**Co-developmental Trajectories of Defiant/Headstrong, Irritability, and Prosocial**

**Emotions from Preschool Age to Early Adolescence**

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**Abstract**

This study ascertains how the proposed subtypes and specifiers of oppositional defiant disorder (ODD) based on irritability and prosocial emotions co-develop and describes the clinical characteristics of the resultant classes. A sample of 488 community children was followed up from ages 3 to 12 years and assessed with categorical and dimensional measures answered by parents and teachers. Latent class growth analysis for three parallel processes (defiant/headstrong, irritability, and limited prosocial emotions [LPE]) identified a 4-class model with adequate entropy (.912) and posterior probabilities of class membership ($\geq$ .921). Class 1 ($n = 38$, 7.9%) was made up of children with defiant/headstrong with chronic irritability and LPE. Class 2 ($n = 128$, 26.3%) was comprised of children with defiant/headstrong with chronic irritability and typical prosocial emotions. Class 3 ($n = 101$, 20.7%) clustered children with LPE without defiant/headstrong and without irritability. Class 4 ($n = 220$, 45.1%) included children with the lowest scores in all the processes.  The classes were distinguishable and showed different clinical characteristics through development. These findings support the validity of ICD-11 ODD subtypes based on chronic irritability and may help to guide clinicians' decision-making regarding treating oppositionality in children.

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**Emotions from Preschool Age to Early Adolescence**

Oppositional defiant disorder (ODD) and its manifestations have gained great interest in the most recent versions of the major classification systems. Although  DSM-5 [1] and ICD-11 [2] agree on the symptoms and descriptions of the disorder, they do not propose exactly the same classification, reflecting the heterogeneity of the disorder differently. The DSM-5 organizes the symptomatology of ODD in the disruptive, impulse control and conduct disorder section according to three subheadings/dimensions: angry/irritable mood, argumentative/defiant behavior, and vindictiveness, without subtypes. However, for the case of marked irritability and severe temper outbursts, DSM-5 proposes the diagnosis of disruptive mood dysregulation disorder (DMDD) in the depressive disorders section. Alternatively, ICD-11 presents two subtypes of ODD (with and without chronic irritability-anger) that may have two specifiers (with limited prosocial emotions (LPE) and with typical prosocial emotions).

These definitions, in part, have been nourished by research findings on the dimensionality of ODD. Stringaris and Goodman [3] proposed three dimensions of ODD symptoms: 1) *irritable*, including loses temper, angry, and touchy; 2) *headstrong,* including argues, defies, annoys, and blames; and 3) *hurtful*, including spitefulness and vindictiveness. This model has been tested in several populations of different ages [4, 5, 6, 7, 8, 9, 10], in most cases resulting in two factors (irritable and headstrong) or, less frequently, three factors (irritable, headstrong, hurtful). These studies have also demonstrated the validity of this differentiation and its clinical utility: the irritability dimension has been associated with depression and anxiety, and the defiant/headstrong dimension with attention deficit/hyperactivity disorder (ADHD) and conduct disorder (CD). However, in a wide sample (>16,000 5- to 18-year-olds) used to study the structure of ODD, Burke et al. [11]

reported that the best structure was a bifactor model that included irritability and oppositional behavior plus a general ODD factor. Like in previous studies, the irritability factor was uniquely associated with depression and anxiety, the defiant factor with ADHD and CD, and the ODD general factor with all the symptoms of both dimensions [12]. The results of a bifactor model would go against separating irritability from ODD, as in DSM-5 DMDD [12]. In short, there is some controversy.

Subtypes include phenomenological subgroups in a diagnosis and are exhaustive and mutually exclusive [1]. Specifiers are not exclusive and facilitate the definition of a more homogeneous subgrouping of individuals with the disorder who share certain features, also adding relevant information for managing the individual's disorder [1] . No subtypes for ODD are proposed in DSM-5. However, based on the central role of irritability in ODD and the strong support of research into the irritability dimension [13, 14], ICD-11 proposes two subtypes: ODD with chronic irritability/anger and ODD without chronic irritability/anger. Previous research on ODD subtypes using person-centered analyses, which enable groups of individuals with similar responses in relation to the studied variables to be analyzed, has found classes that reflect the severity of the symptomatology, while irritable [9] and oppositional classes have also emerged [15, 16, 17, 18]. Children in the irritability class have been found to be more likely to present anxiety disorders, depression, conduct disorder (CD), suicidality, and higher comorbidity with ODD [15, 17]. They have also been shown to experience more difficulties than the low and medium subtypes but not as many as the high group [9], are more likely to have mood symptoms than children in the defiant class, but have similar scores on the aggression and externalizing scales [18].

Regarding specifiers, DSM-5 enables the severity (mild, moderate, severe) to be specified, while like for CD, ICD-11 enables whether ODD presents with LPE or with typical prosocial emotions to be specified. LPE characterized by lack of empathy or remorse, reduced

affect or shallow emotional responding and not caring about the feelings of others, has also shown significant correlation with the number and severity of ODD symptoms. LPE distinguishes a group of children with more severe ODD symptoms that present deficits in executive functioning, social cognition, attention, and aggressive behavior, and are less fearful, recover more easily after an upset, and show less negative reactivity [19, 20].

Providing further data on the validity of the diagnostic constructs with a developmental perspective is a target now that the diagnostic classification system has been revised. This becomes even more necessary given that the discipline is claiming for classification systems based on dimensions of observable behaviors or neurobiology [21]. This work ascertains if the recently proposed ICD-11 subtypes and specifiers of ODD can be modelled with dimensional measures in a general population aged from 3 to 12 years, clustering groups of children with similar problems and evolution and ascertaining the characteristics of the development of each class. As proposed in the classification system, we expected to obtain a) two classes of chronic irritability, one with LPE and another with typical prosocial emotions, b) a class without chronic irritability, and c) a class with children with low scores in the three variables.  Knowing the profiles of the different subtypes and specifiers of ODD through development may help to improve the treatment provided to the children in each specific class.

## Method

### Participants

The sample is part of a longitudinal study of behavioral problems starting at age 3 described in [22]. The children (*N*=2,283) were randomly selected from early childhood schools in Barcelona (Spain). A two-phase design was employed. A total of 1,341 families (58.7%) agreed to participate (33.6% high socioeconomic status (SES), 43.1% middle, and 23.3% low; 50.9% boys) in the first phase of sampling. To ensure the participation of children

with possible behavioral problems, the parent-rated Strengths and Difficulties Questionnaire (SDQ) conduct problems scale [23] plus four ODD DSM-IV-TR symptoms not included in the SDQ questions were used for screening. Two groups were considered: the screen-positive group, which included all the children with SDQ scores ≥ 4, in percentile 90, or with a positive response to any of the 8 DSM-IV ODD symptoms (*N* = 417; 49.0% boys); and the screen-negative group, a random group comprising the 28% of children who did not reach the positive threshold (*N* = 205; 51.2% boys).

The sample for the follow-up included 622 children (mean age= 3.77 years; *SD* = 0.33; 96.9% born in Spain), who were followed yearly from age 3 to 12 years (Table 1). Data from ages 3 to 12 years (10 assessment points) were used to estimate the trajectories. Children with data for less than half the 10 waves (4 or less waves) were excluded. The sample used for this study consisted of 488 children (66.2% screen-positive). Data from 5 or more of the 10 possible annual follow-ups between ages 3 and 12 years represented 78.5% of the initial sample [77.6% from the positive screening group and 80.1% from the negative screening group; $\chi^2 (1) = 0.49$, $p = .484$]. From ages 4 to 12 years, the retention rates in the successive follow-ups were 96.3%, 84.9%, 68.8%, 69.1%, 62.9%, 64.3%, 60.0%, 58.7%, and 45.2%.

**Measures**

*Trajectories*

*Dimensions of ODD*. The symptoms of the Strengths and Difficulties Questionnaire (SDQ) [23] conduct problem scale (loses temper, defies rules, argues, spiteful) plus four symptoms of DSM-IV ODD not covered by the SDQ (deliberately annoys, blames others, touchy, angry-resentful) (0 = *not true*; 2 = *certainly true*) were used to obtain the dimension scores of ODD following Rowe's [7] 2-factor model [4]. Parents answered the questionnaire every year from when the child was aged 3 to 12 years. The irritability dimension included three items, 'touchy-easily annoyed', 'angry and resentful', and 'loses temper'; the median

(*Mdn*) of the ordinal alpha in the sample through follow-ups was .82. The defiant/headstrong dimension included five items ('Argues with adults', 'defies rules', 'deliberately annoys', 'blames others', 'spiteful') (*Mdn* of ordinal alpha = .76). The dimension scores were obtained as the sum of the ratings of the corresponding items. Higher scores indicated greater irritability and defiant/headstrong problems. A score of 2 in defiant/headstrong and in irritability corresponded to percentile 75 in the sample.

*Limited prosocial emotions*. The Inventory of Callous-Unemotional Traits (ICU) [24], which includes 24 items coded on a 4-point Likert-type scale (0: *not at all true*; 3: *definitely true*), evaluates callous-unemotional traits (CU-traits). The total score is the sum of the raw scores as reported annually by teachers and was used to obtain the developmental trajectories of LPE. Higher scores indicate higher CU-traits. *Mdn* of Cronbach's alpha for the total scores through follow-ups was .90. A score of 26 corresponded to percentile 75 in the sample.

*Variables through development*

The *Diagnostic Interview for Children and Adolescents for Parents of Preschool and Young Children* (DICA-PPYC) [25] is a semi-structured diagnostic interview for assessing DSM-5 psychological disorders. It was answered by the parents at each follow-up. The main diagnoses analyzed were disruptive behavior disorders (ADHD, ODD, and CD), and anxiety disorders (separation and generalized anxiety, specific, and social phobia). Comorbidity was defined as the presence of more than one disorder among those evaluated in the interview. The presence of any diagnosis, seeking help, and treatment received for any of the diagnoses assessed in the whole interview were also registered.

The *Child Behavior Checklist* (CBCL/1½-5; CBCL/6-18) [26, 27] measures behavioral and emotional problems as reported annually by parents through 100 and 112 items, respectively, with 3 response options (0: *not true*; 2: *very true/often true*). Empirical scales plus the dysregulation profile (sum of the items of anxious-depressed, attention

problems, and aggressive behavior scales) [28] were used for the analyses (*Mdn* of ordinal

alpha over the 10 follow-ups was above .75 for 9 of the 11 scales analyzed).

The *Children's Global Assessment Scale* (CGAS) [29] is a global measure of

functional impairment rated by the interviewer based on information from the diagnostic

interview with the parents at each follow-up.

The *Strengths and Difficulties Questionnaire* (SDQ) [23] assesses children's mental

health with 25 items (0: *not true*; 2: *certainly true)* on five scales. The teachers reported peer

relationship problems (*Mdn* of ordinal alpha = .79).

The *Children's Behavior Questionnaire Short Form (ages 3,4,5)* and *Very Short Form

(age 7)* [30] measure reactive and self-regulative temperament, with 94 items and 36 items,

respectively, on a 7-point Likert-type scale, ranging from 1 (*extremely untrue*) to 7 (*extremely

true*). It was answered by the parents. The dimensions negative affectivity, effortful control,

and surgency were analyzed (*Mdn* of Cronbach's alpha was .82, .76 and .83, respectively).

*The Social and Communication Disorders Checklist* [31] assesses children's social

cognition deficit. It is a 12-item questionnaire (0: *not true*-2: *very true*) that was completed by

the teacher when the children were 5, 10, and 12 years old (*Mdn* of ordinal alpha = .95).

The *Children's Aggression Scale* [32] assesses aggressive behavior with 22 items (0:

*never* to 4: *many days*). Total scores reported by teachers at each follow-up were used (*Mdn*

of Cronbach's alpha was .87).

**Procedure**

The families were recruited at the schools and gave written consent for the assessment.

All the families of the 3-year-old children from participating schools were invited to answer

the screening questionnaire. The families who agreed and met the screening criteria were

contacted by telephone and interviewed at the school for each annual assessment. The

interviewer team was specifically trained and all the interviewers were blind to the screening

group. The teachers answered the questionnaires after permission from the families was

obtained.

**Statistical Analysis**

The statistical analysis was carried out using MPlus8.5 and SPSS 24. Given the

multistage sampling procedure used, the analyses were weighted by the inverse probability of

selection in the second phase of sampling.

Latent class growth analysis (LCGA) for three parallel processes was used to identify

distinct groups of individual trajectories considering the direct scores for defiant/headstrong,

irritability, and LPE. LCGA was conducted due that Growth Mixture Modelling (GMM),

which allows for variation across individuals within classes, did not converge. The Robust

Maximum Likelihood (MLR) method of estimation was employed, which enables the

inclusion of non-normal and incomplete data, using the expectation maximization algorithm

for missing data with robust standard errors (i.e., full information method). The growth

models considered intercept (I), slope (S; i.e., linear trend), and quadratic trend over the 10

annual assessments from ages 3 to 12 years, with equal spacing between measurement

occasions. The time was rescaled from 3-12 years to 0-9 years, so the first-year assessment (at

age 3 years) represented the intercept.

After checking for possible overlap between measures with bivariate Pearson's

correlations, models with one to seven latent classes of growth patterns were obtained. In

addition to best clinical interpretability, the following criteria were used to determine the

model selected: larger decrement in AIC and sample-size adjusted BIC (aBIC), greater power

and more accurate classification by average posterior probabilities, entropy values equal to or

greater than .70, and more than 5% ($n > 24$) participants in a class/trajectory.

Different clinical characteristics were compared between classes using multiple post-

hoc comparisons. To synthesize the information from the follow-ups, a variable was

considered as present for the binary measures if it was present at at least one of the follow-ups, while the average of the follow-ups was calculated for the quantitative measures. These summary measures were compared between classes using linear models for the continuous measures, logistic models for the binary ones, and multinomial logistic models for the polytomous measures. The risk of type I error was corrected using Tukey [33] when comparing the quantitative measures and Bonferroni-Holm's [34] when comparing the categorical ones.

Internal consistency reliability was calculated using Cronbach's alpha for questionnaires with items having 5 or more response options and with ordinal alpha [35] for items having less than 5 response options.

## Results

### Trajectories of Defiant/headstrong, Irritability, and LPE

Bivariate correlations between observed scores over waves (Supplementary Table S1) within each process ranged from .18 to .74 in absolute values (defiant/headstrong: .26-.69; irritability: .25-.74; LPE: .18-.61), and between two processes they ranged from .01 to .60 in absolute values (defiant/headstrong-irritability: .15-.62; defiant/headstrong-LPE: .07-.34; irritability-LPE: .01-.28). Moreover, the correlation values between observed scores involving two processes cross-sectionally ranged from .06 to .62 in absolute values (defiant/headstrong-irritability: .50-.62; defiant/headstrong-LPE: .16-.32; irritability-LPE: .06-.22).

Table 2 shows the goodness-of-fit indices for the LCGA models from one to seven classes. Based on the aforementioned criteria, the 4-class model (Figures 1 and 2), which showed high entropy (.912) and very high on-diagonal posterior probabilities of class membership ($\geq$ .921), was selected.

Table 3 presents the parameter estimates for the selected 4-class model. Figure 2 represents the three processes for each of the four resultant classes. The profile represented in

the figures shows that class 1 ($n = 38$, 7.9%) (Defiant-Irritability-LPE) included children with the highest scores in the three processes: high and sustained defiant/headstrong, high and sustained CU and high irritability increasing until 8-9 years old, and then decreasing slightly (quadratic term significant). This class clustered children with oppositional defiant problems (ODP) with chronic irritability-anger and LPE. Class 2 ($n = 128$, 26.3%) (Defiant-Irritability-without LPE) included children with high sustained defiant/headstrong, medium-high irritability (highest from ages 5 to 10) (quadratic term significant) and low sustained CU. This class clustered children with ODP with chronic irritability-anger with typical prosocial emotions. Class 3 ($n = 101$, 20.7%) (LPE only) included children with high and sustained CU but low and decreasing defiant/headstrong and low and decreasing irritability. Class 4 ($n = 220$, 45.1%) (all low) included children with the lowest scores in all the processes.

**Clinical Characteristics through Development and Comparisons among the Trajectories**

Tables 4 and 5 show the demographic and clinical (categorical and dimensional) characteristics of the classes through ages 3 to 12 years and the comparison among classes. The clinical characteristics of each class are briefly summarized as follows. Class 1 (Defiant-Irritability-LPE) represented ODP with chronic irritability and LPE and was the most severe developmental trajectory. About 87% of the cases presented ODD. Children in this class showed high comorbidity with internalizing and externalizing psychopathology, higher mean scores of psychopathology (CBCL), peer problems, negative affect, social cognition difficulties, aggressive behavior, and worst functional impairment (100% had required consultation and about 90% treatment). In comparison with all the other classes, class 1 showed higher means of defiant/headstrong, irritability, LPE, and higher means in most of the studied outcomes.

Class 2 (Defiant-Irritability-without LPE) included 43% of children with a diagnosis of ODD. It was similar to class 1 (Defiant-Irritability-LPE) in the percentage of subthreshold

ODD, early age of onset of ODD, comorbidity with anxiety disorders and scores on CBCL withdrawn/depressed and emotionally reactive, and negative affect, but differed in the severity of presentation, with less adverse outcomes and most remarkably a lack of comorbidity with conduct disorder and lower peer problems, social cognition difficulties, and aggressive behavior.

Class 3 (LPE only) was the class that included mostly boys and low SES individuals. The most frequent diagnosis in this class was ADHD, and ICU scores and peer problems were comparable with class 1 (Defiant-Irritability-LPE). In comparison with class 2 (Defiant-Irritability-without LPE), class 3 included a higher percentage of conduct disorders diagnoses, and more difficulties with social cognition and aggressive behavior. In the remaining characteristics, class 3 (LPE only) was less severe than classes 1 (Defiant-Irritability-LPE) and 2 (Defiant-Irritability-without LPE).

Class 4 (all low) clustered children with low scores in all the variables and the least adverse outcomes and better functioning in comparison with the other classes.

**Discussion**

LGCA with parallel processes identified different classes based on ODD dimensions (defiant/headstrong and irritability) and prosocial emotions in a sample of 3- to 12-year-old children from the general population.  A model of four classes best fitted the sample characteristics and clinical interpretability and showed how defiant/headstrong, irritability, and LPE co-develop from preschool age to adolescence. Classes similar to ICD-11 ODD subtypes with chronic irritability-anger with LPE and with typical prosocial emotions (classes 1, 2) were identified in the sample, but the subtype ODD without chronic irritability-anger did not emerge. Additionally, one class clustered children with only LPE and without notable scores on irritability or defiant/headstrong (class 3), and another class (class 4), the most prevalent, clustered children with low values in all the scores. The classes were

distinguishable and showed different clinical characteristics through development. These findings with dimensional measures may support the validity of ICD-11 ODD subtypes based on chronic irritability. In this regard, our hypotheses were partially accomplished.

Two of the classes reflected high ODD dimension scores (34.2% of the sample) (classes 1 (Defiant-Irritability-LPE) and 2 (Defiant-Irritability-without LPE)), representing the two subtypes proposed in ICD-11 in relation to chronic irritability. The results show the co-development of two of the processes (defiant/ headstrong and irritability) in a significant number of cases, supporting keeping them together as a subtype, as suggested by both the bifactor model [12] and the task group on disruptive disorders and dissocial disorders of the ICD-11 revision [36]. Notably, however, a class with chronic irritability also had high levels of LPE (class 1), and LPE has likewise been associated with more serious difficulties [19]. What the specifier LPE particularly may have added to class 1 (Defiant-Irritability-LPE) in comparison to class 2  (Defiant-Irritability-without LPE) was a more severe presentation of the clinical picture, more specifically comorbidity with conduct disorder, and more peer problems, social cognition difficulties and aggressive behavior, characteristics of callous-unemotional traits or LPE [19]. Therefore, to sum up, when the development of the trajectories of ODD dimensions (defiant/headstrong and irritability) are accompanied by joint LPE, they present more severe clinical characteristics.

The two classes with chronic irritability (class 1 Defiant-Irritability-LPE and 2 Defiant-Irritability-without LPE) had the most adverse clinical characteristics. When considering ODD symptomatology, irritability more than defiance has been associated with more severe psychopathological outcomes [9, 15]. Furthermore, previous research has shown that irritability is uniquely associated with anxiety and internalizing disorders  [13, 37], therefore we would expect to find that classes with high irritability present higher internalizing problems. To this effect, in our classes high or high-medium levels of irritability

(classes 1 and 2) were associated with similar perecentages of anxiety disorders and high anxious/depressed and internalizing symptoms. On the other hand, the association of  class 1 (Defiant-Irritability-LPE) with internalizing disorders would be contrary to the expectation that children with CU traits (LPE) present lower levels of anxiety [20]. However, behavior problems are highly hetereogeneous and there are some variants (secondary variants) with high anxiety, high CU, and high conduct problems that show higher physiological arousal to anger stimuli [38], and anger is the basic emotion of ODD. This may explain why children in class 1 also show internalizing problems. Alternatively, as Frick et al. [20] point out, children with behavior problems, with or without CU traits, usually exhibit anxiety problems secondary to their misbehavior.

A class without chronic irritability did not emerge, which may be indicative of the central role of irritability in ODD [13]. Anger is the main emotion involved in ODD, and irritability represents the emotional component of ODD. Network analysis has shown how anger is the core symptom that links all the other ODD symptoms [14]. It is therefore difficult to conceive a pattern of negativistic behavior without a stable negative affect and anger. However, the non-emergence of this subtype could be due to the use of fine dimensional measurement as opposed to less precise measures such as categorical symptoms, which better identify the stability of irritability.

In addition to classes with ODD with and without LPE, there was another class, class 3 (only LPE), without high ODD dimension scores but with a profile of unfavourable clinical characteristics. This trajectory had similar LPE as class 1 (Defiant-Irritability-LPE), included a high percentage of boys, ADHD, CD, peer problems, social cognition difficulties, and aggressive behavior. This profile is coherent with a CD picture which, because of the age of the children and this being a community sample, may have been of incipient development. The emergence of such a class when combining irritability, defiant/headstrong, and LPE

supports the validity of resulting classes given that they represent the different clinical pictures of disruptive behavior disorders of an ODD or a CD type.

This is the first study to simultaneously analyze the co-development of irritability, defiant/headstrong, and prosocial emotions from preschool age to early adolescence in a 10 yearly-based follow-up of a wide sample of boys and girls from the general population. Our study goes beyond previous person-centered approaches that have mainly reported different levels of severity of ODD. Three relevant parallel processes in the field of disruptive behavior disorders usually combined in categorical models, reported by different informants (parents and teachers), were able to be combined using LCGA, and different classes that reflect the observed phenomenology of disruptive behavior problems were obtained. The results, however, should be interpreted considering that this was a community sample in which, as expected, psychopathology was not very prevalent. Such few cases meant that differences between variables may not have emerged.

ODD is a heterogeneous and highly comorbid disorder [39]. According to the classes identified in this study, 7.9% of children in the general population present high scores in the three processes studied, irritability-defiant/headstrong-LPE, and an additional 26.3% do so in two of them (irritability-defiant/headstrong), accompanied by problems in daily functioning. Knowing the heterogeneity within the ODD category has important implications for case conceptualization and treatment in children with irritability, defiant/headstrong, and LPE symptomatology. The results show that there are subsets of ODD in the general population of 3- to 12-year-old children with different presentation and course and potentially different treatment and preventive needs. These results also have important implications for nosology.

## Summary

Oppositional defiant disorder (ODD) is a heterogeneous disorder. Major classification systems (DSM-5 and ICD-11) agree on the symptoms and descriptions of the disorder but

they do not propose exactly the same classification, reflecting the heterogeneity of the disorder differently. This study ascertains how the proposed subtypes and specifiers of ODD based on chronic irritability and prosocial emotions co-develop in a wide general population followed up yearly from ages 3 to 12 years. Different from previous research, which is mostly variable-centered, the focus was not on knowing how the variables are associated among them, but on identifying groups of children with similar responses in relation to the studied variables (person-centred analyses). Latent Class Growth Analysis (LCGA) simultaneously combining three processes identified 4 distinct groups of individual trajectories for irritability, defiant/headstrong behavior, and limited prosocial emotions. Class 1 (7.9%) was made up of children with severe ODP with chronic irritability-anger and limited prosocial emotions (LPE). Class 2 (26.3%) was comprised of children with ODP with chronic irritability-anger with typical prosocial emotions. Class 3 (20.7%) clustered children with LPE without irritability or defiant/headstrong. Class 4 ($n =45.1\%$) included children with the lowest scores in all the processes. The classes were distinguishable among them and showed different clinical characteristics through development. Providing further data on the validity of the diagnostic constructs with a developmental perspective is a target once that diagnostic classification system has been developed. These findings support the validity of ICD-11 ODD subtypes based on chronic irritability and may help to guide clinicians' decision-making regarding treating oppositionality in children.

**Compliance with Ethical Standards**

**Conflicts of interest:** The authors have no conflicts to declare.

**Ethics approval:** The project was approved by the Ethics Committee on Animal and Human

Experimentation of the Universitat Autònoma de Barcelona.

**Consent to participate:** Families gave written consent for the assessment.

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Table 1. *Description of the sample*

|  |  | At age 3 ($N =$ 488) |
| --- | --- | --- |
| Age (years), *Mdn* (*SD*) |  | 3.8 (0.34) |
| Age mother (years), *Mdn* (*SD*) |  | 36.8 (4.32) |
| Age father (years), *Mdn* (*SD*) |  | 38.8 (5.53) |
| Sex, % | Female | 50.8 |
| Socioeconomic status; % | High | 34.2 |
|  | Medium-High/Medium | 47.2 |
|  | Medium-low/Low | 18.6 |
| Born in Spain, % | Yes | 97.7 |
| Ethnicity; % | Caucasian | 91.4 |
|  | Latino | 4.7 |
|  | Other | 3.9 |

Table 2. *Fitting indices for 1- to 7-class LCGAs*

| N. classes | AIC | aBIC | Class: N (weighted) | Class: probability* | Entropy |
|---|---|---|---|---|---|
| 1 | 62904.7 | 62944.3 | 1: 488 | - | - |
| 2 | 60036.2 | 60086.0 | 1: 335 | 1: .987 | .932 |
|   |         |         | 2: 153 | 2: .965 |      |
| 3 | 59204.5 | 59264.5 | 1: 187 | 1: .949 | .919 |
|   |         |         | 2: 65  | 2: .970 |      |
|   |         |         | 3: 236 | 3: .974 |      |
| **4** | **58734.8** | **58804.9** | **1: 38** | **1: .992** | **.912** |
|   |         |         | **2: 128** | **2: .945** |      |
|   |         |         | **3: 101** | **3: .921** |      |
|   |         |         | **4: 220** | **4: .964** |      |
| 5 | 58449.6 | 58529.9 | 1: 188 | 1: .963 | .905 |
|   |         |         | 2: 62  | 2: .917 |      |
|   |         |         | 3: 89  | 3: .923 |      |
|   |         |         | 4: 115 | 4: .915 |      |
|   |         |         | 5: 34  | 5: .994 |      |
| 6 | 58164.4 | 58254.9 | 1: 180 | 1: .956 | .912 |
|   |         |         | 2: 79  | 2: .910 |      |
|   |         |         | 3: 22  | 3: .993 |      |
|   |         |         | 4: 32  | 4: .948 |      |
|   |         |         | 5: 109 | 5: .930 |      |
|   |         |         | 6: 66  | 6: 920  |      |
| 7 | 57966.7 | 58067.3 | 1: 98  | 1: .898 | .907 |
|   |         |         | 2: 47  | 2: .936 |      |
|   |         |         | 3: 51  | 3: .910 |      |
|   |         |         | 4: 29  | 4: .957 |      |
|   |         |         | 5: 22  | 5: .994 |      |
|   |         |         | 6: 163 | 6: 946  |      |
|   |         |         | 7: 79  | 7: 910  |      |

Note. aBIC: Sample-Size Adjusted BIC.

*On-diagonal values for posterior probability of class membership. In bold: selected solution of LCGA

Table 3. *Parameter estimates for the selected 4-class model*

| Class | Process | Parameter estimate (*p*) | | |
|---|---|---|---|---|
| | | Intercept (basal) | Linear trend (slope) | Quadratic trend |
| 1 | Defiant/headstrong | 3.71 (<.001) | 0.18 (.294) | −0.01 (.394) |
| | Irritability | 2.49 (<.001) | 0.41 (.005) | −0.04 (.013) |
| | Limited prosocial emotions | 25.06 (<.001) | 1.37 (.051) | −0.11 (.089) |
| 2 | Defiant/headstrong | 2.41 (<.001) | −0.02 (.869) | 0.00 (.842) |
| | Irritability | 1.84 (<.001) | 0.13 (.035) | −0.02 (.013) |
| | Limited prosocial emotions | 20.13 (<.001) | −0.04 (.932) | 0.01 (.824) |
| 3 | Defiant/headstrong | 2.37 (<.001) | −0.40 (<.001) | 0.03 (<.001) |
| | Irritability | 1.56 (<.001) | −0.28 (<.001) | 0.02 (<.001) |
| | Limited prosocial emotions | 28.01 (<.001) | −0.51 (.310) | 0.06 (.307) |
| 4 | Defiant/headstrong | 1.32 (<.001) | −0.27 (<.001) | 0.02 (<.001) |
| | Irritability | 1.13 (<.001) | −0.12 (<.001) | 0.01 (.098) |
| | Limited prosocial emotions | 16.48 (<.001) | −0.56 (.106) | 0.06 (.110) |

Table 4. *Comparisons of Demographic Characteristics, Variables in the Trajectories and DSM-5 Diagnoses in each Class*

| | Class 1 Defiant-Irritability-LPE | Class 2 Defiant-Irritability | Class 3 LPE only | Class 4 All low | Significant Contrasts |
|---|---|---|---|---|---|
| *Demographics at baseline* | | | | | |
| Sex (% boys) | 53.8 | 45.4 | 69.6 | 43.2 | 3>(2=4) |
| Socioeconomic status % | | | | | |
|   High | 34.2 | 41.5 | 24.3 | 41.9 | 4>3 |
|   Medium/Medium-High | 44.7 | 43.1 | 52.4 | 45.9 | |
|   Low/Medium-Low | 21.1 | 15.4 | 23.3 | 12.2 | 3>4 |
| ODD (%) | 87.2 | 43.1 | 14.7 | 10.3 | 1>2>(3=4) |
|   Subthreshold (%) | 92.3 | 92.2 | 62.7 | 49.8 | (1=2)>3>4 |
|   Consultation (% Yes) | 87.2 | 48.8 | 34.5 | 7.7 | 1>2>3>4 |
|   Severity (% Moderate-severe) | 97.4 | 58.2 | 45.5 | 25.9 | 1>(2=3)>4 |
|   Family burden (%) | 100.0 | 87.6 | 63.1 | 45.6 | 1>2>3>4 |
|   Treatment (%) | 88.2 | 58.7 | 69.0 | 46.2 | 1>(2=4) |
|   Age of onset (mean) | 3.0 | 3.1 | 3.4 | 3.8 | 4>(1=2) |
| ADHD (%) | 53.8 | 28.7 | 29.4 | 8.6 | 1>(2=3)>4 |
|   Age at onset (mean) | 3.0 | 3.1 | 3.5 | 3.3 | |
| Conduct disorder (CD) (%) | 17.9 | 0.0 | 3.9 | 0.4 | 1>3>(2=4) |
|   Age at onset (mean) | 3.2 | 4.4 | 3.8 | 4.2 | 2>1 |
| Any disruptive disorder (%) | 92.3 | 50.0 | 35.3 | 15.3 | 1>2>3>4 |
| Any anxiety (%) | 53.8 | 47.7 | 27.5 | 29.3 | (1=2)>(3=4) |
| Any DSM-5 diag. (%) | 100.0 | 94.6 | 78.4 | 68.2 | 1>2>3>4 |
| Comorbidity DSM-5 (%) | 57.9 | 31.5 | 15.7 | 7.2 | 1>2>3>4 |
| Consultation any disorder (%) | 100.0 | 96.2 | 93.1 | 81.5 | 1>(2=3)>4 |
| Treatment by any disorder (%) | 89.7 | 76.0 | 69.6 | 44.6 | 1>(2=3)>4 |
| Psychological treatment (%) | 81.6 | 51.5 | 47.1 | 15.2 | 1>(2=3)>4 |

*Note.* Linear models for continuous measures; logistic models for binary measures; multinomial logistic models for polytomous measures. Risk of type I error corrected by Tukey's correction (Tukey, 1949) for quantitative measures and Bonferroni-Holm's (Holm, 1979) for the categorical ones.

ODD: oppositional defiant disorder; ADHD: attention deficit/hyperactivity disorder; any anxiety, including separation anxiety and generalized anxiety; specific phobia and social phobia; any disruptive disorder, including ODD, ADHD, CD; comorbidity: presence of more than one DSM-5 diagnosis in the Diagnostic Interview for Children and Adolescents.
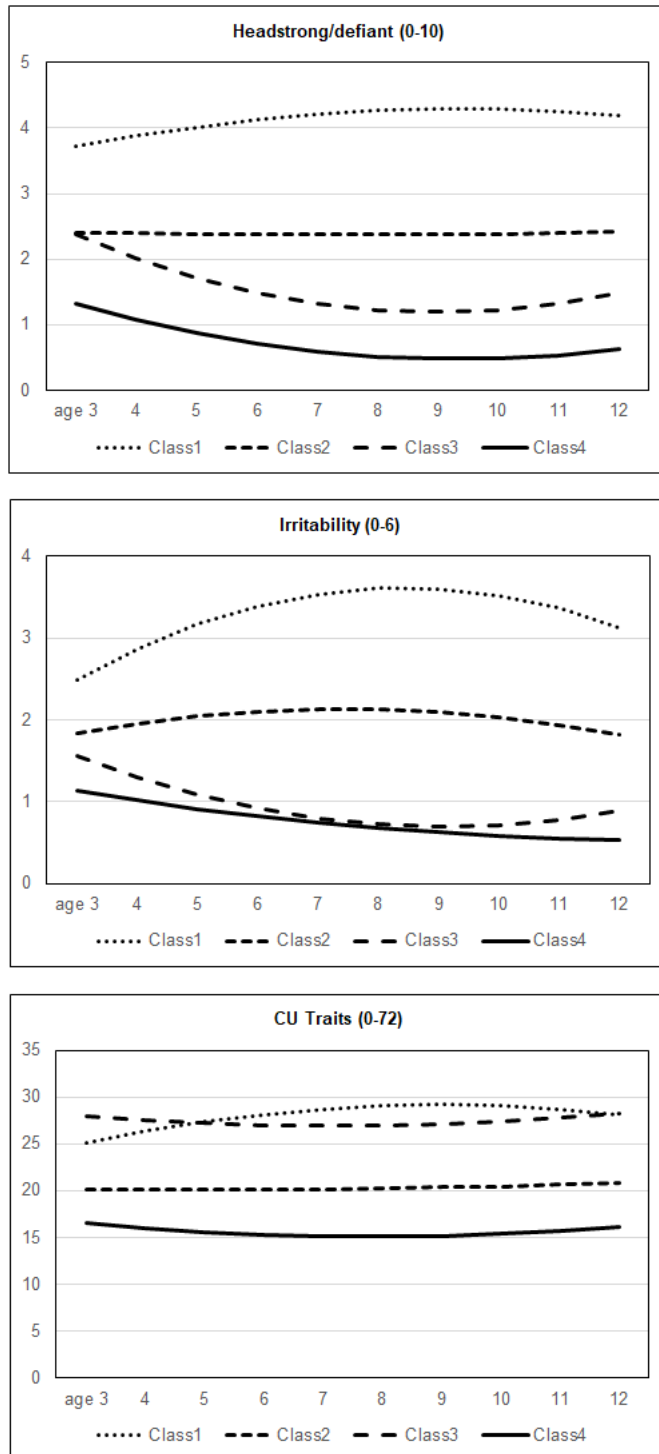
Table 5. *Comparisons of Dimensional Characteristics in each Class (mean through follow-ups)*

| | α (Mdn) | Class 1 Defiant-Irritability-LPE | Class 2 Defiant-Irritability | Class 3 LPE only | Class 4 All low | Significant Contrasts |
|---|---|---|---|---|---|---|
| *Trajectories variables* | | | | | | |
| SDQ_Headstrong-Parents | .76 | 4.1 | 2.4 | 1.6 | 0.8 | 1>2>3>4 |
| SDQ_Irritability-Parents | .82 | 3.2 | 2.0 | 1.0 | 0.8 | 1>2>3>4 |
| ICU total-Teachers | .90 | 28.0 | 20.3 | 27.6 | 15.5 | (1=3)>2>4 |
| *Psychopathology-Parents* | | | | | | |
| CBCL1½-5/6-18 (T scores) | | | | | | |
| Anxious/depressed | .75 | 57.9 | 53.7 | 48.4 | 47.2 | 1>2>(3=4) |
| Social problems | .85 | 58.4 | 53.5 | 49.6 | 46.8 | 1>2>3>4 |
| Attention problems | .92 | 57.4 | 53.3 | 52.7 | 46.6 | 1>(2=3)>4 |
| Aggressive behavior | .87 | 65.8 | 54.7 | 48.5 | 44.9 | 1>2>3>4 |
| Withdrawn/depressed (6-18) | .65 | 56.0 | 52.9 | 49.5 | 47.5 | (1=2)>(3=4) |
| Rule breaking behavior (6-18) | .57 | 66.6 | 53.1 | 49.6 | 46.0 | 1>2>3>4 |
| Emotionally reactive (3-5) | .82 | 56.2 | 53.3 | 49.3 | 47.0 | (1=2)>3>4 |
| Internalizing problems | .83 | 57.5 | 54.0 | 48.9 | 46.9 | 1>2>(3=4) |
| Externalizing problems | .88 | 65.9 | 54.5 | 49.0 | 44.9 | 1>2>3>4 |
| Total problems | .93 | 62.2 | 54.8 | 49.6 | 45.4 | 1>2>3>4 |
| Dysregulation-2007 | .89 | 9.2 | 5.8 | 5.6 | 4.5 | 1>2>3>4 |
| Functional Impairment CGAS | NA | 63.4 | 71.3 | 73.9 | 79.3 | 4>3>2>1 |
| SDQ_Peer problems-Teachers | .79 | 2.0 | 1.2 | 1.7 | 0.8 | (1=3)>2>4 |
| *Temperament-Parents* | | | | | | |
| CBQ_Surgency | .83 | 4.5 | 4.2 | 4.5 | 4.2 | 1>4 |
| CBQ_Negative affect | .82 | 4.1 | 3.9 | 3.5 | 3.5 | (1=2)>(3=4) |
| CBQ_Effortful control | .76 | 5.0 | 5.1 | 5.0 | 5.4 | 4>(1=2=3) |
| *Social cognition-Teachers* | | | | | | |
| SCDC_Total | .95 | 6.7 | 3.1 | 5.2 | 1.2 | 1>3>2>4 |
| *Aggressive Behavior-Teachers* | | | | | | |
| CAS_Total | .87 | 220.2 | 199.3 | 207.3 | 191.9 | 1>3>2>4 |

*Note.* Linear models for continuous measures. Risk of type I error corrected by Tukey's correction (Tukey, 1949).

CAS: Children's Aggression Scale; CBCL: Child Behavior Checklist; CGAS: Children's Global Assessment Scale; CBQ: Children's Behavior Questionnaire Short Form; Children's Global Assessment Scale; SCDC: Social and Communication Disorders Checklist; SDQ: Strengths and Difficulties Questionnaire.

*Figure 1*. Trajectories for Defiant/headstrong, Irritability and CU traits (Limited Prosocial

Emotions). Each panel shows the 4 trajectories separately for each measure.
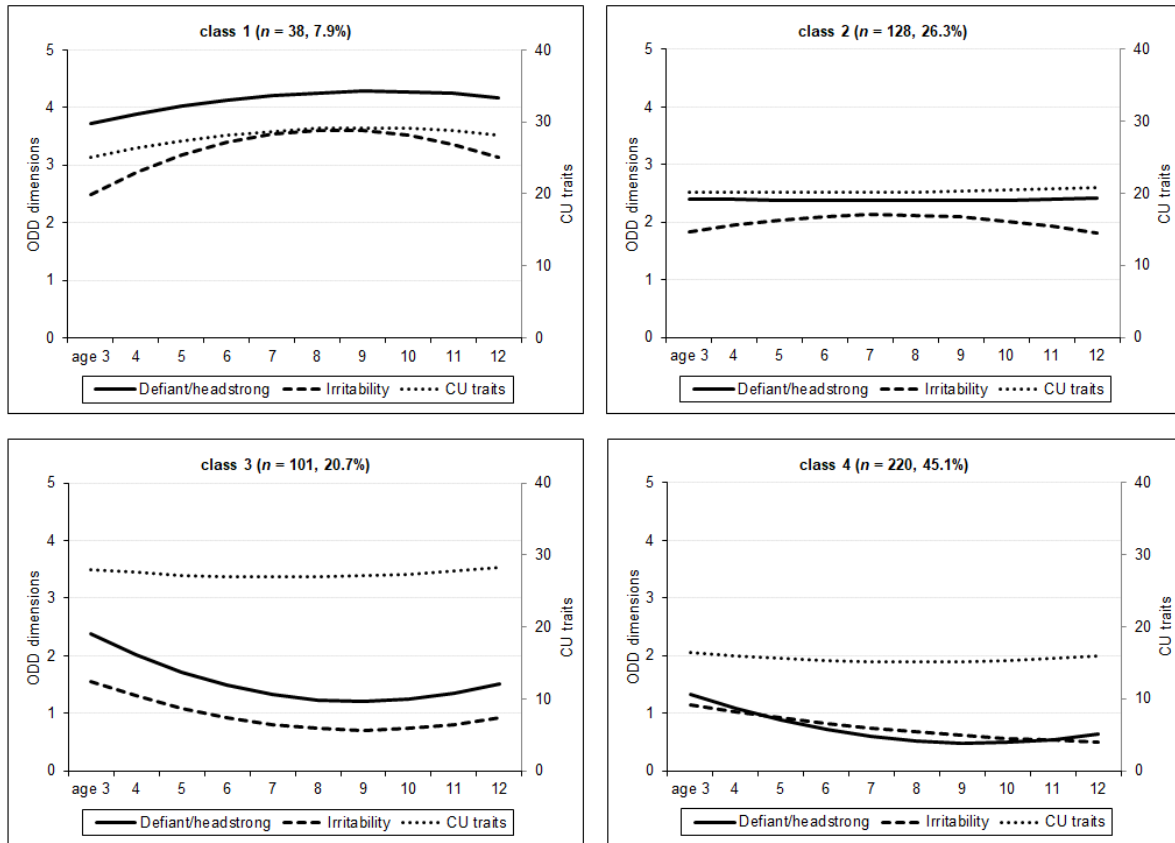
*Figure 2*. Trajectories for Defiant/headstrong (possible range: 0-10), Irritability (possible range: 0-6), and CU traits (Limited Prosocial Emotions-LPE) (possible range: 0-72) by classes (*N* weighted). Each panel shows the trajectories of each resultant class combining the three measures. Class 1: Defiant-Irritability-LPE; Class 2: Defiant-Irritability-without LPE; Class 3: LPE only; Class 4: all low.