., Espy, K. A., & Isquith, P. K. (2003). *Behavior Rating Inventory of Executive Function - Preschool version*. Lutz, FL: Psychological Assessment Resources.
- Goodman, R. (2001). Psychometric properties of the Strengths and Difficulties Questionnaire. *Journal of the American Academy of Child and Adolescent Psychiatry*, *40*, 1337-1345. doi: 10.1097/00004583-200111000-00015
- Graham, J. W. (2009). Missing data analysis: Making it work in the real world. *Annual Review of Psychology*, *60*, 549-576. doi: 10.1146/annurev.psych.58.110405.085530
- Halperin, J. M., & McKay, K. E. (2008). *Children's Aggression Scale*. Lutz, FL: Psychological Assessment Resources
- Hawes, D. J., & Dadds, M. R. (2005). The treatment of conduct problems in children with callous-unemotional traits. *Journal of Consulting and Clinical Psychology*, *73*, 737-741. doi: 10.1037/0022-006X.73.4.737
- Hawes, D. J., Dadds, M. R., Brennan, J., Rhodes, T., & Cauchi, A. (2013). Revisiting the treatment of conduct problems in children with callous-unemotional traits. *Australian and New Zealand Journal of Psychiatry*, *47*(7), 646-653. doi: 10.1177/0004867413484092
- Hawes, D. J., Price, M. J., & Dadds, M. R. (2014). Callous-unemotional traits and the treatment of conduct problems in childhood and adolescence: A comprehensive

- review. *Clinical Child and Family Psychology Review*, *17*, 248-267. doi:
10.1007/s10567-014-0167-1
- Hicks, B. M., Markon, K. E., Patrick, C. J., Krueger, R. F., & Newman, J. P. (2004).
Identifying psychopathy subtypes on the basis of personality structure. *Psychological
Assessment*, *16*, 276–288.
- Kahn, R. E., Frick, P. J., Youngstrom, E. A., Youngstrom, J. K., Feeny, N. C., & Findling, R.
L. (2013). Distinguishing Primary and Secondary Variants of Callous-Unemotional
Traits Among Adolescents in a Clinic-Referred Sample. *Psychological Assessment*,
25(3), 966-978. doi: 10.1037/a0032880
- Kelley, K., & Preacher, K. J. (2012). On effect size. *Psychological Methods*, *17*, 137–152.
doi: 10.1037/a0028086
- Kimonis, E. R., Frick, P. J., Cauffman, E., Goldweber, A., & Skeem, J. (2012). Primary and
secondary variants of juvenile psychopathy differ in emotional processing.
Development and Psychopathology, *24*(3), 1091-1103. doi:
10.1017/s0954579412000557
- Kimonis, E. R., Skeem, J. L., Cauffman, E., & Dmitrieva, J. (2011). Are Secondary Variants
of Juvenile Psychopathy More Reactively Violent and Less Psychosocially Mature
Than Primary Variants? *Law and Human Behavior*, *35*(5), 381-391. doi:
10.1007/s10979-010-9243-3
- Klingzell, I., Fanti, K. A., Colins, O. F., Frogner, L., Andershed, A.-K., & Andershed, H.
(2016). Early Childhood Trajectories of Conduct Problems and Callous-Unemotional
Traits: The Role of Fearlessness and Psychopathic Personality Dimensions. *Child
Psychiatry and Human Development*, *47*(2), 236-247. doi: 10.1007/s10578-015-0560-
0

- Kochanska, G. (1993). Toward a synthesis of parental socialization and child temperament in early development of conscience. *Child Development, 64*, 325–347.
- Kotelnikova, Y., Olino, T.M., Klein, D.N., Kryska, K.R., & Hayden, E.P. (2015). Higher- and lower-order factor analyses of the Children's Behavior Questionnaire in early and middle childhood. *Psychological Assessment*. doi: 10.1037/pas0000153
- Lahey, B. B., & Waldman, I. D. (2012). Phenotypic and causal structure of conduct disorder in the broader context of prevalent forms of psychopathology. *Journal of Child Psychology & Psychiatry, 53*, 536-557. doi: 10.1111/j.1469-7610.2011.02509.x
- Lee, Z., Salekin, R. T., & Iselin, A. R. (2010). Psychopathic Traits in Youth: Is There Evidence for Primary and Secondary Subtypes? *Journal of Abnormal Child Psychology, 38*, 381-393. doi: 10.1007/s10802-009-9372-7
- Longman, T., Hawes, D. J., & Kohlhoff, J. (in press). Callous-unemotional traits as markers for conduct problem severity in early childhood: A meta-analysis. *Child Psychiatry and Human Development*. doi: 10.1007/s10578-015-0564-9
- Obradović, J., Pardini, D. A., Long, J. D., & Loeber, R. (2007). Measuring interpersonal callousness in boys from childhood to adolescence: an examination of longitudinal invariance and temporal stability. *Journal of Clinical Child Psychology, 36*, 276-292.
- Osa, N. de la, Granero, R., Penelo, E., Doménech, J. M., & Ezpeleta, L. (2014a). Psychometric properties of the Alabama Parenting Questionnaire – Preschool revision (APQ-Pr) in 3 year-old Spanish preschoolers. *Journal of Child and Family Studies, 23*, 776-784. doi: 10.1007/s10826-013-9730-5
- Patrick, C. J. (2010). Conceptualizing the psychopathic personality. In R. T. Salekin & D. R. Lynam (Eds.), *Handbook of child & adolescent psychopathy* (pp. 15-48). New York: Guilford Press.

- Putnam, S. P., & Rothbart, M. K. (2006). Development of short and very short forms of the Children's Behavior Questionnaire *Journal of Personality Assessment*, *87*, 103-113.
- Ray, J. V., Frick, P. J., Thornton, L. C., Steinberg, L., & Cauffman, E. (2016). Positive and negative item wording and its influence on the assessment of callous-unemotional traits. *Psychological Assessment*, *28*(4), 394-404. doi: 10.1037/pas0000183
- Rowe, R., Maughan, B., Pickles, A., Costello, E. J., & Angold, A. (2002). The relationship between DSM-IV oppositional defiant disorder and conduct disorder: Findings from the Great Smoky Mountain Study. *Journal of Child Psychology and Psychiatry*, *43*, 365-373. doi: 10.1111/1469-7610.00027
- Scholte, E. M., & van der Ploeg, J. D. (2007). The development of a rating scale to screen social and emotional detachment in children and adolescents. *International Journal of Methods in Psychiatric Research*, *16*, 137-149. doi: 10.1002/mpr.222
- Shaffer, D., Gould, M. S., Brasic, J., Ambrosini, P., Fisher, P., Bird, H., & Aluwahlia, S. (1983). A Children's Global Assessment Scale (CGAS). *Archives of General Psychiatry*, *40*, 1228-1231. doi: 10.1001/archpsyc.1983.01790100074010
- Sharf, A., Kimonis, E. R., & Howard, A. (2014). Negative life events and Posttraumatic Stress Disorder among incarcerated boys with callous-unemotional traits. *Journal of Psychopathology and Behavioral Assessment*, *36*(3), 401-414. doi: 10.1007/s10862-013-9404-z
- Shields, A., & Cicchetti, D. (1997). Emotion regulation among school-age children: The development and validation of a new criterion Q-sort scale. *Developmental Psychology*, *33*, 906-916.
- Skuse, D. H., James, R. S., Bishop, D. V., Coppin, B., Dalton, P., Aamodt-Leeper, G., . . . Jacobs, P. A. (1997). Evidence from Turner's syndrome of an imprinted X-linked locus affecting cognitive function. *Nature Biotechnology*, *387*(6634), 705-708.

- Stringaris, A., Goodman, R., Ferdinando, S., Razdan, V., Muhrer, E., Leibenluft, E., & Brotman, M. A. (2012). The Affective Reactivity Index: a concise irritability scale for clinical and research settings. *Journal of Child Psychology and Psychiatry*, *53*(11), 1109-1117.
- Unitat d'Epidemiologia i de Diagnòstic en Psicopatologia del Desenvolupament. (2009). *Protocolo de Factores de Riesgo. Versión para preescolares*. Universitat Autònoma de Barcelona, Departament de Psicologia Clínica i de la Salut, Barcelona.
- Vaughn, M. G., Edens, J. F., Howard, M. O., & Smith, S. T. (2009). An Investigation of Primary and Secondary Psychopathy in a Statewide Sample of Incarcerated Youth. *Youth Violence and Juvenile Justice*, *7*(3), 172-188. doi: 10.1177/1541204009333792
- Viding, E., & McCrory, E. J. (2012). Genetic and neurocognitive contributions to the development of psychopathy. *Development and Psychopathology*, *24*(3), 969-983. doi: 10.1017/s095457941200048x
- von Eye, A., & Bergman, L. R. (2003). Research strategies in developmental psychopathology: Dimensional identity and the person-oriented approach. *Development and Psychopathology*, *15*, 553-580. doi: 10.1017/S0954579403000294
- West, S. G., Ryu, E., Kwok, O. M., & Cham, H. (2011). Multilevel modeling: Current and future applications in personality research. *Journal of Personality and Social Psychology*, *79*, 2-50. doi: 10.1111/j.1467-6494.2010.00681.x
- Willoughby, M. T., Waschbusch, D. A., Moore, G. A., & Propper, C. B. (2011). Using the ASEBA to screen for callous unemotional traits in early childhood: Factor structure, temporal stability, and utility. *Journal of Psychopathology and Behavioral Assessment*, *33*, 19-30. doi: 10.1007/s10862-010-9195-4

Table 1

Demographic Characteristics of the total sample at Baseline (n=622) and comparison between trajectories.

		Percentages (%)							χ^2	df	p
Total sample		T1 Null n=622	T2 ANX Increasing n=42	T3 CU+ANX+ODD n=17	T4 CU+ODD- Increasing n=54	T5 CU+ODD- Decreasing n=105	T6 ANX Decreasing n=65				
Sex											
	<i>Girls</i>	50.2	52.7	40.0	33.3	47.1	43.1	52.6	6.18	5	.290
	<i>Boys</i>	49.8	47.3	60.0	66.7	52.9	56.9	47.4			
Ethnic group											
	<i>Non-hispanic white</i>	89.1	92.6	83.3	93.3	92.0	91.2	82.8	14.5	10	.152
	<i>Hispanic-American</i>	6.4	4.6	6.7	6.7	4.0	3.9	5.2			
	<i>Other</i>	4.5	2.7	10.0	0.0	4.0	4.9	12.1			
Socioeconomic status											
	<i>High</i>	35.5	36.9	29.0	6.7	39.2	37.3	31.6	32.1	20	.042
	<i>Mean-high</i>	32.3	35.0	29.0	13.3	33.3	27.5	29.8			
	<i>Mean</i>	14.0	13.7	22.6	33.3	13.7	11.8	10.5			
	<i>Mean-low</i>	13.8	10.7	16.1	33.3	7.8	19.6	22.8			
	<i>Low</i>	4.4	3.8	3.2	13.3	5.9	3.9	5.3			

Note: ODD: Oppositional defiant disorder; CU: Callous-unemotional traits; ANX: Anxiety.

Trajectories: T1=Null, T2=Anxiety increasing, T3=CU+anxiety+ODD, T4: CU+ODD-decreasing, T5=CU+ODD-increasing, T6=Anxiety decreasing

Table 2
Comparison of Trajectories at baseline (3 years-old)

		Adjusted means						*Relevant comparison (based on Cohen's-d)		
		T1: Null <i>n=337</i>	T2: ANX increasing <i>n=42</i>	T3: CU+ANX+ODD <i>n=17</i>	T4: CU+ODD -Increasing <i>n=54</i>	T5: CU+ODD -Decreasing <i>n=105</i>	T6: ANX decreasing <i>n=65</i>	Each trajectory versus T1=null	Other contrasts T3 vs T4 T3 vs T5	
<i>ICU</i>	Callousness	4.10	5.68	6.26	6.11	6.51	5.49	T1< T4,T5		
	Uncaring	10.32	12.57	13.10	14.42	13.55	11.19	T1< T3,T4,T5		
	Unemotional	4.75	5.05	4.65	4.22	4.72	5.28			
	Total	19.21	23.41	24.13	24.82	24.91	22.02	T1< T3,T4,T5		
<i>SDQ-ODD</i>	ODD (teachers)	2.51	3.49	4.83	4.37	4.16	2.57	T1< T3,T4,T5		
<i>CBCL</i>	DSM-anxiety	2.36	3.61	5.25	1.93	2.77	8.30	T1< T2,T3,T6	T3>T4	T3>T5
<i>CBQ-SF</i>	Surgency	4.27	4.52	4.55	4.65	4.54	4.02	T1< T4		
	Negative affectivity	3.71	4.15	3.94	3.50	3.75	4.34	T1< T2,T6	T3>T4	
	Effortful control	5.35	5.13	5.12	5.11	5.08	5.25			
<i>BRIEF-P</i>	Inhibit	21.77	24.03	25.73	28.01	25.54	21.64	T1< T3,T4,T5		
	Emotional control	11.61	12.75	15.94	13.32	12.55	12.09	T1< T3,T4	T3>T4	T3>T5
<i>K-CPT¹</i>	Omissions (age 4)	47.90	49.92	46.10	52.16	49.20	48.19		T3<T4	
	Commissions (age 4)	52.29	52.71	55.58	50.40	51.62	54.12		T3>T4	
<i>CBCL</i>	Attention problems	1.75	2.46	2.93	2.70	2.18	2.51	T1< T2,T3,T4		
<i>CAS¹</i>	Total aggression	54.21	54.69	58.08	61.38	57.79	53.80	T1< T3,T4,T5		
<i>SCDC</i>	Total (age 5)	1.59	3.23	5.99	6.09	4.65	1.74	T1< T2,T3,T4,T5		
<i>Life events</i>	Total number	2.69	2.55	3.76	2.64	2.58	3.16	T1< T3	T3>T4	T3>T5
<i>APQ</i>	Positive parenting	40.71	40.42	40.45	40.85	41.08	41.03			
	Punitive parenting	3.52	3.12	3.87	4.23	3.88	3.81			
	Inconsistent parenting	6.54	6.71	8.35	6.83	7.34	8.01	T1<T3	T3>T4	
<i>Parenting</i>	Limits	22.62	22.02	20.38	22.45	22.17	21.89	T1>T3	T3<T4	
	Autonomy	9.70	9.03	9.17	9.99	9.26	9.03			
<i>ASR</i>	Aggressive beh.; mother	3.65	4.12	7.53	4.17	4.35	5.06	T1<T3	T3>T4	T3>T5
	Rule-breaking; mother	1.04	1.35	2.37	0.98	1.40	1.68	T1<T3	T3>T4	T3>T5
	Aggressive beh.; father	2.95	4.16	5.02	4.72	4.61	3.76	T1<T3,T4,T5		
	Rule-breaking; father	1.28	1.45	2.75	1.59	1.75	1.66	T1<T3	T3>T4	

Note: ¹ T-scores. Results adjusted to family SES and other comorbid disorder different to ODD/ANX. *Contrast with moderate-high effect size ($|d|>0.50$).

Trajectories: T1=Null, T2=Anxiety increasing, T3=CU+anxiety+ODD, T4: CU+ODD-decreasing, T5=CU+ODD-increasing, T6=Anxiety decreasing

ICU: Inventory of Callous-Unemotional Traits; SDQ-ODD: Strengths and Difficulties Questionnaire-oppositional defiant disorder symptoms; CBCL: Child Behavior Checklist; CBQ-SF: Children's Behavior Questionnaire-Short Form; BRIEF-P: Behavior Rating Inventory of Executive Function preschool; K-CPT: Kiddie-Continuous Performance Test; CAS: Children's Aggression Scale; SCDC: Social Communication Disorders Checklist; APQ: Alabama Parenting Questionnaire; ASR: Adult Self-Report

Table 3

Comparison of Trajectories at end of follow-up (7 years old)

	Adjusted means						*Relevant comparison (based on Cohen's-d)		
	T1:	T2:	T3:	T4:	T5:	T6:	Each trajectory versus T1=null	Other contrast	
	Null <i>n</i> =337	ANX increasing <i>n</i> =42	CU+ANX+ODD <i>n</i> =17	CU+ODD -Increasing <i>n</i> =54	CU+ODD -Decreasing <i>n</i> =105	ANX decreasing <i>n</i> =65		T3 vs T4	T3 vs T5
<i>CBQ-VSF</i> Surgency	4.27	4.34	4.44	4.58	4.63	4.03	T1<T2,T3,T6	T3>T4	T3>T5
Negative affectivity	3.39	4.51	4.46	3.36	3.59	4.07			
Effortful control	5.03	5.02	5.13	4.90	4.85	4.97			
<i>CAS¹</i> Total aggression	39.54	40.65	63.63	48.97	58.37	47.17	T1< T3,T4,T5,T6	T3>T4	T3>T5
<i>ERC</i> Liability-negativity	22.61	29.64	31.47	23.79	25.58	25.42	T1< T2,T3,T5,T6	T3>T4	T3>T5
Emotion regulation	28.93	26.77	27.17	28.62	28.44	27.62	T1< T2,T3		
<i>Affective Reactivity Index</i>	6.44	7.08	11.59	8.73	10.28	7.14	T1< T3,T4,T5,T6	T3>T4	
<i>SPSRQ-C</i> Punishment	2.20	2.69	2.81	2.04	2.17	2.73	T1< T2,T3,T6	T3>T4	T3>T5
(age 6) Impulsivity	2.13	2.71	3.26	2.43	2.31	2.38	T1< T2,T3	T3>T4	T3>T5
Drive	2.43	2.89	3.33	2.78	2.57	2.67	T1< T2,T3	T3>T4	T3>T5
Reward	2.84	3.36	3.60	3.10	3.05	3.06	T1< T2,T3	T3>T4	T3>T5
<i>CBCL</i> Affective	0.86	3.40	3.36	1.49	1.00	2.29	T1< T2,T3,T6	T3>T4	T3>T5
<i>DSM5-scales</i> Anxiety	1.45	6.68	6.43	2.10	1.64	4.17	T1< T2,T3,T6	T3>T4	T3>T5
Somatic	0.50	1.38	1.17	0.58	0.71	0.84	T1< T2,T3	T3>T4	
ADHD	2.06	5.95	6.98	4.34	4.18	2.84	T1< T2,T3,T4,T5	T3>T4	T3>T5
ODD	1.34	3.42	5.35	2.23	2.73	2.02	T1< T2,T3,T4,T5	T3>T4	T3>T5
Conduct	0.46	1.74	3.99	1.62	1.37	1.25	T1< T2,T3,T4,T5,T6	T3>T4	T3>T5
<i>Impairment: CGAS</i> Total	79.23	67.83	64.52	73.89	74.84	73.57	T1>T2,T3,T4,T5,T6	T3<T4	T3<T5

Note: ¹ T-scores. Results adjusted to family SES and other comorbid disorder different to ODD/ANX. *Contrast with moderate-high effect size ($|d|>0.50$).

Trajectories: T1=Null, T2=Anxiety increasing, T3=CU+anxiety+ODD, T4: CU+ODD-decreasing, T5=CU+ODD-increasing, T6=Anxiety decreasing

CBQ-VSF: Children's Behavior Questionnaire-Very Short Form; CAS: Children's Aggression Scale; ERC: Emotion Regulation Checklist; ARI: Affective Reactivity Index; SPSRQ-C: Sensitive to Punishment and Sensitive to Reward Questionnaire-Child Revised; CBCL: Child Behavior Checklist; CGAS: Children's Global Assessment Scale.

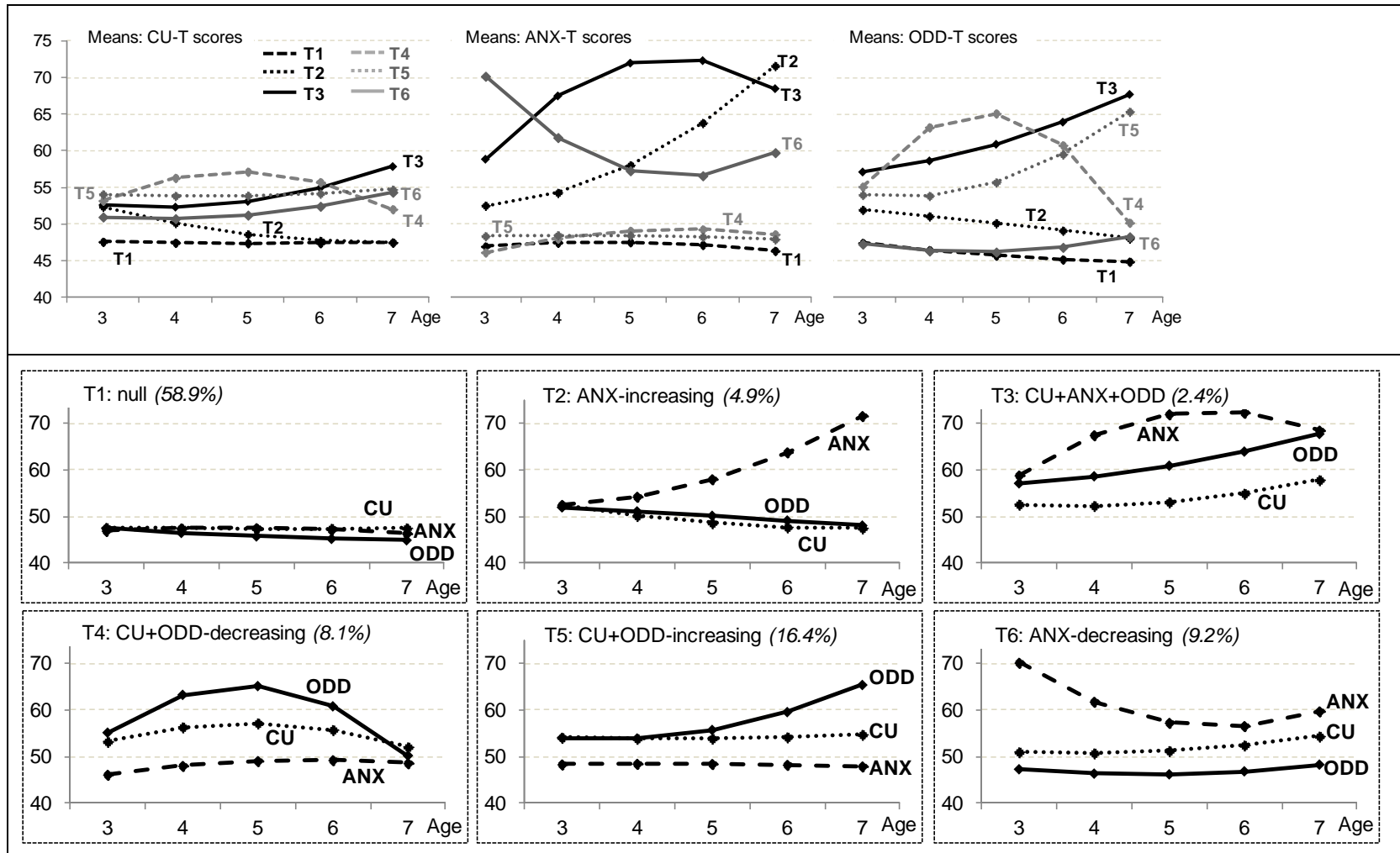


Fig. 1. Developmental trajectories for the co-occurrence of callousness-unemotional (CU), anxiety (ANX) and oppositional-defiant-disorder ODD. Above panel figures depict separately the six trajectories of CU, ANX and ODD. The figures in the panel below show the trajectories of each resultant class combining the three constructs (CU, ANX and ODD). (X-axis: children's age, Y-axis: mean for the T-score).

Supporting information captions

Table S1.
Oppositionality and Anxiety items used in the trajectories.

Table S2.
Measures at Baseline (age 3) and for Outcomes (age 7)

Table S3.
Descriptive statistics of the measures

Table S4.
Goodness-of-fit indexes and description for the GMM solutions considering 3 to 6 trajectories.

Table S5.
Model results: coefficients for mean values of the intercept, slope and quadratic terms.

Table S6.
Comparison of Trajectories at baseline (3 years-old) (results adjusted to family social status and other comorbid disorder different to ODD and anxiety)

Table S7.
Comparison of Trajectories at end of follow-up (7 years-old)