

Disentangling Heterogeneity of Childhood Disruptive Behavior Problems Into Dimensions and Subgroups

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Objective: Irritable and oppositional behaviors are increasingly considered as distinct dimensions of oppositional defiant disorder. However, few studies have explored this multidimensionality across the broader spectrum of disruptive behavior problems (DBPs). This study examined the presence of dimensions and distinct subgroups of childhood DBPs, and the cross-sectional and longitudinal associations between these dimensions.

Method: Using factor mixture models (FMMs), the presence of dimensions and subgroups of DBPs was assessed in the Generation R Study at ages 6 ($n = 6,209$) and 10 ($n = 4,724$) years. Replications were performed in two population-based cohorts (Netherlands Twin Registry, $n = 4,402$, and Swedish Twin Study of Child and Adolescent Development, $n = 1,089$) and a clinical sample ($n = 1,933$). We used cross-lagged modeling in the Generation R Study to assess cross-sectional and longitudinal associations between dimensions. DBPs were assessed using mother-reported responses to the Child Behavior Checklist.

Results: Empirically obtained dimensions of DBPs were oppositional behavior (age 6 years), disobedient behavior, rule-breaking behavior (age 10 years), physical aggression, and irritability (both ages). FMMs suggested that one-class solutions had the best model fit for all dimensions in all three population-based cohorts. Similar results were obtained in the clinical sample. All three dimensions, including irritability, predicted subsequent physical aggression (range, 0.08–0.16).

Conclusion: This study showed that childhood DBPs should be regarded as a multidimensional phenotype rather than comprising distinct subgroups. Incorporating multidimensionality will improve diagnostic accuracy and refine treatment. Future studies need to address the biological validity of the DBP dimensions observed in this study; herein lies an important opportunity for neuroimaging and genetic measures.

Key words: disruptive behavior disorder, classification, DSM-5, irritable mood, factor mixture model

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The nosology of childhood disruptive behavior disorders has given rise to considerable academic debate, even since before the disorders were operationalized by the *DSM* in 1980.¹⁻⁵ Many studies using different informants, instruments, and study populations have addressed the heterogeneity and developmental continuities of disruptive behavior disorders.⁶⁻¹¹ More recently, with the development of the *DSM-5*, several changes in the criteria for oppositional defiant disorder (ODD) and conduct disorder (CD) were made. For example, it can now be specified whether CD had its onset before the age of 10 years, which is indicative of a poorer prognosis.^{9,12} Another important change is the possibility to differentiate irritable from

oppositional ODD subtypes.^{13,14} However, to our knowledge, these studies have not assessed whether the ODD dimensions can be discerned on a broader spectrum of disruptive behavior problems (DBPs) beyond a priori-defined *DSM* criteria, which would strengthen our current diagnostic frameworks with an empirical basis.

Recent research established that ODD subtypes have divergent developmental courses; most notably, irritability is associated with later depression and anxiety.¹³⁻¹⁵ Findings from behavioral genetics studies have provided further support for distinguishing irritable from oppositional symptoms,¹⁶ and the *DSM-5* now allows for better classification of ODD symptoms along these dimensions. It is still unclear, however, how irritability is related to other DBPs. So far, significant associations of irritability with oppositionality, but less so with CD, have been described.¹⁷ However, earlier work from this cohort demonstrated that both irritable and headstrong dimensions predicted later ODD, CD, and depression to a similar extent.¹⁸ On the basis of these studies that emphasize the distinct developments of ODD and CD,^{10,19} the *DSM-5* posits CD as a disorder of



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physical violence and delinquency, and ODD as a disorder of oppositionality and irritability. However, comorbidity between these disorders is common.⁸ It might well be that irritability is a distinct dimension on the broad spectrum of DBPs that influences the development of other DBP dimensions, for example, aggression and noncompliance. Indeed, developmental studies have provided preliminary evidence for this, as reviewed by Wakschlag *et al.*²⁰ They discussed that problematic defiance/rule-breaking is often associated with negative affect, but most of what is known about this association is derived from small observational studies. Unfortunately, empirical studies investigating irritability across the broad spectrum of DBPs are lacking.

Developmental scientists have stressed the importance of disentangling the heterogeneity of disruptive behavior,^{5-11,20} and many studies have addressed this with various approaches. One option is classifying DBPs by age of onset, as proposed by the *DSM-5*. However, this will in practice be less useful for clinicians, as retrospective symptoms recall is often unreliable.^{4,21} Furthermore, it is still unclear whether early-onset DBPs will be limited to childhood or whether these children will continue to have problems later in life.⁹ Thus, an empirically based refinement of diagnosis based on the pattern of symptoms a child or adolescent exhibits could be more promising. Given the recent interest in the irritability subtype of ODD, it is important to examine how irritability is associated with other DBPs. A seminal meta-analysis of factor analytic studies by Frick *et al.* has demonstrated that DBPs can be classified along two principal axes, namely, overt/covert, and destructive/nondestructive,⁶ with different developmental trajectories.^{7,21} So far, no study has identified a distinct irritability dimension on the broader spectrum of DBPs, even though irritability has been found to be a distinguishable dimension of ODD specifically. In addition, it remains to be studied more thoroughly how irritability is associated with other DBP dimensions over time. To move toward a more developmentally sensitive nosology of DBPs that would transcend current diagnostic boundaries, it is crucial to examine these symptom patterns across ages.^{18,20,21}

This study had two aims. First, we empirically assessed the multidimensionality across the whole spectrum of childhood DBPs, while simultaneously examining whether meaningful subgroups could be discerned. Hereby we wish to extend recent research that has focused on ODD symptoms specifically, with the goal of testing whether a distinct irritability dimension can be distinguished on a broader DBPs spectrum. The majority of studies on the heterogeneity of DBPs used either dimensional (e.g., factor analysis) or categorical (e.g., latent class analysis) statistical methods.^{6,9,14,16-18} We performed factor mixture models (FMMs), which allow the presence of both dimensional and categorical latent variables and are therefore appropriate for studying the heterogeneity of psychiatric problems.^{22,23} This is important, as recent studies have examined the latent structures of DBPs without clearly characterizing the dimensional or categorical latent structures of DBPs.^{6,13,14,16,17} Second, longitudinal associations between the different dimensions of DBPs were studied using a cross-lagged model. Data from three

population-based cohorts were used, as replication is important for FMMs. In addition, we explored consistency in a sample of clinically referred children in order to test generalizability. Although different population subgroups might be present in clinical samples due to referral bias,²² these analyses will aid translation to clinical practice. Hereby our findings could be more easily interpreted by clinicians treating children with DBPs.

METHOD

Study Populations

This study was conducted using data from three population-based cohorts that collaborate under the FP7-ACTION consortium. Primary analyses were conducted in the Generation R Study, a prospective population-based cohort from fetal life onward, which included 9,778 pregnant women living in Rotterdam, the Netherlands. The aim of the Generation R project is to identify early environmental and genetic factors that affect health and development.²⁴ For the current study, data were used from two time points. At age 6 years, 6,209 children with behavioral data were included in the analyses and comprised fewer children of ethnic minorities and lower socioeconomic status than would be expected from regional demographic statistics. At age 10 years, 4,724 children were included. Children who participated at follow-up were more often of Dutch nationality, had lower Child Behavior Checklist (CBCL) total problems scores ($p < .001$), and had older and more highly educated mothers.²⁴ Study protocols were approved by the local ethics committee.

Independent replications were performed in the Netherlands Twin Registry (NTR; $n = 4,402$) and the Swedish Twin Study of Child and Adolescent Development (TCHAD; $n = 1,089$) cohorts. Both are twin cohorts, nationally representative with respect to socioeconomic status and ethnicities,^{25,26} which aim to explore the genetic and environmental influences on cognitive function, psychopathology, and well-being during development. From each twin pair, one twin was randomly selected.

Additional replication was conducted in a clinical sample of children aged 6 to 11 years of age ($n = 1,933$) who were referred to one of three child and adolescent mental health services in the greater metropolitan area of Rotterdam, the Netherlands. Sampling took place in 2011 for a period of 9 months. This sample is representative of the clinical population in this study base, and has previously been used for clinical validation of the Dutch CBCL.²⁷

Measures

DBPs were consistently assessed with the CBCL in all samples, a widely used reliable and valid measure for behavioral problems.²⁸ The CBCL was completed by the primary caregiver, principally the mother (Table 1). In the Generation R sample, the CBCL/1.5-5 was used at the first time point when most children (58%) were less than 6 years of age, whereas the remaining children were either 6 (38%) or 7 (3%) years of age. In the next examination, the CBCL/6-18 was used, which was also used in the NTR and clinical samples. TCHAD used the CBCL/4-18, an earlier version of the CBCL.

The items included in the FMM analyses were part of the Aggressive Behavior scale of the CBCL/1.5-5, and the Aggressive Behavior and Rule-Breaking Behavior scales of the CBCL/6-18. Items were selected on clinical relevance for measuring DBPs using the following three predefined criteria. Items were not included if (a) they did not reflect problem behavior (e.g., "prefers being with older kids"); (b) were more indicative of behavior problems or disorders other than DBPs (e.g., "can't stand waiting, wants

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