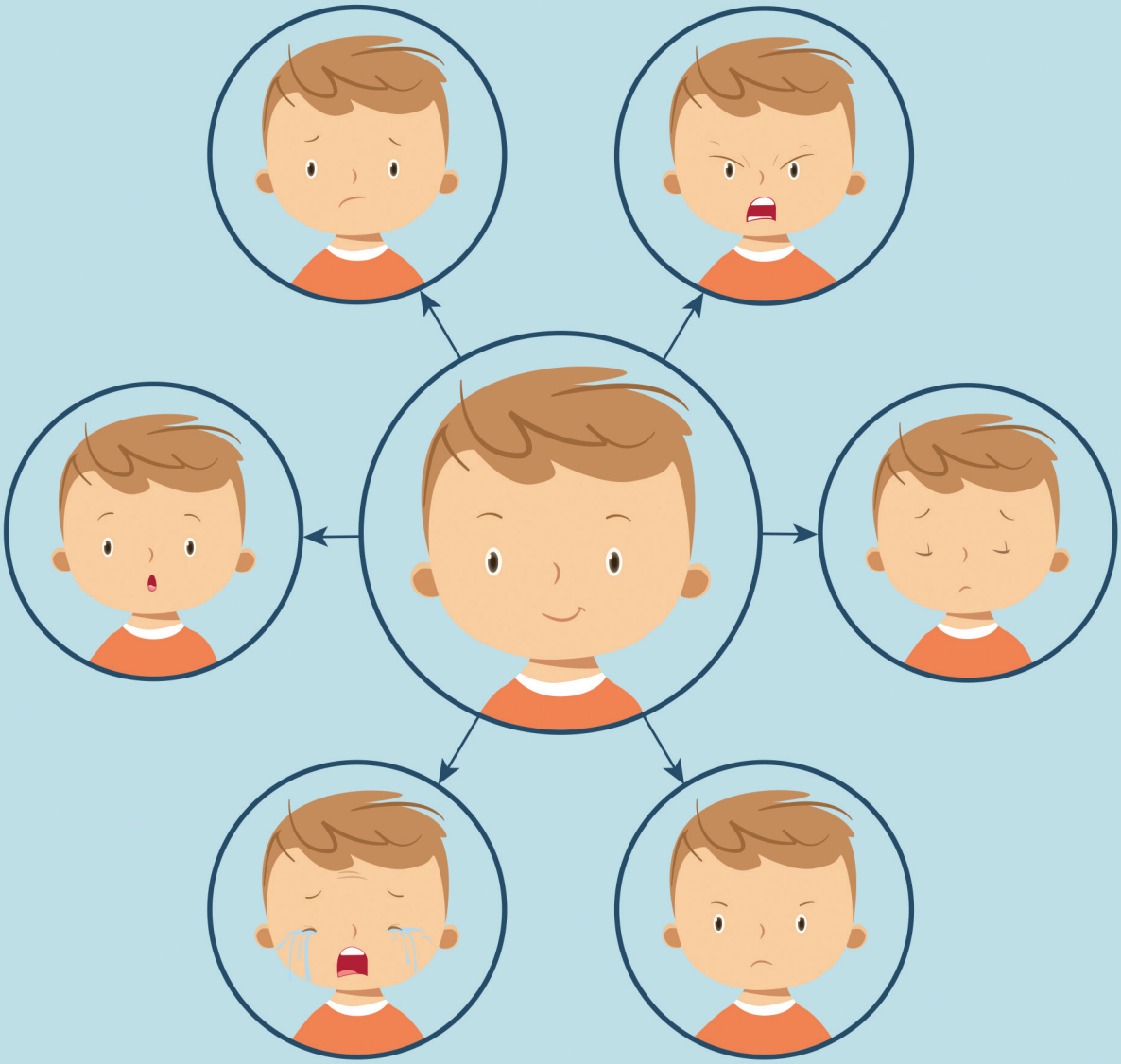
Dysregulation in Childhood and Adolescence:

Measurement, Development, and Correlates



Marike Deutz

Dysregulation in Childhood and Adolescence: Measurement, Development, and Correlates

Dysregulatie in de Kindertijd en Adolescentie:
Meetkenmerken, Ontwikkeling en Correlaten
(met een samenvatting in het Nederlands)

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Marike Hester Francisca Deutz

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Marike Deutz
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CHAPTER 1

General Introduction

Jimmy, an 8-year old boy, grows up in a two-parent family with his 4-year old sister Amelia. At request of both his parents and his teacher, Jimmy is referred for diagnostic evaluation at an outpatient mental health clinic. During the intake interview, Jimmy's parents describe Jimmy as "a difficult child". Jimmy argues a lot, demands a lot of attention, is very stubborn, and always seems restless. Getting him to sleep often takes over an hour, as Jimmy is afraid of ghosts, the dark, thunderstorms, and of being kidnapped. When his parents tell him no, Jimmy often "explodes": screams, kicks or hits his parents, and slams doors. When they send him to his room, Jimmy can cry and sulk all evening, telling his parents that they don't love him. Jimmy's parents state how they find it difficult that Jimmy's mood can change "like night and day". When the clinician asks Jimmy's parents how it feels to be Jimmy's parent, Jimmy's father says it is difficult while Jimmy's mother bursts into tears.

At school, Jimmy's teacher notes that Jimmy has a hard time sitting still in his chair. He often does not pay attention to instructions and cannot work independently for more than five minutes. There have also been incidences in which Jimmy destroyed things belonging to other children, like the time he ran into a construction built by a few classmates. Such things always seem to happen to Jimmy, he "acts before he thinks". Reprimands from the teacher for such incidents often result in Jimmy crying and feeling guilty and fearing that the other children do not like him. The school has indicated that if Jimmy's behavior does not change, they cannot provide him the educational context that he needs.

When Jimmy is asked how he feels about school, he tells the clinician that he hates school. He often has a stomachache in the morning, but his parents force him to go to school anyway. Jimmy fears possibly having to go to another school and worries a lot about this. He feels like his parents are always mad at him, even though he is trying hard to be good. When asked what would make him happy, Jimmy says he wants to go to a deserted island, so no one can be mad at him.

Children like Jimmy, who show significant concurrent disturbances in regulating their affect (emotion), behavior and cognition, are likely to meet criteria for multiple disorders, like attention hyperactivity deficit disorder (ADHD), oppositional defiant disorder (ODD) and anxiety disorders. Such children continually to challenge their parents and teachers and do not easily fit diagnostic assessment and treatment protocols. Co-occurrence of different disorders (comorbidity) is rule rather than exception, and many studies have documented how children with comorbid behavioral and emotional problems are generally the most at risk in their development (e.g.,

Cuffe et al., 2015; Ezpeleta, Domènech, & Angold, 2006; Larson, Russ, Kahn, & Halfon, 2011; Wolff & Ollendick, 2006).

The notion that disorders co-occur at higher rates than to be expected by chance (Angold, Costello, & Erkanli, 1999; Caron & Rutter, 1991), has led to a growing line of studies on comorbidity in both children and adolescents as well as adults. Despite this surge in research, little is known about the meaning behind the high rates of co-occurrence of different forms of psychopathology. For example, it could be that different forms of psychopathology co-occur because they share symptom overlap, because one form of psychopathology increases or causes risk for developing another form or because multiple forms of psychopathology share common etiology and risk factors. It is important that we know how we can measure such co-occurrence of different forms of psychopathology to ultimately better understand the nature of co-occurring psychopathology patterns and intervene as effectively as possible.

Recently, children like Jimmy, who present symptoms of anxiety, attention problems and aggression, have been labeled 'dysregulated'; referring to their concurrent self-regulatory problems in multiple domains, including affective, behavioral, and cognitive self-regulation (the 'ABCs of self-regulation'; Althoff, Verhulst, Rettew, Hudziak, & van der Ende, 2010). The Dysregulation Profile (DP) has emerged as a useful measure of co-occurring psychopathology patterns and can be operationalized using the well-known and widely used questionnaires of the Achenbach System of Empirically Based Assessment (ASEBA; Achenbach, 2009) such as the Child Behavior Checklist (CBCL). The DP uses scores on three main forms of psychopathology, specifically using the ASEBA syndrome scales: Anxious/Depressed (part of the Internalizing scale), Aggressive Behavior (part of the Externalizing scale), and Attention Problems (part of the Externalizing scale for 1.5-5-year-old children, but not for 6-to-18-year-old children). These three scales are jointly referred to as the AAA-scales (Ayer et al., 2009). The DP thus captures a large part of child clinical populations. The AAA-scales are generally strongly related, suggesting that some common factors might be explaining all these forms of psychopathology, although no previous studies had examined this.

The overall aim of this dissertation is to increase knowledge of co-occurring psychopathology patterns by focusing on how to measure and understand the DP. We strive to advance theory formation on dysregulation in childhood and adolescence by conducting research into conceptualization and operationalization, stability and change, antecedents, outcomes and psychophysiological correlates of the DP. This dissertation is centered around three main research questions: (1) how to conceptualize and operationalize the DP? (2) how stable is the DP over time and how can the normative developmental course of the DP from age 4 to age 17 in the general population be described? and (3) what are early childhood antecedents, adolescent outcomes and psychophysiological correlates of the DP?

The Dysregulation Profile

Starting with Biederman et al. (1995), several studies have described a profile of elevated scores on the Anxious/Depressed, Aggressive Behavior and Attention Problems scales of the Child Behavior Checklist that was thought to characterize expressions of bipolar disorder in children, henceforth the labels CBCL – Juvenile Bipolar Disorder Profile and Pediatric Bipolar Disorder Profile were used (e.g., Althoff, Rettew, Faraone, Boomsma, & Hudziak, 2006; Boomsma et al., 2006; Holtmann, Goth, Wockel, Poustka, & Bolte, 2008; Hudziak, Althoff, Derks, Faraone, & Boomsma, 2005; Volk & Todd, 2007). These studies were published in a time in which diagnoses of pediatric bipolar disorder, characterized by intense mood changes, alternating depressive episodes (feeling sad and down), and manic episodes (feeling energetic and overactive), were rising in the United States (Kessing, Vradi, & Andersen, 2014). The possibility to screen for juvenile bipolar disorder with a questionnaire that was already widely used in research and clinical settings, was evaluated in several studies (e.g., Biederman et al., 2009; Faraone, Althoff, Hudziak, Monuteaux, & Biederman, 2005). Subsequent studies, however, disputed the predictive validity of this specific CBCL-profile for bipolar disorder (Diler et al., 2009; Mick, Biederman, Pandina, & Faraone, 2003). Rather, the profile predicted a wide range of both internalizing and externalizing psychopathologies and disorders, personality dysfunction, suicidality, substance use, psychiatric hospitalization, and functional impairment (Althoff, Verhulst, et al., 2010; De Caluwé, Decuyper, & De Clercq, 2013; Halperin, Rucklidge, Powers, Miller, & Newcorn, 2011; Holtmann, Buchmann, et al., 2011; Meyer et al., 2009). Hence, it was suggested to rename the profile into the Dysregulation Profile, or DP for short (Althoff, 2010; Ayer et al., 2009). This name closely aligned with studies demonstrating that emotional dysregulation, i.e., failure to adaptively modulate emotions (Aldao, Gee, De Los Reyes, & Seager, 2016; Manczak, Ham, Sinard, & Chen, 2018), is a salient transdiagnostic factor, as it is present in both externalizing (e.g., aggressive) and internalizing (e.g., anxious) forms of psychopathology. The term dysregulation is also in line with descriptions of behavior already frequently used by clinicians for children like Jimmy (Althoff, Verhulst, et al., 2010).

Aim 1: Conceptualization and Operationalization of the DP

There is no consensus on the preferred conceptualization of the DP. As most psychological constructs, the DP is a hypothetical construct that needs validation with a construct validity approach. Construct validity is an understudied, but essential element of validity examination of the DP. Construct validity concerns "the degree to which a test measures what it claims, or purports, to be measuring" (Brown, 1996, p. 231). Construct validity can be differentiated into within-network validity and between-network validity (Marsh, 1990; Marsh, Ellis, Parada, Richards, & Heubeck, 2005). *Within-network validity* is concerned with specific features of

a construct: its components, structure, attributes and theoretical statements relating these features (e.g., conceptualization). In examining within-network validity, factor-analytic techniques can be used to conduct tests of multidimensionality (whether a set of items reflects a common underlying construct; Reise, 2012). *Between-network validity* is concerned with locating the construct in a broader conceptual space: examining patterns of relations between a construct and other relevant constructs and determine whether these patterns are logically consistent. The construct validation process should initially focus on within-construct issues before moving to between-construct issues. Marsh et al. (2005) formulated it as follows:

"*In summary, resolution of within-construct issues should be a logical prerequisite to between-constructs research, but researchers are often seduced into pursuing between-networks research before they have done the hard work of developing an appropriate measure, evaluating the psychometric properties of responses, validating the structure (using item analysis, reliability, stability, and, particularly, factor analysis), and revising their measures appropriately.*" (Marsh et al., 2005, p. 84)

Operationalization of the DP can be done in different ways. In this dissertation we focus on the DP as a questionnaire-based measure of dysregulation. The DP has most often been measured with ASEBA-questionnaires, primarily with the parent-reported CBCL (CBCL-DP; e.g., Althoff, Ayer, Rettew, & Hudziak, 2010; Holtmann, Buchmann, et al., 2011), but also with the multi-informant Strengths and Difficulties Questionnaire (SDQ-DP; Holtmann, Becker, Banaschewski, Rothenberger, & Roessner, 2011). The CBCL and SDQ are generally considered to be comparable instruments: both questionnaires measure a broad spectrum of child and adolescent emotional and behavioral problems. The DP consists of elevated scores on scales representing dysregulation of affect/emotion (Anxious/Depressed and Emotional Symptoms for ASEBA vs. SDQ), behavior (Aggressive Behavior/Conduct Problems) and attention/cognition (Attention Problems/Hyperactivity-Inattention) (Althoff, Verhulst, et al., 2010; Winsper & Wolke, 2014).

Using either of these questionnaire systems, the DP has been measured in many ways. For the CBCL-DP, the range of operationalizations include: summed T-scores (Holtmann, Buchmann, et al., 2011; Volk & Todd, 2007), summed raw-scores (McGuire et al., 2013), latent classes (Althoff, Verhulst, et al., 2010; De Caluwé et al., 2013), and a cut-off approach of summed T-scores (Doerfler, Connor, & Toscano, 2010; Jucksch et al., 2011). For the SDQ-DP, a 5-item score has been used (Holtmann, Becker, et al., 2011) as well as a 15-item score (Winsper & Wolke, 2014). This range of operationalizations hinders the progress of the field. When one construct is measured in different ways, it becomes more difficult to compare results of studies. Furthermore, each operationalization has different (implicit) implications for how the DP is conceptualized, and these differences make it difficult to build a solid theory of dysregulation.

Although there has been an exponential growth in studies on the DP in the last decade, no studies have used factor analysis to examine the structure of the DP. Therefore, for the first aim of this dissertation, we used factor analysis to examine the within-network validity of the DP, thus studying conceptualization and operationalization of the DP. Factor analysis of the DP is especially needed to validate the structure of the measure. With factor analysis, the most appropriate structure of a construct can be determined. In the sixties of the past century, factor-analytic work on co-occurrence of behavioral and emotional symptoms (Achenbach, 1966) revealed the presence of two broad-band psychopathology factors in childhood and adolescence: externalizing (including aggressive and rule-breaking symptoms) and internalizing (including anxious and depressive symptoms). This two-dimensional structure of psychopathology explained the strong interrelations of small-band syndromes *within* the broad-band scales very well (such as interrelations between the Aggressive Behavior and Rule-Breaking Behavior syndrome scales from the Externalizing scale).

More recently, the long-dominant two-dimensional structure of externalizing and internalizing psychopathology has been extended, as rising awareness of co-occurrence *between* the broad-band scales has led to testing of hierarchical models of psychopathology. In these hierarchical models, higher-order factors explain the interrelatedness of externalizing and internalizing psychopathology. Bifactor models, hierarchical models in which symptoms load on both a general underlying factor as well as a specific factor, have been applied in the field of psychopathology research (e.g., Martel, von Eye, & Nigg, 2012; Tackett, Daoud, De Bolle, & Burt, 2013) Although bifactor models are not new – they stem from research on intelligence (in which a general 'g' factor was found to underlie various forms of intelligence) – applying them to the structure of psychopathology is still relatively new. This field has seen a surge of publications after the publication of two seminal studies by Lahey et al. (2012) and Caspi et al. (2014), that documented a 'general psychopathology factor' (GP, or 'p factor') that underlies a range of psychopathology from the externalizing and internalizing spectrum. Subsequent replications in several adult as well as child and adolescent samples (Laceulle, Vollebergh, & Ormel, 2015; Lahey et al., 2015; Murray, Eisner, & Ribeaud, 2016; Neumann et al., 2016; Patalay et al., 2015), has provided convincing support for the notion that there is a common liability to all forms of psychopathology (for a review, see Caspi & Moffitt, 2018). Bifactor analytic techniques could be relevant for the examination of the DP as well, because bifactor models are highly relevant for understanding comorbidity at the most general level (Krueger & Eaton, 2015). Testing the factor structure is essential for advancing conceptualization of the DP. Furthermore, since both GP and DP approaches are concerned with common interrelatedness of externalizing and internalizing symptomatology, we aimed to determine whether both approaches can be integrated.

In sum, the current lack of consensus on conceptualization and operationalization of the DP hinders theory formation on the DP and can be solved by taking a step back and by focusing on important, but often ignored, issues of measurement. Therefore, the first aim of this dissertation is concerned with examining within-network validity of the DP, primarily by examining competing factor models, namely one-factor, second-order and bifactor models of the DP, to determine which factor structure best represents the DP. *Chapters* 2 and 3 present systematic evaluations of the factor structure of the DP across reporters, gender and developmental period using ASEBA (*Chapter* 2), and SDQ-questionnaires (*Chapter* 3). By examining the DP in distinct developmental periods, we furthermore aimed to examine whether the DP is constructed similarly in different developmental periods (early childhood, middle childhood, adolescence) by conducting measurement invariance analyses. *Chapter* 4 presents an examination of the DP and GP models within one study, with respect to their core components, stability and antecedents and outcomes.

Aim 2: Stability and Change of the DP

The second aim of this dissertation is to examine stability and change, specifically the normative developmental course of the DP across different developmental periods (from early childhood to adolescence). For this aim, both individual rank-order stability and group-level developmental change were studied.

Examining developmental stability of the DP is an essential validating feature. The degree of stability may provide evidence for the extent to which dysregulation might represent a trait-like behavior, potentially based in biological differences. Understanding stability of the DP might clarify the long-term prognosis of dysregulation and is therefore crucial for the development and timing of screening strategies. Stability of dysregulation, however, is an understudied topic, with scarce evidence to date suggesting high stability of the CBCL-DP in a twin-study across 7, 10 and 12 years (Boomsma et al., 2006), medium 9-year stability of the CBCL-DP in an ADHD-sample across ages 7-11 and ages 16-26 (Halperin et al., 2011), as well as high stability of the SDQ-DP in a cohort study across 4, 7, 8 and 9.5 years (Winsper & Wolke, 2014).

There are several gaps in the research on stability and change of the DP that we aim to address in this dissertation. First, studies are needed that examine stability of the DP across larger periods of development (i.e., from early childhood to late adolescence). By extending the time frame in which stability is studied, we can examine whether early dysregulation could be a sign of persistent problems with regulation of affect, behavior and attention across development. If this is the case, this would provide empirical support for the use of the DP in early childhood for potential screening purposes. Second, studies are needed that examine the stability of the DP within a hierarchical factor-analytic framework, to illuminate underlying

processes of co-occurring psychopathology patterns. Specifically, within hierarchical factor-analytic models of the DP, both homotypic and heterotypic continuity can be studied. Homotypic continuity reflects stability of one form of psychopathology predicting itself at a later time point, and heterotypic continuity describes when one specific form of psychopathology predicts another form of psychopathology at a later time point (Angold et al., 1999). Studying homo- and heterotypic continuity could give insight into the complex mechanisms that underlie (development of) co-occurring psychopathology patterns, as measured by the DP. Specifically, we aim to test whether dysregulation, measuring co-occurring psychopathology patterns, remains stable while the specific manifestations of psychopathology (such as aggressive or anxious behaviors) might be more susceptible to change and therefore less stable.

Next to rank-order stability, or inter-individual consistency, it is important to examine the degree of developmental stability or change. We therefore aim to examine the developmental course of the DP. The development of the DP could be non-linear, as we expect a peak in early adolescence, when major cognitive, physical and social changes occur (Steinberg, 2005), which could be reflected in higher dysregulation. To test such a hypothesis, models are needed that consider non-linear patterns of change. Such complex models ideally require at least five repeated assessments (Raykov & Penev, 2014). We thus examined the normative developmental course of the DP using longitudinal data from six time points. Knowledge on how the development of dysregulation occurs in the general population can help us determine what is normative. Such knowledge could inform the timely detection of a potential abnormal peak of dysregulation. Furthermore, knowledge of the developmental course of dysregulation can guide planning of early detection, prevention and intervention.

In sum, the second aim of this dissertation is concerned with examining stability of the DP as well as the normative developmental course of the DP. In *Chapters* 3 and 4, we expanded the developmental timespan over which the (rank-order) stability of the DP has been studied by examining the stability of the DP across different developmental periods, i.e., from middle childhood to adolescence and from early childhood to adolescence. Furthermore, we examined stability within a factor-analytic framework, as to examine both homotypic stability of dysregulation as well as of more specific forms of psychopathology (i.e., anxiety/depression, aggression and attention problems), and heterotypic stability (e.g., whether dysregulation longitudinally predicts specific forms of psychopathology and vice versa). In *Chapter* 5, we examine the normative development of the DP from early childhood to adolescence to determine its developmental course.

Aim 3: Antecedents, Correlates, and Outcomes of the DP

The third aim of this dissertation is to examine longitudinal antecedents and outcomes and concurrent correlates of the DP. Exploring these relations can provide a more complete picture of the development and implications of dysregulation and contributes to examination of the between-network validity of the DP. Two notions drove the research in this dissertation related to this aim. First, we aimed to determine unique antecedents, correlates and outcomes of dysregulation versus more specific forms of psychopathology. Generally, it has been difficult to identify specific etiology and outcomes for different forms of psychopathology. Rather, many risk factors predict a range of psychopathology (also called multifinality) and many different forms of psychopathology have the same outcomes. High levels of co-occurrence between different forms of psychopathology therefore call for a transdiagnostic approach, of which the main goal is to identify dysfunctional processes that cut across diagnostic categories. The DP could be a highly useful measure for this purpose. However, no studies yet examined etiology and outcomes of the DP within a factor-analytic operationalization of dysregulation. Such an approach however can give insight into overlapping and unique etiology and outcomes of dysregulation versus specific forms of psychopathology (i.e., anxiety/depression, aggression and attention problems). We therefore aimed to examine etiology and outcomes of dysregulation within a factor-analytic framework. Second, although the DP is often described as resulting from self-regulatory deficits or linked to a dysregulated temperamental or personality profile (Althoff et al., 2012; Castellanos-Ryan et al., 2016), few studies have specifically examined such links. We therefore especially investigated links between the DP and self-regulatory measures such as effortful control and ego-resiliency (*Chapter* 3), self-control and executive functioning measures (*Chapter* 4), and between the DP and temperament (*Chapter* 4) and personality pathology (*Chapter* 5). As such, this aim also contributed to the establishment of the construct and predictive validity of the DP. In the section below, we will elaborate on the background of our study of antecedents, outcomes and correlates of the DP.

Antecedents. To better understand the nature of dysregulation, and to identify potential targets for prevention and intervention, it is imperative to know what increases the risk to develop dysregulation. Knowledge of early antecedents of dysregulation can aid in developing screening strategies, as such knowledge provides information about which children are most at risk for developing dysregulation. Furthermore, identifying (potentially) modifiable predictors of relatively stable dysregulation advances prevention and intervention strategies as focusing on such predictors could deter youth from a potential chronic trajectory of dysregulatory problems.

Unfortunately, only a handful of studies have examined longitudinal antecedents of the DP. One study showed that the dysregulation class was most strongly related to maternal and paternal externalizing and internalizing psychological symptoms and hostility (compared to

the other three identified psychopathology classes of internalizing, externalizing/emotionally reactive, and no problems; (Basten et al., 2013). Evidence from cross-sectional studies also points to the role of family factors, with links shown between dysregulation and more negative parenting (Jucksch et al., 2011; Kim et al., 2012). In addition, poor language ability and peer relations predicted change in dysregulation in a community sample (McQuillan et al., 2018) and concurrent links were demonstrated between dysregulation and cognition and intelligence (Basten et al., 2014; Blanken et al., 2017). We therefore focused on predictors from the family domain and extended the research on negative parenting by also examining links with positive maternal caregiving and stimulation and support in the child's environment, and mother-child attachment patterns. Other antecedents that were studied included temperament and self-regulation (for construct validity purposes), and cognitive ability (*Chapter* 4).

Adolescent outcomes. A variety of outcomes have been linked to the DP, such as substance use, suicidality, and a range of psychiatric disorders. Several studies have shown that the DP predicts personality dysfunction, i.e., personality disorders and personality pathology (Althoff, Verhulst, et al., 2010; De Caluwé et al., 2013; Halperin et al., 2011). In this dissertation, we add to the literature on adolescent outcomes of the DP by: (1) examining not only initial levels, but also change over time of the DP in relation to outcomes, (2) examining outcomes of both mother- and youth reported DP, and (3) examining not only youth-reported outcomes but also task-based and school-records data to avoid shared method variance explaining relations.

Biological correlates. Interpretation of the DP and its predictive validity might be further improved by examining biological correlates of the DP. Studying biological correlates of the DP can increase our understanding of the dysfunction of biological systems implicated in the regulation of affect, behavior and cognition. Future identification of biomarkers could be useful for early diagnosis, understanding of underlying mechanisms of psychopathology (development) and for identifying heterogenous subpopulations with shared biological characteristics that could affect treatment response.

Several studies to date examined biological correlates of the DP. One study demonstrated that in a longitudinal community sample, children with persistent DP show more blunted hypothalamic-pituitary-adrenal axis (HPA-axis) responses at stress tasks compared to children with no-DP or non-persistent DP (Ayer et al., 2013). Associations between thyroid dysfunction and DP were reported in one study (Holtmann, Duketis, Goth, Poustka, & Boelte, 2010), but were not replicated in another study (Zepf, Wockel, Poustka, & Holtmann, 2008). One study in children born extremely preterm showed that exposure to passive cigarette smoke as well as recovery of Mycoplasma from the placenta predicted higher levels of the DP at age 2 (controlling for maternal education; Frazier et al., 2015). Summarizing, a small body of research has studied different biological processes suggested to be implicated in the (development of) the DP. In

this dissertation, we aimed to contribute to the exploration of biological processes implicated in dysregulation. In our work, we focused on the autonomic nervous system, specifically on resting heart rate and heart rate reactivity, as no studies yet had examined ANS (dys-)function in relation to dysregulation. This is surprising as ANS (dys-)function has consistently been implicated in the development of both externalizing and internalizing psychopathology (Dietrich et al., 2007; Latvala et al., 2016; Lorber, 2004; Monk et al., 2001; Ortiz & Raine, 2004), and is thought to be a major component of emotion regulation (Appelhans & Luecken, 2006; Kreibig, 2010). Furthermore, heart rate measures are often easy and inexpensive to assess and could therefore be more practical potential biomarkers that could be assessed in clinical practice. Heart rate measures are therefore an important avenue of research into biological correlates of the DP.

In sum, to better understand the nature and implications of the DP, the third aim of this dissertation is to examine antecedents, outcomes and biological correlates of the DP across development. We examine a broad range of longitudinal early childhood antecedents (e.g., temperament, maternal depression), adolescent outcomes (e.g., mental health and academic outcomes) and concurrent (biological) correlates (e.g., self-regulation measures, heart rate measures) to study construct and predictive validity of the DP and ultimately contribute to forming a developmental theory of the DP. Longitudinal antecedents are reported in *Chapter* 4, outcomes in *Chapters* 3, 4 and 5, and concurrent correlates in *Chapters* 2, 3 and 6.

Project design

For this dissertation, we adopted a multi-sample multi-method multi-informant approach, utilizing four different samples from three different countries. The samples, measures and reporters used in this dissertation are described below, and their most important characteristics (e.g., sample type and size, percentage of boys, instruments used to define the DP) are presented in Table 1.1.

Samples. In this thesis, four different samples, mainly from longitudinal community studies, were used to examine the research aims in different populations, to increase generalizability of study findings. *Chapter* 2 and 5 were based on the Flemish Study on Parenting, Personality and Development (FSPPD; Prinzie et al., 2003), *Chapter* 3 on Project Achieve from the United States (Project Achieve; Hill & Hughes, 2007), and *Chapter* 4 from the Study of Early Child Care and Youth Development from the United States (SECCYD; NICHD Early Child Care Research Network, 2005). Examining the DP in (longitudinal) *community* samples benefits theory formation on the etiology and outcomes of the DP and advances our knowledge on which children in the general population are most at risk for dysregulation. Furthermore, we aimed to examine measurement properties and validity of the DP in community samples primarily as

this would benefit our knowledge on whether the DP could be a useful screener in the general population. In addition, by utilizing community data that was longitudinal, in which children were followed over often lengthy periods of time (e.g., 13 years), allowed us to learn more about the developmental course of psychopathology related to etiology of outcomes.

Although most of the work in this dissertation was conducted in community samples, we also included a Canadian sample of children referred for externalizing behavior and comparison children in *Chapter* 6. Most of the previous studies on the DP conducted in clinical populations focused on the role of the DP as a specifier of psychopathology severity in specific populations such as children with ADHD (Peyre, Speranza, Cortese, Wohl, & Purper-Ouakil, 2015; Taskiran et al., 2018), disruptive behavior disorders (Masi, Pisano, Milone, & Muratori, 2015), Obsessive-Compulsive Disorder (McGuire et al., 2013) or anxiety disorders (Caporino, Herres, Kendall, & Wolk, 2016). We however aimed to describe links between psychopathology using the DP and biological correlates in a sample of children referred for externalizing behavior which presents a more representative and generalizable clinical population than a specific population of children with one exact disorder.

Measurement of the DP. In this dissertation, we examined the DP using two different broadly used questionnaire systems for measuring emotional and behavioral problems in children and adolescents: the ASEBA (Achenbach, 2009) and the SDQ (Goodman, 1997). Both systems have (near-)equivalent forms for different reporters, are widely used in research and clinical practice, and are thought to be fairly comparable (Goodman & Scott, 1999; Stone, Otten, Engels, Vermulst, & Janssens, 2010). As the ASEBA questionnaires were originally used to define the DP, and have since dominated literature of dysregulation, in four of the five chapters we examined the DP using ASEBA questionnaires, namely the Child Behavior Checklist (CBCL; *Chapters* 2, 4, 5, 6), the Teacher Report Form (TRF; *Chapter* 2) and the Youth Self Report (YSR; *Chapter* 2, 4). *Chapter* 3 concerns the examination of the DP on the multi-informant SDQ with the goal to examine whether the DP is an independent construct, regardless of questionnaire used.

Reporters. Most of the work on the DP so far used mother-reports to define the DP. One previous study reported that parent-, teacher- and youth-reports could be used to define a group of dysregulated children (Althoff, Rettew, Ayer, & Hudziak, 2010), but no studies yet examined whether the *structure* of the DP is similar across reporters. We therefore utilized mother-, father-, teacher-, and youth-reports to examine the factor structure of the DP and made explicit comparisons across reporters to determine whether dysregulation is constructed similarly across these different reporters (i.e., we examined measurement invariance, *Chapters* 2, 3) and examined agreement among reporters (*Chapters* 3, 4). Furthermore, by using different reporters of the DP we also aimed to avoid relying on maternal data for measurement of both antecedents/outcomes and the DP, as this increases shared method variance.

Measurement of antecedents, outcomes, and correlates. To study construct and predictive validity of the DP, we examined a range of longitudinal antecedents and outcomes and concurrent correlates from multiple domains (child, family, peers, school) of the DP. We adopted a multi-method multi-informant approach, utilizing questionnaire, observational, experimental, psychophysiological, and school-records data. When we relied on questionnaire data solely, which is the case in Chapter 2 and 5, we used different informants for the predictor and outcomes, to reduce shared method variance.

Outline of this Dissertation

In the chapters that follow, five empirical studies are presented that address the three main research aims of this dissertation: (1) how to conceptualize and operationalize the DP? (2) how stable is the DP over time and how can the normative developmental course of the DP from age 4 to age 17 in the general population be described? and (3) what are early childhood antecedents, adolescent outcomes and psychophysiological correlates of the DP?

In *Chapter* 2 "The Dysregulation Profile in Middle Childhood and Adolescence across Reporters: Factor Structure, Measurement Invariance, and Links with Self-Harm and Suicidal Ideation", we report an investigation of the factor structure of the DP using ASEBA measures across multiple reporters, namely mothers, fathers, teachers and youth themselves (aim 1). Additionally, measurement invariance across gender, parents and time is examined (aim 1), as well as links between DP and self-harm and suicidal ideation (aim 3).

In *Chapter* 3 "Evaluation of the Strengths and Difficulties Questionnaire - Dysregulation Profile (SDQ-DP)", we examine the factor structure of the DP using the Strengths and Difficulties Questionnaire (aim 1), as this instrument is increasingly being used to define the DP and its use in research and clinical practice is also becoming more widespread. It is thus important to examine whether both instruments can be used to measure the DP, which would also establish the DP as a relevant profile independent of its measure. We examine the SDQ-DP across multiple reporters (aim 1). Next to examining measurement invariance, stability of the DP is examined (aim 2). Validity of the SDQ-DP is examined by linking the DP with self-regulatory measures as well as outcomes in adolescence such as disciplinary measures (aim 3).

In *Chapter* 4 "General Psychopathology and Dysregulation Profile in a Longitudinal Community Sample: Stability, Antecedents, and Outcomes", we present a study in which we examine DP as well as a similar model of general psychopathology (GP) in the sample same, to investigate similarities and differences between the models, with the aim to examine whether both fields could be integrated (aim 1). The approach used to compare these models is to examine a broad range of antecedents and outcomes of DP and GP models (aim 3). Additionally, stability is examined (aim 2).

Chapter 5 "The Child Behavior Checklist – Dysregulation Profile from Childhood to Adolescence: Normative Development and Associations with Personality Pathology" examines the normative development of the CBCL-DP (aim 2), and studies how both early childhood initial levels of the DP as well as change across development are related to late adolescent personality pathology (aim 3).

Finally, *Chapter* 6 "Underlying Psychophysiology of Dysregulation: Resting Heart Rate and Heart Rate Reactivity in Relation to Childhood Dysregulation" examines psychophysiological correlates of both person-centered and variable-centered DP (aim 1), specifically resting heart rate and heart rate reactivity (aim 3).

The overall discussion in *Chapter* 7 summarizes the findings of the five chapters and provides an integration and discussion of the findings.

Table 1.1. Overview of the Five Studies Included in This Dissertation

Ch.	Aims	Sample	N	% boys	Type of study	Assessments and mean age in years	DP instruments	DP operationalization	Antecedents, Correlates and Outcomes
2	1, 3	FSPPD[a] (Belgium)	697	49.8	Longitudinal cohort-sequential	DP: T1: M_{age} = 7.90 T2: M_{age} = 13.93	CBCL (M, F) TRF (T) YSR (Y)	CFA	Correlates: Self-harm and suicidal ideation (Y)
3	1, 2, 3	Project Achieve (United States)	1073	52.5	Longitudinal cohort	DP: T1: M_{age} = 6.57 T2: M_{age} = 9.57 T3: M_{age} = 13.57	SDQ (P, T, Y)	CFA, sum scores	Correlates: Effortful control (TB), ego-resiliency (T) Outcomes: Disciplinary actions (T), antisocial behavior (Y)
4	1, 2, 3	NICHD (United States)	768	49.8	Longitudinal cohort	DP/GP: T1: M_{age} = 8 T2: M_{age} = 14 Antecedents: Birth – 54 months Outcomes: Age 15	CBCL (M) YSR (Y)	CFA	Antecedents: Birth weight (M), attachment (O), temperament (M), cognitive ability (TB), delay of gratification (TB), impulsivity (TB), self-control (T), positive parenting (O), harsh control (M), maternal depression (M), home environment (O) Outcomes: Average grade (T), days attended (T), aggression (Y), depression (Y), psychopathy (Y), sleep problems (Y), friendship quality (Y), loneliness (Y), psychosocial maturity (Y), resistance to peer pressure (Y), risk-taking propensity (TB), risk-taking (Y)
5	2, 3	FSPPD (Belgium)	668	49.5	Longitudinal cohort-sequential	DP: T1-T6: ages 4-17 Outcomes: T7: M_{age} = 18.48	CBCL (M)	CFA	Outcomes: Personality pathology dimensions (Y)
6	1, 3	DBD treatment study (Canada)	182	75.8	Cross-sectional predominantly clinically referred	DP: T1: M_{age} = 9.70	CBCL (M)	CFA, LPA	Correlates: Resting heart rate (N), heart rate reactivity (N/TB), temperament (M)

Note. M = mother-report, F = father-report, P = parent-report, T = teacher-report, Y = youth self-report, TB = task-based, O = observational, N = neurobiological.
Note. CFA = Confirmatory Factor Analysis, LPA = Latent Profile Analysis.
Note. Antecedents and outcomes are measured longitudinal, correlates are measured concurrently.
[a] The FSPPD started in 1991. For Chapter 2, we used data from the third wave (2001) as T1, for Chapter 5 we used data from the first wave (1991) as T1.

CHAPTER 2

The Dysregulation Profile in Middle Childhood and Adolescence Across Reporters: Factor Structure, Measurement Invariance, and Links With Self-Harm and Suicidal Ideation

Deutz, M. H. F., Geeraerts, S. B., van Baar, A. L., Deković, M., & Prinzie, P. (2016). The Dysregulation Profile in Middle Childhood and Adolescence Across Reporters: Factor Structure, Measurement Invariance and Links With Self-Harm and Suicidal Ideation. *European Child and Adolescent Psychiatry*, 25, 431-442.

AUTHOR CONTRIBUTIONS

M. Deutz conceptualized the study. M. Deutz analyzed the data with assistance of S. Geeraerts. M. Deutz wrote the manuscript. P. Prinzie was responsible for the data collection. A. van Baar, M. Deković and P. Prinzie provided feedback on the conceptualization, analyses and manuscript. S. Geeraerts provided feedback on the manuscript.

ABSTRACT

Recently, a phenotype of severe dysregulation, the Dysregulation Profile (DP), has been identified. DP consists of elevated scores on the Anxious/Depressed, Aggressive Behavior and Attention Problems scales of the Child Behavior Checklist (CBCL), Teacher Report Form (TRF) or Youth Self Report (YSR). A drawback in current research is that DP has been conceptualized and operationalized in different manners and research on the factor structure of DP is lacking. Therefore, we examined the factor structure of DP across multiple reporters, measurement invariance across gender, parents and time, as well as links between DP and self-harm and suicidal ideation.

Data from a large community sample were used (N = 697), covering middle childhood (M_{age} = 7.90, *SD* = 1.16) and adolescence (M_{age} = 13.93, *SD* = 1.14). Mothers, fathers, teachers and youth themselves reported on children's emotional and behavioral problems using the CBCL, TRF, and YSR.

Results indicated that in middle childhood and in adolescence, a bifactor model with a general factor of Dysregulation alongside three specific factors of Anxiety/Depression, Aggressive Behavior, and Attention Problems fitted best, compared to a second-order or one-factor model. The model showed good fit for mother-, father-, teacher-, and youth-reports and showed invariance across gender, parents and time. Youth-, mother-, and father-reported Dysregulation was uniquely and positively related to adolescent-reported self-harm and suicidal ideation.

The Dysregulation Profile is best conceptualized as a broad dysregulation syndrome, which exists over and above Anxiety/Depression, Aggression, and Attention Problems as specific problems. The bifactor model of DP explains the uniqueness and interrelatedness of these behavioral problems and can help explaining shared and non-shared etiology factors. The exclusive link between the general dysregulation factor and adolescents' self-harm and suicidal ideation further established the clinical relevance of the bifactor model.

INTRODUCTION

Children with both emotional and behavioral problems show dysregulation across all three components of self-regulation: they have impairments in the ability to regulate affect (anxiety, depression), behavior (aggression) and cognition (attention) (Althoff, Verhulst, et al., 2010). This phenotype of severe dysregulation is often represented by the Child Behavior Checklist Dysregulation Profile (CBCL-DP or DP; Ayer et al., 2009). DP consists of elevated scores on three syndrome scales of the Child Behavior Checklist: Anxious/Depressed (AD), Aggressive Behavior (AB) and Attention Problems (AP) (or simply AAA-scales; Ayer et al., 2009).

The Dysregulation Profile is not specific to the CBCL, but an independent construct that has been found with a variety of questionnaires assessing emotional and behavioral problems, such as the equivalent questionnaire for teachers (Teacher Report Form; TRF, e.g., Althoff, Rettew, et al., 2010) and the Strengths and Difficulties Questionnaire (Holtmann, Becker, et al., 2011). Consequently, we use the more general term of Dysregulation Profile (DP) instead of CBCL-DP.

Research on the Dysregulation Profile originated from research on childhood predictors of bipolar disorder. The CBCL – Juvenile Bipolar Disorder Profile or Pediatric Bipolar Disorder Profile were the original names for the profile consisting of elevated scores on the AAA-scales, as this profile was found to be predictive of bipolar disorder (Biederman et al., 1995). Several studies have since examined the link between DP or JBD/PBD and bipolar disorder and results have been inconsistent (Diler et al., 2009; Mick et al., 2003). Instead of a marker for later bipolar disorder, DP is now thought to identify children with poor regulation of emotion, attention, and behavior (Ayer et al., 2009). A growing line of research indicates that DP is a clinically relevant phenotype, uniquely predicting adverse outcomes like psychiatric problems (e.g., Althoff, Verhulst, et al., 2010), pathological personality (De Caluwé et al., 2013) and suicidality (e.g., Ayer et al., 2009; Holtmann, Buchmann, et al., 2011). Research on the Dysregulation Profile is also closely related to a small, but important field of clinical research that has demonstrated remarkably high rates of comorbidity between the clinical manifestations of the three components of self-regulation (affect: anxiety/depression, behavior: Oppositional Defiant Disorder (ODD), cognition: Attention Deficit Hyperactivity Disorder (ADHD) (Angold et al., 1999).

Many of the studies that examined children with multiple types of psychopathology using the CBCL have focused on co-occurring internalizing and externalizing problems (e.g., Keiley, Lofthouse, Bates, Dodge, & Pettit, 2003; Mesman & Koot, 2000). Attention problems were not considered in these studies, as they are not part of the externalizing spectrum in the CBCL and TRF (Achenbach & Rescorla, 2001). As attention problems especially are characterized by deficits in self-regulation (e.g., Barkley, 1997), which may be the core of comorbidity, the Dysregulation Profile is especially relevant in research on comorbid behavior problems.

In a recent review, DP has been called "a useful index for identifying children and adolescents at risk for psychiatric problems" (Bellani, Negri, & Brambilla, 2012, p. 158). Given the widespread use of the CBCL in both research and practice, the possibility to identify relevant profiles on this measure to detect children who need early intervention in order to prevent aggravation of behavior problems into psychiatric problems, is an important area of research (Bellani et al., 2012).

Different Conceptualizations and Operationalizations of DP

In the growing body of research on the Dysregulation Profile, one major drawback is that DP is operationalized in different manners. These differences in operationalization make comparisons between studies difficult, and hinder the progress of research on DP. How DP is operationalized relates to how it is conceptualized theoretically. Some researchers have claimed that DP might indicate a single syndrome consisting of diverse emotional and behavioral symptoms (e.g., Ayer et al., 2009). This assumption is implicitly accepted by authors who used summed T-scores (e.g., Holtmann, Buchmann, et al., 2011; Volk & Todd, 2007), latent class analysis (LCA) (Althoff, Verhulst, et al., 2010; De Caluwé et al., 2013), or summed raw scores (e.g., McGuire et al., 2013) to define DP. Another view that has been proposed, is of DP as coexisting disorders, i.e., co-morbidity (e.g., Carlson, 2007), which is implicitly accepted by authors who use a cut-off approach of summed T-scores per AAA-scale (Jucksch et al., 2011) to define DP.

Another way to group different operationalizations of DP is into variable- or person-centered approaches. Where variable-centered approaches consider how variables are related to each other, person-centered analyses examine how these variables group within individuals. An example of a variable-centered approach is using a summed score for DP, while LCA is a person-centered approach. Factor analysis can be seen as a variable-centered approach. With factor analysis, a continuous underlying variable can explain the interrelations between AAA-scales. Although the mentioned studies have all contributed to the understanding of DP, research on the factor structure of DP is lacking. Examination of the factor structure can contribute to understanding the conceptualization of DP. Therefore, in this study the factor structure of DP was examined by comparing three competing models. To determine the generalizability of the results, all models were examined separately for two different developmental periods, middle childhood and adolescence. In addition, the best-fitting model was examined for multiple reporters (mothers, fathers, teachers, and youth), and for measurement invariance across gender, parents, and time. External validity and clinical relevance was examined by assessing the relation of the best-fitting model for all reporters with self-harm and suicidal ideation as reported by the adolescents themselves.

Factor Structure of DP

Although several studies have indicated that the constellation of the three AAA-scales into DP is meaningful, no actual research has used factor analysis to examine which structure best represents DP. Therefore, in this study, the factor structure of DP was examined by testing three competing models using Confirmatory Factor Analysis (CFA). The simplest model is the one-factor model (Figure 2.1), in which the symptoms representing anxious/depressed, aggressive behavior and attention problems load onto one common factor of dysregulation. If this model would fit the data well, this suggests that the variance of these symptoms can be captured in one underlying factor, making it unnecessary to distinguish between AAA-scales. Therefore, this model fits well with the conceptualization of DP as representing a one-dimensional syndrome.

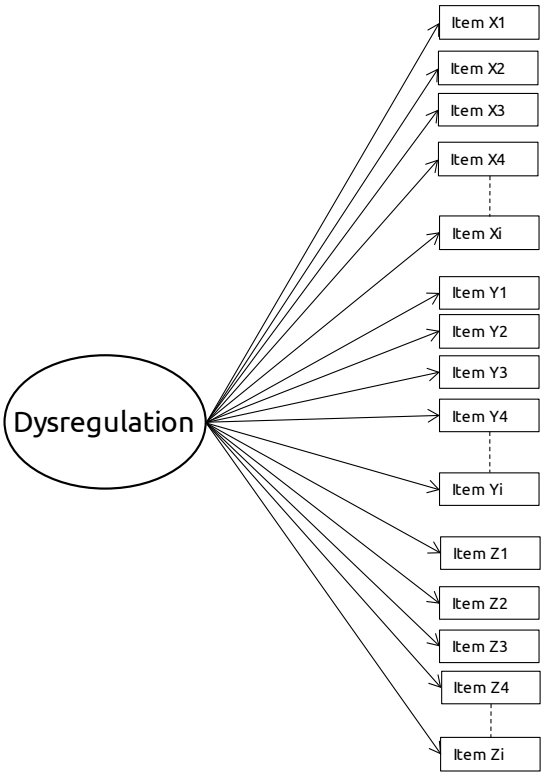

Figure 2.1. One-factor DP model.

Similar to a one-factor model, a bifactor model (Figure 2.2), accounts for the hypothesis of DP representing a syndrome, as the emotional and behavioral symptoms comprising the AAA-scales share a general dysregulation factor. However, additional specific factors account for unique variance over and above the general factor. The bifactor model has been used in research on

psychopathology before, for example in research on ADHD (Martel, von Eye, & Nigg, 2010). It provides a new perspective on how to conceptualize psychopathology: next to disorder-specific factors, there might be a general underlying psychopathology factor ('p factor'), which describes the individual liability towards developing psychopathology in general (e.g., Caspi et al., 2014; Patalay et al., 2015). With regard to DP, the bifactor model implies a similar conceptualization: aside from distinct AAA-scales, accounted for by domain-specific factors, there is an underlying syndrome of dysregulation, represented by a general factor.

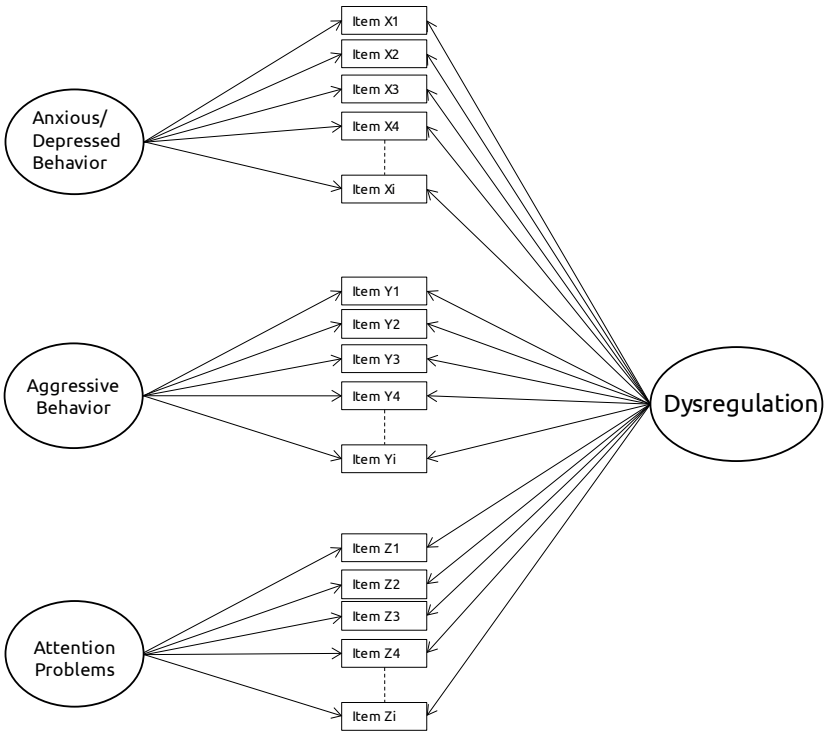

Figure 2.2. Bifactor DP model.

Lastly, a second-order model[1] (Figure 2.3) was tested that reflects three domain-specific latent factors representing the AAA-scales, which themselves load on a higher-order factor of dysregulation. This model proposes that the three AAA-scales are distinct, but that an overarching dysregulation factor encompasses the interrelatedness, or comorbidity, between the three domain-specific factors. Therefore, second-order models are applicable from the perspective of DP as representing comorbidity.

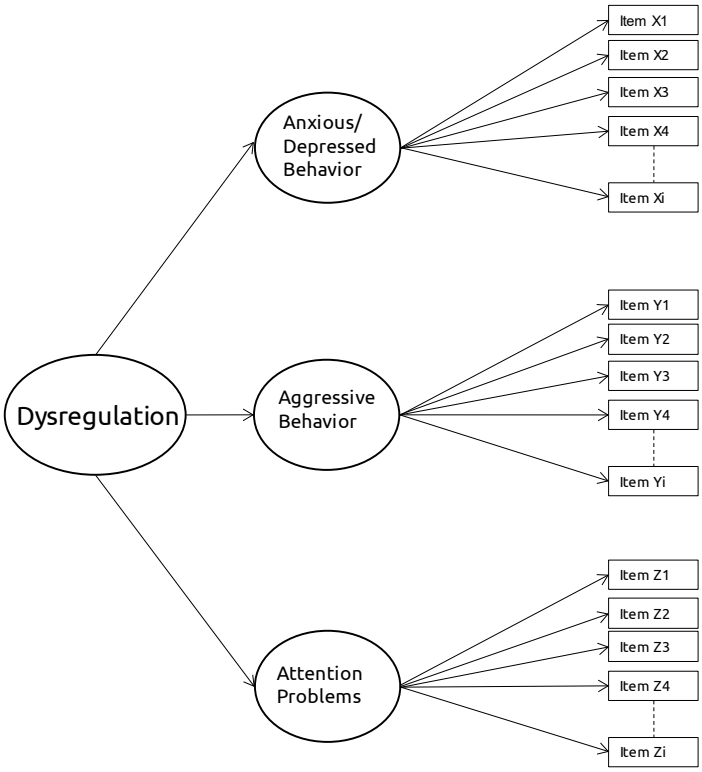

Figure 2.3. Second-order DP model.

The results of the test of three competing models have important clinical implications. Treatment guidelines would need to be differentiated according to the model that shows the best fit: a one factor model would focus on a general treatment for Dysregulation, overlooking differentiation in the AAA symptoms present; a bi-factor model would suggest that treatments of anxiety/depression, aggression and attention problems could share identical components, most likely in targeting children's self-regulatory capacities, whereas specific symptoms could be used for tailoring the treatment to the child's needs; and a second-order model would suggest that Dysregulation could only be treated by taking into account the specific profile of symptoms shown in the three domain-specific latent factors.

Research on DP as well as research on the specific domains of anxiety/depression, attention problems and aggression suggests that there are both shared and unique factors in the etiology of these forms of psychopathology (e.g., Angold et al., 1999; Boomsma et al., 2006; Martel, Nikolas, Jernigan, Friderici, & Nigg, 2012; Mesman & Koot, 2000). This would indicate that a

1 A second-order model is statistically indistinguishable from a model with three correlated latent factors.

bifactor model would show the best fit, as this model allows for unique etiological factors to be examined for the specific and general factors separately. In a second-order model this is not possible, as the relations between specific factors are thought to be entirely encompassed by one general factor. In addition, over a decade ago, it has already been suggested that covariation among symptoms of different psychiatric disorders cannot be explained by one general factor (Angold et al., 1999), indicating that a one-factor DP model would not show good fit. Therefore, it is expected that the bifactor model would show the best fit to the data.

Measurement Invariance across Gender, Parents and Time

When two groups are compared in terms of prevalence, means and correlates, it is typically assumed that both the measurement instrument and its underlying theoretical and psychological constructs are functioning in the same way across groups and time. However, these assumptions are rarely tested statistically (Byrne, 2008). In this study we examined measurement invariance across gender, parents (as only father- and mother-reports are equivalent regarding the items constituting the AAA-scales), and time.

Measurement invariance across gender. Previous studies examining DP showed inconsistent results concerning gender differences. Differences in prevalence were reported, with some studies indicating that boys were overrepresented (Althoff, Rettew, et al., 2010; Jucksch et al., 2011), whereas other studies indicated that DP was more prevalent for girls (Holtmann et al., 2007). Another study showed no gender difference (Holtmann, Buchmann, et al., 2011). Before comparisons are to be made across gender, it is necessary to determine whether the factor structure of the construct of dysregulation is invariant (i.e., equivalent) across gender. Therefore, we tested measurement invariance for gender of the best-fitting DP factor model on mother-reports (as these are most often used in clinical and research practice).

Measurement invariance across parents. Many studies have examined (dis-)concordance between mother- father- teacher- and youth-reports of children's emotional and behavioral problems using the Achenbach System of Empirically Based Assessment (ASEBA; Achenbach & Rescorla, 2001), which consists of the CBCL, TRF, and YSR used in this study. These studies have shown that in general, the concordance between reporters is low to moderate (Grietens et al., 2004; Salbach-Andrae, Klinkowski, Lenz, & Lehmkuhl, 2009; Verhulst & Akkerhuis, 1989). One study so far has reported on the cross-informant agreement on DP, using LCA to classify 6-to-18-year old children. The DP latent class was identified across all informants (parents, teachers, and youth themselves). Cross-informant agreement was moderate, with Kappa's ranging from .14 to .28 (Althoff, Rettew, et al., 2010). Although LCA (a person-centered approach) does not necessarily result in a similar conclusion when using factor analysis (a variable-centered approach), these results do inform on our hypothesis that the factor structure of DP is to be

found for all reporters. The majority of studies on DP so far have used mother-reports only, or parental reports without differentiating between mother- and father-reports. In this study the factor structure of DP was examined for father- teacher-, and youth-reports separately, in addition to mother-reports, to examine whether a DP structure could be found for all reporters. To further determine if the DP structure is similar across reporters, we examined measurement invariance for different reporters, fathers and mothers who answered the same item-set, with equivalent models. When measurement invariance between parents holds, the DP structure can be seen as equivalent for fathers and mothers.

Measurement invariance across time. To examine whether Dysregulation is an equivalent construct in middle childhood and adolescence, measurement invariance across time was examined using mother-reports. Results inform our knowledge of whether DP constitutes a similar construct in different developmental periods.

External Validity

Several studies have documented links between DP and parent- and self-reported self-harm and suicidal ideation, concurrently and over time, with the CBCL and other measures of suicidality (e.g., Althoff, Verhulst, et al., 2010; Ayer et al., 2009; Holtmann, Buchmann, et al., 2011). Given the robustness of this link, and the fact that suicidality is a form of severe adolescent psychopathology, we also examined the link between DP and suicidality to further establish the external validity of the factor model. We examined cross-informant associations of DP with youth-reported self-harm and suicidal ideation.

In sum, the factor structure of DP was examined in middle childhood and adolescence and across reporters. Measurement invariance was examined across gender, parents and time. It was expected that a bifactor model of DP would best represent the data, indicating that DP consists of a general dysregulation factor as well as domain-specific factors for each of the AAA-scales. Based on a previous study, in which a DP-class across multiple reporters was identified, we expected that a similar factor structure would be present for mothers, fathers, teachers, and youth themselves, and that the structure would be invariant across parents. In addition, as this phenotype has been found for boys and girls separately (e.g., Althoff et al., 2006), we expected DP to be invariant across gender. Given the reported stability (Boomsma et al., 2006), we expected DP to be invariant across time. The dysregulation construct was expected to be positively related to adolescent-reported self-harm and suicidal ideation.

METHODS

Procedure and Participants

Data for this study were collected as part of the ongoing longitudinal Flemish Study on Parenting, Personality and Development (FSPPD), a large community-based study. All parents provided informed written consent to participate in the study. As details of the recruitment procedures of FSPPD have been presented elsewhere (Prinzie et al., 2003), only the features of the methodology pertinent to the present article are presented.

For this study, we used data from the 2001 (middle childhood) and 2007 (adolescence) measurement wave to cover both middle childhood and adolescence as developmental periods. For middle childhood (M_{age} = 7.90 (SD = 1.16), 49.8% boys), data on the CBCL and TRF were available for 597 mothers, 560 fathers, and 697 teachers. In adolescence (M_{age} = 13.93, SD = 1.14, 47.4% boys), data were available for 479 mothers, 445 fathers, 414 teachers.

Mothers and fathers' educational levels were as follows: elementary school (0.9%, 3.0%), secondary education (41.1%, 43.3%), non-university higher education (45.2%, 34.4%), and university (12.8%, 19.2%), respectively.

Instruments

Mothers and fathers completed the CBCL 4/18 (Achenbach, 1991a), teachers completed the TRF 4/18 (Achenbach, 1991b), and adolescents completed the YSR 11/18 (Achenbach, 1991c). Parents and teachers were asked to rate 120 behavioral descriptions on whether they described the child now or within the past six months. Items were rated on a 3-point scale (0 = *not true*, 1 = *somewhat or sometimes true*, 2 = *very true or often true*).

For this study, items from the syndrome scales Anxious/Depressed (CBCL: 14 items, TRF: 18 items, YSR: 16 items), Attention Problems (CBCL: 10 items, TRF: 20 items, YSR: 9 items), and Aggressive Behavior (CBCL: 20 items, TRF: 25 items, YSR: 19 items) were used. Cronbach's αs for the AAA-scales ranged from .60 to .94 across reporters and time points (mean α = .83).

Item 45 ('Nervous, highstrung, or tense') was part of AD *and* AP in the 1991 versions of the CBCL, TRF and YSR. However, in the revised versions from 2001 item 45 was considered part of AD only. As we wanted to avoid cross-loadings in our factor analyses we considered item 45 to be part of AD only, consistent with the 2001 guidelines (Achenbach & Rescorla, 2001). Items with generally less than 2.5% endorsement across reporters and measurement waves were excluded from the analyses as these caused converging problems. The deleted items were items 80 ('Stares blankly') and item 97 ('Threatens people'). The final number of items for the syndrome scales for parents, teachers, and youth respectively was 14, 18, and 16 for Anxious/Depressed, 8, 18 and 8 for Attention Problems, 19, 24, and 18 for Aggressive Behavior.

Trichotomous (0, 1, 2) responses for the items of the CBCL and TRF were dichotomized (0 vs. 1 and 2), consistent with other studies in which the factor structure of the CBCL was examined, (e.g., Achenbach & Rescorla, 2001; Dumenci, Erol, Achenbach, & Simsek, 2004; Ivanova et al., 2007).

To test the external validity of the DP, two items of the Youth Self Report (Achenbach, 1991c) assessing self-harm and suicidal ideation (thoughts or behaviors) were used. Item 18 asked 'I deliberately try to hurt or kill myself' and item 91 asked 'I think about killing myself'. A sum score was created of the two items, as both items were moderately correlated (*Spearman's* $\rho = .461$). This sum score was again dichotomized. Data were available for 475 adolescents.

Analyses

M*plus* version 7 (Muthén & Muthén, 2012) was used to perform the CFA. The Weighted Least Squares Means and Variances adjusted estimator (WLSMV) with delta parameterization was used to address categorical symptom ratings and resulting non-normality (Cheung & Rensvold, 2002). Model fit was evaluated using three primary indices: the comparative fit index (*CFI*), the Tucker-Lewis index (*TLI*) and the Root Mean Square Error of Approximation (*RMSEA*). Generally, values of *CFI* and *TLI* between .90 and .95 indicate acceptable fit, and values ≥.95 indicate good fit. Values of *RMSEA* ≤0.08 indicate acceptable fit, and values ≤.05 indicate good fit (Hu & Bentler, 1999; Kline, 2006). Although Chi-Square is reported, it is not interpreted, as it is nearly always significant in larger samples and/or complex models (Kline, 2005). When comparing models, Chi-Square difference tests for WLSMV estimator (see Muthén & Muthén, 2012) were conducted, with significant Chi-Square values indicating a worse model fit.

To evaluate measurement invariance across gender, a multi-group approach was used in which metric invariance (shown by equivalent factor loadings) and scalar invariance (shown by equivalent intercepts) were tested. Following procedures described by Muthén and Muthén (2012) for testing measurement invariance with categorical indicators using the WLSMV estimator and delta parameterization, two models were tested using mother-reports. Model 1 was the less restrictive model, in which thresholds and factor loadings were free across groups, scale factors were fixed at one in both groups and factor means were fixed at zero in both groups. Model 2 was the more restrictive model, in which thresholds and factor loadings were constrained to be equal across groups, scale factors were fixed at one in one group and free in the other and factor means were fixed at zero in one group and free in the other. This model was tested for metric and scalar invariance, and when these conditions held, strong factor invariance could be assumed.

As a different constellation and number of items is used in teacher- and youth-reports (TRF, YSR) compared to parent-reports (CBCL), measurement invariance across reporters could only

be examined for mothers and fathers. Similar to testing measurement invariance of gender, two models were compared following procedures described by Muthén and Muthén (2012) to examine measurement invariance across parents and across time. Due to the dependent nature of the data, one-group model approach was used, in which covariance of items and factors between parents or over time were specified (Chiorri, Hall, Casely-Hayford, & Malmberg, 2016).

As changes in CFI (ΔCFI) and RMSEA ($\Delta RMSEA$) are the most widely used and empirically supported criterion to define invariance (Chen, 2007; Cheung & Rensvold, 2002), we used these indicators for measurement invariance across gender and parents. Values of $\Delta CFI \leq .01$ and $\Delta RMSEA \leq .015$ indicate that the invariance hypothesis should not be rejected (Chen, 2007).

RESULTS

Factor Structure of DP

The three competing models on mother-reports were compared for middle childhood and adolescence data separately. The least restricted model was the bifactor model, which consisted of three orthogonal first-order factors (AAA-scales), together with a general factor of Dysregulation on which all items of the AAA-scales loaded. This model was then restricted into a second-order model, which consisted of three first-order factors (the AAA-scales) loading onto one second-order Dysregulation factor. Subsequently, this second-order model was restricted into a one-factor model, consisting of all items of the AAA-scales loading only on one Dysregulation factor. Chi-Square difference tests were conducted to examine whether restrictions led to a significantly worse model fit. Table 2.1 presents the fit statistics of all three models in both developmental periods, as well as the results of the Chi-Square difference tests. As can be seen from this table, the bifactor model showed good fit in middle childhood and in adolescence. This fit significantly degraded when the model was restricted into a second-order model and subsequently into a one-factor model. Therefore, the bifactor model was selected for further analyses.

Table 2.1. Fit Indices for the One-Factor, Second-Order, and Bifactor Models of DP for Middle Childhood and Adolescence Using CBCL Mother-Reports

Model	χ^2	*df*	*RMSEA*	*RMSEA 90% CI*	*CFI*	*TLI*	$\Delta\chi^2$
Middle Childhood							
1.Bifactor Model	1281.294	777	.033	[.030 - .036]	.938	.932	
2.Second-Order Model	1496.990	816	.037	[.034 - .040]	.917	.912	2 vs. 1 (39) = 202.312, p <.001
3.One-Factor Model	2039.855	819	.050	[.047 - .053]	.851	.843	3 vs. 2 (3) = 198.549, p <.001
Adolescence							
1.Bifactor Model	1142.179	777	.031	[.027 - .035]	.952	.947	
2.Second-Order Model	1321.710	816	.036	[.032 - .039]	.934	.930	2 vs. 1 (39) = 183.810, p <.001
3.One-Factor Model	1645.471	819	.046	[.043 - .049]	.891	.886	3 vs. 2 (3) = 170.506, p <.001

Comparison of Reporters

To examine whether the same factor structure holds across reporters, we replicated the bifactor model on father-, teacher-, and youth-data. The fit indices of these tests are reported in Table 2.2 As can been seen from Table 2.2, the bifactor model showed acceptable to good fit for all reporters in both developmental periods. For the DP-factor, all loadings were significant (except for the teacher-reports). Some of the loadings for the scale-specific factors were also non-significant, these were mostly from the Aggressive Behavior scale.

Table 2.2. Fit Indices for the Bifactor Model of DP for Different Reporters in Middle Childhood and Adolescence

Developmental Period	Reporter	*N*	χ^2	*df*	*RMSEA*	*RMSEA 90% CI*	*CFI*	*TLI*
Middle Childhood								
	Mother	597	1281.294	777	.033	[.030 - .036]	.938	.932
	Father	560	1147.422	777	.029	[.026 - .033]	.941	.934
	Teacher	697	3298.970	1650	.038	[.036 - .040]	.928	.923
Adolescence								
	Mother	479	1142.179	777	.031	[.027 - .035]	.952	.947
	Father	445	1077.051	777	.029	[.025 - .034]	.950	.944
	Teacher	419	2637.617	1650	.038	[.035 - .040]	.944	.939
	Youth	476	1323.920	777	.038	[.035 - .042]	.912	.902

Measurement Invariance across Gender and Parents

Table 2.3 shows the results for the tests for measurement invariance across gender, parents and time. All models showed good fit. ΔCFI and ΔRSMEA indicated that for both developmental periods the restricted models across gender and across parents did not fit significantly worse. Also, the restricted model over time did not fit significantly worse. It can thus be concluded that the DP construct is invariant across gender and parents in middle childhood and in adolescence and that it is invariant across time.

Relations of Dysregulation with Suicidal Behavior

As a test for external validity, the DP bifactor model of each reporter was linked to a sum score of two youth-reported items measuring self-harm and suicidal ideation. For each reporter, correlations between the sum score for self-harm and suicidal ideation, the general Dysregulation factor and each of the specific factors of Anxiety/Depression, Aggression and Attention Problems were estimated, resulting in four correlations. For the youth-reported models we did not include items 18 and item 91 in the Anxious/Depressed scale, as we used these items to measure self-harm and suicidal ideation.

All models showed good fit (fit statistics can be obtained from the first author). For youth-reports, the general Dysregulation factor showed a strong association with self-harm and suicidal ideation (r = .565, p < .001), but not with any of the specific factors of Anxiety/Depression (r = .095, p = .299), Aggression (r = .068, p = .475), or Attention Problems (r = -.040, p = .722).

For mother-reports, youth-reported self-harm and suicidal ideation was significantly related to the general Dysregulation factor (r = .264, p = .008), but not to any of the specific factors of Anxiety/Depression (r = .123, p = .218), Aggression (r = .116, p = .362) and Attention Problems (r = .139, p = .225).

For father-reports, self-harm and suicidal ideation was also significantly related to the general Dysregulation factor (r = .194, p = .039), but not to any of the specific factors of Anxiety/Depression: r = .058, p = .631; Aggression: r = .201, p = .100; Attention Problems: r = .180, p = .213).

Finally, for teacher-reports, self-harm and suicidal ideation was not related to either the general Dysregulation factor (r = -.032, p = .784), the specific Anxiety/Depression factor (r = -.046, p = .707), or the specific Attention Problems factor (r = -.043, p = .698). Teacher-reported DP was however significantly associated to the specific factor of Aggression (r = .288, p = .048).

In sum: youth-reported self-harm and suicidal ideation was only significantly related to the general Dysregulation factor and not to any of the specific AAA-factors when mothers, fathers, and adolescents reported on DP. For teacher-reports, only specific Aggression was associated with self-harm and suicidal ideation.

Table 2.3. Measurement Invariance of the Bifactor Model of DP across Gender, Parents and Time in Middle Childhood and Adolescence Using CBCL Mother-Reports

	χ^2	*df*	*RMSEA*	*RMSEA 90% CI*	*CFI*	*TLI*	*Δdf*	*ΔCFI*	*ΔRMSEA*
Across Gender									
Middle Childhood									
Model 1: Less Restrictive Model	1910.872	1554	.028	[.023 - .032]	.950	.944			
Model 2: Metric and Scalar Invariance	1998.153	1630	.028	[.023 - .032]	.948	.945	76	.002	.000
Adolescence									
Model 1: Less Restrictive Model	1951.260	1554	.033	[.028 - .037]	.942	.936			
Model 2: Metric and Scalar Invariance	2069.602	1630	.034	[.029 - .038]	.936	.932	76	.006	.001
Across Parents									
Middle Childhood									
Model 1: Less Restrictive Model	4039.699	3272	.020	[.018 - .022]	.943	.939			
Model 2: Metric and Scalar Invariance	4076.765	3348	.019	[.017 - .021]	.946	.943	76	.003	.001
Adolescence									
Model 1: Less Restrictive Model	3811.037	3272	.018	[.016 - .021]	.955	.952			
Model 2: Metric and Scalar Invariance	3858.223	3348	.018	[.015 - .020]	.957	.956	76	.002	.000
Across Time									
Model 1: Less Restrictive Model	3902.025	3272	.018	[.016 - .020]	.954	.951			
Model 2: Metric and Scalar Invariance	4000.231	3348	.018	[.016 -.020]	.952	.950	76	.002	.000

DISCUSSION

We tested whether DP is best conceptualized as comorbidity (i.e., a second-order model) or as a syndrome, either completely (i.e., a one-factor model), or next to specific problems of anxiety/depression, aggression and attention problems (i.e., a bifactor model). Our results provided convincing support for the hypothesized bifactor structure. This indicates that, both in middle childhood and adolescence, DP is best conceptualized as a *syndrome*, which exists over and above to specific problems of anxiety and depression, aggression and attention problems. These results might help explain findings of specific as well as general etiology factors in the development of anxiety/depression, aggression, and attention problems (e.g. Angold et al., 1999; Martel, Nikolas, et al., 2012; Mesman & Koot, 2000). In addition, it might help explain the heterogeneity in symptom presentation over time.

Importantly, the DP bifactor structure was successfully replicated for father- teacher-, and youth-reports, both in middle childhood and adolescence. Furthermore, measurement invariance across parents was examined which demonstrated that the DP structure similarly appeared across fathers and mothers in assessing their children and adolescents. Measurement invariance across time demonstrated the equivalence of DP across two developmental periods (middle childhood and adolescence). These replications show the robustness of the bifactor DP structure across parents and time and underscore that a differentiation should be made between a general syndrome, representing DP, and the specific problems of the AAA-scales. Moreover, the results are in line with findings of Althoff, Rettew, et al. (2010), who demonstrated that teachers, parents and youth themselves all identified a specific subgroup of dysregulated children who showed elevated symptoms on each of the AAA-scales. As we used different statistical techniques (CFA vs LCA), our results suggest that both with person- and variable-centered approaches the structure of DP can be validated across reporters. Our results underscore the conclusion that mothers-, fathers-, teachers-, and youth-reports of child and adolescent problem behavior similarly define the factor structure of DP, suggesting that all three reporters could be used in future research and clinical practice. We could examine measurement invariance only across parents due to a different constellation as well as different number of items for parents, teachers and youths.

Our study is the first to examine whether the conceptualization of DP is similar for boys and girls, by examining whether the bifactor model was invariant across gender. The same bifactor structure of DP was found for boys and girls, both in middle childhood and adolescence. With measurement invariance across gender, means and variances of DP between boys and girls can be reliably compared in future studies.

One of the major advantages of bifactor models in the study of DP is that it can help disentangling common and unique variance of the specific factors of Anxiety/Depression, Aggression, and Attention Problems versus the general Dysregulation factor, and therefore it is a promising model to use in further research.

We tested external validity of the bifactor model by linking the DP bifactor model for each of the reporters to adolescents' reported self-harm and suicidal ideation. Interestingly, when youth themselves, their mothers or their fathers were reporters, the general Dysregulation factor was found to be related to higher rates of concurrent self-harm and suicidal ideation as reported by adolescents themselves, whereas none of the specific factors of Anxiety/Depression, Aggressive Behavior, and Attention Problems showed any relation to suicidality. For teacher-reports, only Aggressive Behavior was related to self-harm and suicidal thoughts or behaviors. One explanation is that in the Teacher Report Form, a relatively smaller part of the items measures symptoms of anxiety and depression whereas a larger part measures symptoms of aggression. Furthermore, the constellation of items in subscales differs between the CBCL, TRF, and YSR, which could affect the results when linking DP to external measures. Also, these teachers only spend a few hours each week with the adolescent, thereby giving them a different perspective on the adolescent's behavior than his or her parents.

These findings are in line with the results of Althoff, Rettew, et al. (2010), who studied the cross-informant agreement of DP using latent class analysis. They reported that children in the DP class as identified by parental and youth reports had a heightened risk for suicidal thoughts and behaviors (especially when both parent and child placed the child in the DP class). However, children identified by teachers as being dysregulated did not show a heightened risk of self-reported suicidal thoughts and behaviors.

Furthermore, these results indicate that the previously demonstrated link between DP and suicidal behavior (Ayer et al., 2009; Holtmann, Buchmann, et al., 2011), was not an artifact of only elevated Anxious/Depressed behavior causing a high DP score. Moreover, this finding is in line with LCA research showing that only the DP class showed elevated suicidal ideation (Althoff et al., 2006), again indicating the uniqueness of DP as a construct next to other forms of psychopathology. These findings add to previous literature indicating that comorbidity of psychiatric problems especially is related to suicidality (Bridge, Goldstein, & Brent, 2006). Replication in larger, and possibly clinical, samples is necessary. Nonetheless, the moderate to strong relations between both mother-, father-, and youth-reported DP with youth-reported self-harm and suicidal thoughts and behavior in this community sample already underscores the need for study on DP as a high-risk marker for severe problems.

Suggestions for Future Research

As this study used a community sample, the results have to be replicated for clinical samples in order to further validate the factor structure of DP. Another suggestion is to examine the relations between DP and other measures of self-regulation in order to further validate the construct. Furthermore, as the development of self-regulatory capacities is an important developmental task in early childhood (Bronson, 2000), it is important to examine Dysregulation in young children as well. We have recently conducted such a study on DP using a sample of predominantly clinically referred preschoolers (Geeraerts et al., 2015). In this study, we aimed to replicate and further validate the bifactor structure of DP using the CBCL 1.5-5. The results showed that a bifactor model fitted the data better than a second-order and a one-factor model for both parent-reported and teacher-reported DP. In addition, analyses on criterion validity showed that the general DP factor and the specific AAA-factors were differentially related to different markers of dysregulation and clinically relevant criteria like sleep problems and inhibition.

Finally, as the Dysregulation Profile makes uses of three scales that comprise a broad range of the CBCL syndrome scales, it is likely that children scoring high on Dysregulation would also score high on the so-called p factor that has been reported in recent studies (Caspi et al., 2014; Patalay et al., 2015). The p factor describes liability to developing psychopathology in general and emotional dysregulation has been found to be a salient early developmental feature of the p factor (Caspi et al., 2014). Further research could elucidate the distinction and developmental timing of the Dysregulation Profile and the p factor.

Implications for Clinical Practice

Bifactor models have several implications for clinical practice (Martel et al., 2010) and the bifactor DP model may therefore have great potential for clinical use. For example, bifactor models can suggest subtypes for DSM diagnoses. They can also inform treatment decisions by suggesting that treatment should be tailored to symptom profile. For example, a bifactor model of DP could suggest that treatment of Anxiety/Depression, Aggression and Attention problems shares identical components, most likely in targeting children's self-regulatory capacities. Symptom presentation could provide further information on how to tailor the treatment to the child's needs.

Another implication of the bifactor structure of Dysregulation is that the use of the subscales as independent sources of information should be discouraged. High scores on a specific subscale (e.g., aggressive behavior) should be considered within the broader spectrum of psychopathology. For example, a child scoring high only on the Aggressive Behavior subscale of the CBCL or TRF needs a different treatment approach than a child that scores high on the Aggressive Behavior

subscale *and* the Anxious/Depressed subscale. Also, the results of this study suggest that when examining co-occurring behavior problems in children and adolescents, it is important to look beyond co-occurring Internalizing and Externalizing behavior problems (in the higher-order structure of the CBCL) and consider attention problems as well. For younger children, examining co-occurring Internalizing and Externalizing Problems is thought to be similar to examining the Dysregulation Profile (Basten et al., 2013) as the Attention Problems subscale is part of broad band scale Externalizing problems for the CBCL 1.5/5. However, in the CBCL 6/18 only Aggressive and Rule-breaking Behavior make up the broad band scale Externalizing Problems, and therefore this conclusion does not necessarily hold for older children.

The Dysregulation Profile can help in identifying children who have problems with self-regulation across all its components (affect, behavior, and cognition). As DP can describe dysregulation problems using scores of only three scales, the profile is much more parsimonious and clearly interpretable than a Total Problems score on the CBCL. Although high Total Problems scores could also indicate dysregulation problems, high scores might also indicate a large amount of problems within the internalizing or externalizing spectrum only.

Clinicians could make use of this profile by assessing whether children show elevations on *all three* of the AAA-scales, as a way of classifying children as having dysregulation problems. One possible future direction might be to add the Dysregulation Profile in the Achenbach System of Empirically Based Assessment (ASEBA; Achenbach, 2009). As this study added to a growing body of research demonstrating that different forms of psychopathology are often underlain by more general factors (Caspi et al., 2014; Patalay et al., 2015), it is recommended that clinicians always consider high scores on a specific subscale within the broader spectrum of psychopathology. For example, when a child is referred for aggressive problems it is advisable to examine as well whether a child suffers also from anxiety. Moreover, clinicians can be ascertained that DP has a similar structure in boys and girls and that mother-, father-, teacher-, and youth-reports can be used to assess this profile.

In conclusion, this study adds to the existing body of research on DP as a broad syndrome of dysregulation by demonstrating that a bifactor model best represents the AAA-scales that constitute DP. This syndrome exists next to specific problems of anxiety and depression, aggressive behavior and attention problems both in middle childhood and adolescence, and for mothers, fathers, teachers and youth themselves as reporters. The bifactor DP model was invariant across gender, across parents and across time and was uniquely associated to youth-reported self-harm and suicidal ideation, underscoring the severity of dysregulatory problems. With the bifactor model, general and specific factors can be teased apart, providing the opportunity to examine predictors, consequences and the development of DP in a more refined way.

CHAPTER 3

Evaluation of the Strengths and Difficulties Questionnaire - Dysregulation Profile (SDQ-DP)

Deutz, M. H. F., Shi, Q., Vossen, H. G. M., Huijding, J., Prinzie, P., Deković, M.,van Baar, A. L., & Woltering, S. (2018). Evaluation of the Strengths and Difficulties Questionnaire – Dysregulation Profile (SDQ-DP). *Psychological Assessment*, 30, 1174-1185.

AUTHOR CONTRIBUTIONS

M. Deutz conceptualized the study. M. Deutz and Q. Shi analyzed the data. M. Deutz wrote the manuscript. All authors provided feedback on the conceptualization, analyses and manuscript.

ABSTRACT

The Dysregulation Profile (DP) has emerged as a measure of concurrent affective, behavioral and cognitive dysregulation, associated with severe psychopathology and poor adjustment. While originally developed with the Child Behavior Checklist, more recently the DP has also been defined on the Strengths and Difficulties Questionnaire (SDQ), mostly with a 5-item, but also a 15-item, SDQ-DP measure. This study evaluated the SDQ-DP by examining its factor structure, measurement invariance, and construct validity. Different SDQ-DP operationalizations were compared. In a US longitudinal community sample (N = 768), a bifactor model consisting of a general Dysregulation factor and three specific factors of Emotional Symptoms, Conduct Problems, and Hyperactivity-Inattention fitted best, across three different developmental periods (early childhood, middle childhood, adolescence) and across three different reporters (parents, teachers, youth). Measurement invariance across reporter, gender, and developmental period was demonstrated. These findings indicate that the SDQ-DP, like the CBCL-DP, reflects a broad syndrome of dysregulation that exists in addition to specific syndromes of emotional symptoms, conduct problems, and hyperactivity-inattention. SDQ-DP bifactor scores were strongly related with scores on the 5- and 15-item SDQ-DP measures and similarly concurrently associated with two markers of self-regulation, ego-resiliency and effortful control, and longitudinally with antisocial behavior and disciplinary measures. As reliability, validity and stability was weaker for the SDQ-DP 5-item measure, use of all 15 items is recommended. Advantages of using a bifactor approach are discussed as well as the potential of the SDQ-DP as an easy screening measure of children at risk for developing serious psychopathology.

INTRODUCTION

A considerable number of children and adolescents referred for clinical treatment present a complex picture of co-occurrence of affective, behavioral, and cognitive dysregulation, causing significant diagnostic and therapeutic challenges for clinicians. The Dysregulation Profile (DP), based on the Child Behavior Checklist (hence the term CBCL-DP), has emerged as a reliable, valid and relatively simple dimensional measure of this complex phenotype of dysregulation (Althoff, Ayer, et al., 2010; Ayer et al., 2009). The CBCL-DP is not linked to a specific disorder such as attention-deficit/hyperactivity disorder (ADHD), or juvenile bipolar disorder (Diler et al., 2009; McGough et al., 2008). Rather, the DP broadly characterizes dysregulation, which is presupposed to be underlain by deficits in self-regulation as self-regulation is thought to be impaired in all the psychopathological symptom domains measured with the DP (Althoff, Ayer, et al., 2010; Althoff, Verhulst, et al., 2010; Ayer et al., 2009).

More recently, the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997), has also been validated as a measure to capture the dysregulation phenotype (Holtmann, Becker, et al., 2011). The SDQ, like the CBCL, is a behavioral screening questionnaire with equivalent forms for parents, teachers and youth self-reports. Although the CBCL and SDQ have been found to correspond well (Goodman & Scott, 1999; Stone et al., 2010), they also differ. The SDQ, in contrast to the CBCL, is freely available online and significantly shorter (25 versus 113 items). The brevity of the SDQ might make it more practical for quick screening or regular short-term monitoring of children's emotional and behavioral problems.

Given that the SDQ is increasingly being used in research, and the exponential growth in the past decade of research on childhood emotional and behavioral dysregulation using the CBCL-Dysregulation Profile (see Bellani et al., 2012; Caro-Canizares, Garcia-Nieto, & Carballo, 2015, for reviews), it can be expected that the SDQ-Dysregulation Profile will be used in many more studies to come. Research evaluating the structure and psychometric properties of the SDQ-DP however is lacking, leading to a scarcity of evidence for the use of the SDQ-DP as a screening measure either to identify at-risk children in the general population or to identify subgroups of high-risk patients with greater clinical severity (Carballo et al., 2014). The aim of this study is therefore to examine the factor structure, reliability, measurement invariance and validity by examining concurrent associations of the SDQ-DP with measures of self-regulation in early childhood as well as longitudinal outcomes of early childhood SDQ-DP. Furthermore, correspondence between different operationalizations of the SDQ-DP in terms of overlap, reliability and validity will be examined as to advise on the use in research and clinical practice.

Operationalization of the Dysregulation Profile on the CBCL and SDQ

Both the CBCL-DP and SDQ-DP have been operationalized using scores on scales characterized by dysregulation of affect (Anxiety/Depression or Emotional Symptoms), behavior (Aggressive Behavior or Conduct Problems) and cognition (Attention Problems or Hyperactivity-Inattention), see also Althoff, Ayer, et al. (2010) and Winsper and Wolke (2014). For the SDQ-DP, in addition, a short 5-item measure has been developed using stepwise linear discriminant analyses and receiver operating characteristic (ROC) analysis of all 25 SDQ items (Holtmann, Becker, et al., 2011). This SDQ-DP 5-item measure is a summed score of 5 items from the Emotional Problems (2 items), Conduct Problems (2 items), and Hyperactivity-Inattention (1 item) scales. It was highly correlated with CBCL-DP scores operationalized as summed T-scores of the AAA-scales (r = .75; Holtmann, Becker, et al., 2011). This SDQ-DP 5-item measure has been used in most of the research using the SDQ-DP so far. However low reliability (α = .52) has been reported for the 5-item SDQ-DP measure (Holtmann, Becker, et al., 2011). The use of all 15 items representing emotional symptoms, conduct problems, and hyperactivity-inattention, either summed or within a factor model, might result in a more reliable measure of SDQ-DP. Correspondence between different measures of the SDQ-DP as well as potential differences in validity are therefore examined in this study.

The Factor Structure of the SDQ-Dysregulation Profile

Factor-analytic studies can provide insight into how the DP can best be conceptualized. Recent studies used Confirmatory Factor Analysis (CFA) to examine the factor structure of the CBCL-DP, and showed that a bifactor model consisting of a general DP factor and three specific factors of Anxiety/Depression, Aggression and Attention Problems best described the CBCL-DP (Deutz, Geeraerts, van Baar, Deković, & Prinzie, 2016; Geeraerts et al., 2015). This study aimed to replicate this research as it is important to examine consistency in theoretical conceptualization of DP, regardless of whether the CBCL or the SDQ is used to measure emotional and behavioral symptoms. We tested three competing factor models of SDQ-DP that each conceptualize the DP differently. The simplest model is the one-factor model (Figure 3.1), in which symptoms (items) describing emotional, conduct, and hyperactivity-inattention problems all load onto one factor of Dysregulation, representing the idea that the DP is a unidimensional syndrome.

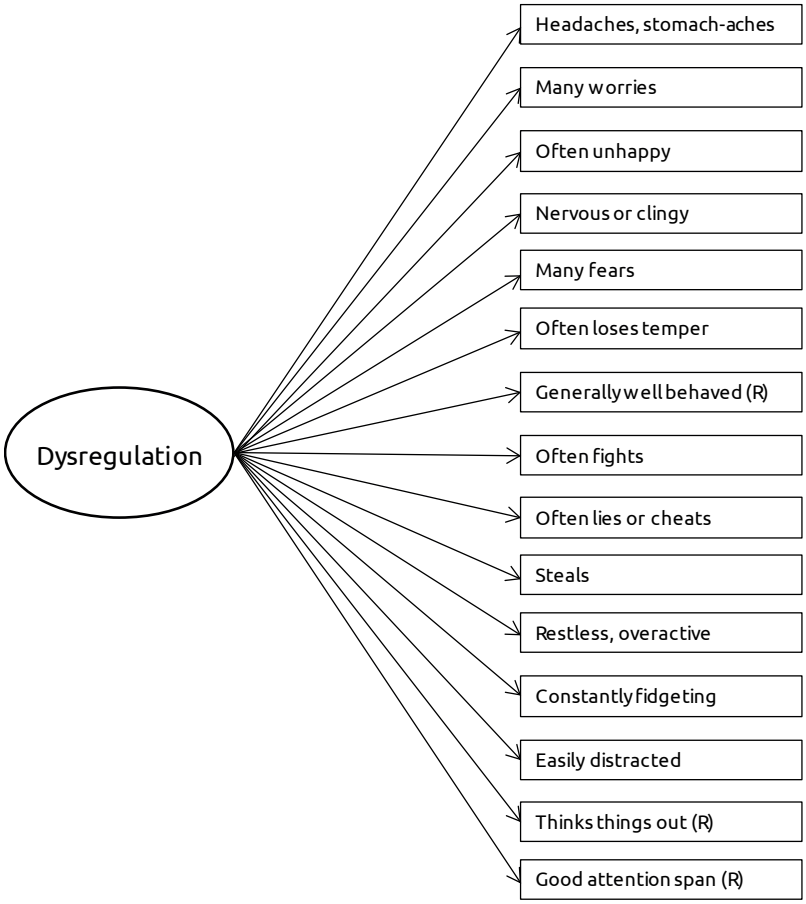

Figure 3.1. One-factor SDQ-DP model.

In a second-order model (Figure 3.2), specific first-order factors represent distinct problems of emotional symptoms, conduct problems and hyperactivity-inattention. A second-order DP factor then accounts for the commonalities between the factors, a perspective in line with the idea that dysregulation represents comorbidity (Carlson, 2007).

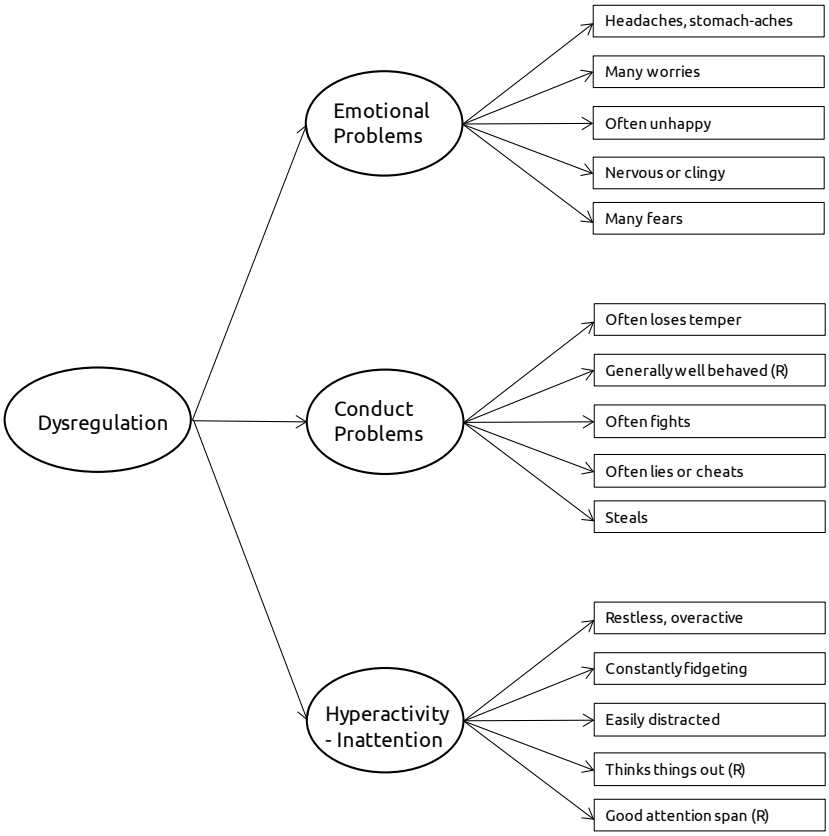

Figure 3.2. Second-order factor SDQ-DP model.

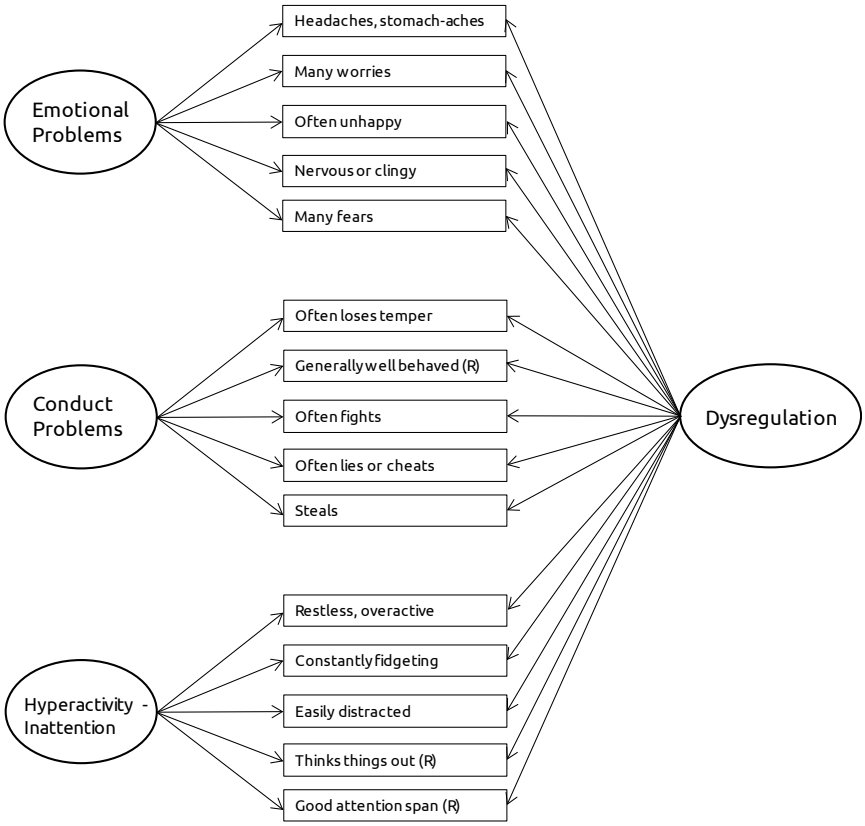

Figure 3.3. Bifactor SDQ-DP model.

The third model is the bifactor model (Figure 3.3), in which symptoms of behavioral and emotional problems load onto one general dysregulation factor, as well as onto specific factors of Emotional Symptoms, Conduct Problems and Hyperactivity-Inattention. While both a one-factor and bifactor model describe dysregulation as one broad syndrome, they differ on whether they suggest that distinguishing between different types of self-regulatory problems is useful (bifactor model) or unnecessary (one-factor model). A bifactor model in general suggests that there might be both shared and nonshared etiological factors and that treatment should be tailored to symptom profile (Martel et al., 2010).

Evaluation of the factor structure of the SDQ-DP is particularly useful because factor scores have several advantages over sum scores. While all items representing symptoms are given equal weight when sum scores are calculated, factor scores are computed based on different weights for different items. Factor scores therefore reflect the fact that some symptoms might be more characteristic of dysregulation than others, corroborating the idea that the DP is more than merely the sum of its components (Boomsma et al., 2006). Factor scores can also

reduce measurement error and therefore result in a purer measure of the DP. It is very relevant to examine whether a bifactor approach can also be used to describe the SDQ-DP given that bifactor models have more recently been rediscovered as an effective approach to examine multidimensionality, i.e., determining whether a set of items (symptoms) reflect a common underlying construct (Reise, 2012). Notwithstanding these advantages, factor scores are less useful in clinical practice as these are based on groups, whereas sum scores can easily be computed for each individual. Furthermore, factor scores are dependent upon characteristics of the dataset whereas individual sum scores are more comparable across studies.

Concurrent Construct and Longitudinal Predictive Validity of the SDQ – DP

The CBCL-DP and SDQ-DP have been associated with a wide range of negative adjustment outcomes such as greater psychiatric comorbidity and functional impairment, reduced psychosocial functioning, worse family functioning, more frequent parental psychiatric history, and sleeping problems (Althoff, Verhulst, et al., 2010; Carballo et al., 2014; Caro-Cañizares, Serrano-Drozdowskyj, Pfang, Baca-García, & Carballo, 2017; Holtmann, Buchmann, et al., 2011; Legenbauer, Heiler, Holtmann, Fricke-Oerkermann, & Lehmkuhl, 2012). Consequently, both the CBCL- and SDQ-Dysregulation Profile have been described as indices of overall psychological severity and functional impairment (Bellani et al., 2012; Carballo et al., 2014). However, little research used a bifactor approach to examine such relationships of the Dysregulation Profile, while bifactor models come with the major advantage of parsing out specific and overlapping risk factors and outcomes for general dysregulation versus more specific forms of psychopathology. Bifactor models therefore provide a more refined way to examine predictors and outcomes, and can give purer estimates of constructs. This would aid our understanding of the construct of dysregulation. In this study, construct validity was evaluated by examining associations between the DP and two markers of self-regulation: ego-resiliency and effortful control. Whereas the DP has consistently been described as resulting from self-regulatory deficits, only a handful of studies have examined associations between the DP and measures indicative of self-regulation such as inhibition (Geeraerts et al., 2015) and emotion regulation (Legenbauer et al., 2016). The concept of ego-resiliency has its roots in the Ego-Control/Ego-Resiliency Model (Block & Block, 1980), a theoretical model of self-regulation. Ego-control refers to the inhibition/expression of impulses whereas ego-resiliency describes the ability to modulate these impulses flexibly and adaptively. Effortful control can be defined as children's ability to inhibit predominant responses to activate subdominant ones (Kochanska, Murray, & Harlan, 2000). Longitudinal or predictive validity was evaluated by examining associations with negative adjustment outcomes in adolescents, namely antisocial behavior and disciplinary measures.

The Current Study

The objective of this study is to evaluate the Strengths and Difficulties Questionnaire - Dysregulation Profile (SDQ-DP) by: (a) examining the factor structure of the SDQ-DP, (b) as a prerequisite for valid comparisons, examining measurement invariance of the best-fitting model to determine whether the SDQ-DP is similarly defined across reporters (parents, teachers, youth), gender and developmental period (early childhood, middle childhood, adolescence), (c) examining correspondence between the SDQ-DP best-fitting factor model, the 5-item SDQ-DP measure (Holtmann, Becker, et al., 2011) and the 15-item summed SDQ-DP score (Winsper & Wolke, 2014), and (d) investigating construct and predictive validity by examining relations with markers of self-regulation and negative adjustment outcomes. Given that a bifactor model best described the CBCL-DP (Deutz et al., 2016; Geeraerts et al., 2015), we expect that a bifactor model also represents SDQ-DP best. This hypothesis is further supported by research demonstrating that a bifactor model can adequately describe the structure of the full SDQ including prosocial and peer problems factors (Caci, Morin, & Tran, 2015; Kóbor, Takács, & Urbán, 2013), although no research as yet has been conducted on the factor structure of the SDQ-DP specifically.

METHOD

Procedure and Participants

The present study is part of a 12-year longitudinal cohort study (2000-2012) called 'Project Achieve' (see Hill & Hughes, 2007), aimed at examining relations between grade retention and academic achievement. Project Achieve was approved by the Research Ethics Board of Texas A&M University. Originally, 1374 children from three different school districts (one urban, two small city districts) in Texas, USA, were targeted, based on several inclusion criteria: (a) scoring below the median of the school district on a state-approved district-administered literacy test, (b) not having received special education, and (c) not having been retained at first grade. The project's focus on children with relatively low academic readiness skills was because these children are known to be at increased risk for the development of emotional and behavioral problems and therefore represent a population of concern. Out of those 1374 eligible participants, parents of 784 children (65%) provided consent across two sequential cohorts in 2000 and 2001 (449 for cohort 1 and 335 for cohort 2). Children with and without consent did not differ on a broad array of variables such as age, gender, ethnicity and socioeconomic status (Hill & Hughes, 2007). Parents, teachers (all waves) and children (only in adolescence) received a monetary reward of $25 for their participation at each wave of data collection.

This study included participants for whom SDQ data (either parent- or teacher-report) was available for at least one of the included waves. This resulted in a final sample of 768 children (52.5% male) that was ethnically diverse (37.5% Hispanic, 34.4% Caucasian, 22.8% African-American, and 5.3% other: e.g., Asian). 476 children (62.5%) were classified as economically disadvantaged based on children's eligibility to receive free or reduced school lunch.

For this study, we used data from three measurement waves representing three distinct developmental periods namely: early childhood (T1, M_{age}= 6.57, *SD* = 0.39), middle childhood, (T2, M_{age} = 9.57, *SD* = .039), and adolescence (T3, M_{age} = 13.57, *SD* = 0.39). At T1, SDQ-data were available for 496 parents (35.4% missing), and 678 teachers (11.7% missing). For 451 children (58.7%) both parent- and teacher-reported data was available at T1, while for 45 children (5.9%) no parent- or teacher-reported SDQ-data was available at T1. At T2, data were available for 446 parents (41.9% missing) and 528 teachers (31.3% missing). For 359 children (46.7%) both teacher- and parent-reported data was available. At T3, data were available for 352 parents (54.2% missing), 437 teachers (43.1% missing), and 505 adolescents (34.2% missing), with 272 children (35.4%) having data for all reporters at T3. Participants for whom SDQ-data was available at all time points (for at least one reporter per time point: 458 children, 40.4%) did not differ statistically from participants who had missing data on any of the waves (310 children, 59.6%) on gender, SES, or T1 parent- and teacher-reported scores on the Emotional Symptoms, Conduct Problems, and Hyperactivity-Inattention scales of the SDQ as well as the 5- and 15-item SDQ-DP measures. They only differed on ethnicity with Hispanic children being slightly more likely to have missing data on any of the waves.

Instruments

Strengths and Difficulties Questionnaire. The Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) is a brief 25-item behavioral screening questionnaire asking to what extent both positive and negative psychological attributes of the child were true in the past six months, using a 3-point scale (0 = *not true*, 1 = *somewhat true*, 2 = *certainly true*). The SDQ has good psychometric properties (Stone et al., 2010), and has parallel forms for parents, teachers, and children aged 11 and over. In this study, parents and teachers completed age-equivalent forms of the SDQ at all three time points, while youth reported on the SDQ in adolescence (T3) only.

The SDQ consists of five subscales, each consisting of five items: Prosocial Behavior, Hyperactivity-Inattention, Emotional Symptoms, Conduct Problems, and Peer Relationships. In this study, we used items from three subscales to estimate the Dysregulation Profile (DP) factor models: Emotional Symptoms, Conduct Problems and Hyperactivity-Inattention. After reverse coding of positively worded items, Cronbach's α on these subscales ranged from .70 to .80 (mean α = .74) across reporters and time points.

In addition, scores for the SDQ-DP 5-item measure were computed according to the study of Holtmann, Becker, et al. (2011), by summing scores on five items: two items from the Emotional Symptoms scale (13: often unhappy, down-hearted, or tearful; 8: many worries, often seems worried), two items from the Conduct Problems scale (12: often fights with other children or bullies them, 22: steals from home, school or elsewhere) and one item from the Hyperactivity-Inattention subscale (2: restless, overactive, cannot stay still for long). Cronbach's α's were low, ranging from .54 to .65 across reporters and time points (mean α = .59). A cut-off point of ≥ 5 is suggested to identify children exhibiting clinical levels of problems (Holtmann, Becker, et al., 2011). Using this cut-off, on average 9.40% of children in the study met this criterion (averaged across reporters and developmental periods). The SDQ-DP 15-item measure as used by Winsper and Wolke (2014) was computed by summing scores on the 15 items of the Emotional Symptoms, Conduct Problems and Hyperactivity-Inattention, with Cronbach's α ranging from .80 to .87 across reporters and time points (mean α = .85)

Validity Measures

Measures of ego-resiliency and inhibitory control were only assessed at T1; therefore, examination of construct validity was limited to T1 only. Longitudinal outcomes were assessed at T3.

Ego-resiliency. The measure of ego-resiliency (the ability to express and modulate impulses effectively and adaptively) was derived from a selection of items of the California Child Q-Set (Caspi et al., 1992), filled out by teachers at T1 using a 1-5 Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). In a previous study on this dataset (Kwok, Hughes, & Luo, 2007) exploratory and confirmatory factor analyses resulted in the development of a 7-item ego-resiliency scale consisting of 4 items describing ego-resiliency (resourceful in initiating activities; curious, eager to learn, open; self-reliant, confident; persistent, does not give up easily) and 3 items describing ego-brittleness (becomes rigidly repetitive; falls to pieces under stress; rapid mood shifts, emotionally labile). After reverse-coding the ego-brittleness items, we computed a mean score of these 7 items with higher scores representing higher ego-resiliency. The measure showed good internal consistency (Cronbach's alpha α = .85).

Effortful control. At T1, trained research assistants individually administered tasks from a behavioral battery designed to assess behavioral self-regulation by tapping into the ability to deliberately slow down motor activity (Kochanska, Murray, & Coy, 1997). This study used data from three tasks: Telephone Poles, Stars, and Walk-a-Line. In the Walk-a-Line task, children were asked to walk along a ribbon that was taped onto the floor. In the Telephone poles tasks, children were asked to draw wires (i.e., straight lines) to connect telephone poles for the squirrels to sit on using a ruler. In the Star task children were given a picture of a star and were asked to draw the shape staying in the lines. In each of the tasks children participated in

three trials: a baseline trial with no instructions regarding speed, a fast trial in which children were asked to be as fast as possible and the third trial was a slow trial, in which children were asked to slow or inhibit their (gross or fine motor) behaviors. As effortful control is defined as the ability to inhibit a predominant response to perform a subdominant response (Kochanska et al., 2000), differences between the fast trial and the slow trial (in which children had to deliberately slow down motor behavior after preceding instructions to be as fast as possible) were averaged across the three tasks (α = .75) to create the effortful control score. Higher scores indicate higher effortful control.

Longitudinal Construct Validity

Antisocial involvement. At T3, students were interviewed individually and were asked to briefly report by saying yes or no on whether they have been involved in each of four antisocial activities (i.e., been caught by the police, taken part in a fight, destroyed things, and skipped school) during the past year. This 4-item Antisocial Involvement Questionnaire is adapted from an 8-item measure used by Mahoney and Stattin (2000). Data were available for 505 adolescents.

Disciplinary actions. At T3, teachers reported whether any of the five following disciplinary actions occurred for the student: sent to the office for disciplinary reasons, assigned to in-school-suspension, assigned to disciplinary alternative education, judicial placement outside school district and expelled from school (all answered as yes or no). At each time point, scores on the five disciplinary actions were summed. Data were available for 437 adolescents.

Statistical Analyses

All analyses were conducted in Mplus 7.4 (Muthén & Muthén, 2012) using the Weighted Least Squares Means and Variances adjusted estimator (WLSMV) with Delta parameterization to account for categorical symptom ratings and resulting non-normality. First, three competing SDQ-DP factor models (one-factor, second-order, bifactor, see Figure 3.1, 3.2, 3.3) were compared in three developmental periods (early childhood, middle childhood, and adolescence) and across three different reporters (parents, teachers, youth) using Confirmatory Factor Analysis (CFA). The least restricted model in terms of degrees of freedom is the bifactor model (see Figure 3.3), in which the 15 items loaded both onto one of three orthogonal first-order factors (Emotional Symptoms, Conduct Problems, Hyperactivity-Inattention), as well as on a general factor of Dysregulation. This model was restricted into a second-order model (Figure 3.2), in which the 15 items loaded onto one of three first-order factors which in turn loaded onto a second-order Dysregulation factor. The second-order model is statistically indistinguishable from a three-factor correlated model. Finally, the second-order model was restricted into a one-factor model (Figure 3.1), in which all items loaded only onto one Dysregulation factor.

Second, measurement invariance (MI) of the best-fitting model across reporter, gender, and developmental period was tested following recommendations of Muthén and Muthén (2012) for testing MI with categorical (ordinal) indicators using the WLSMV estimator and Delta parameterization.

Finally, correlations between the Dysregulation factor scores of the best-fitting model, and scores on the 5-item and 15-item SDQ-DP measures were computed, to examine overlap. Construct and predictive validity was examined with regression analyses in Mplus, controlling for gender, socio-economic status and three dummy-variables for ethnicity (African-American vs White, Hispanic vs White, Other vs White).

Model fit was evaluated using three primary and widely used fit indices: the Root Mean Square Error of Approximation (RMSEA), the comparative fit index (CFI), and the Tucker-Lewis index (TLI), at the following thresholds for good fit: RMSEA ≤.05, and CFI/TLI ≥ .95 (Cheung & Rensvold, 2002; Hu & Bentler, 1999). Chi-square is reported, but not interpreted as it is nearly always significant in larger samples and/or complex models (Kline, 2005). Changes in RMSEA (ΔRMSEA) and CFI (ΔCFI) are used as the main criterion to define invariance as they are much less sensitive to sample size and more sensitive to a lack of invariance than chi-square-based tests of MI (Meade, Johnson, & Braddy, 2008). Measurement invariance holds if the changes in fit statistics between Model 1 and 2 are ≤ .015 for ΔRMSEA ≤ .01 for ΔCFI (Chen, 2007).

RESULTS

Factor Structure

Factor scores for the early childhood models (both parent- and teacher-reported) could not be saved because in each model, R-Square for one item (10, 18 or 25) could not be computed. This warning was checked and in each model the factor loading of the specific item was restricted to the value closest to the original factor loading until the warning disappeared (e.g., for the parent-reported model this meant that the factor loading of item 25, which was .785, was constrained to .70 thus adding one degree of freedom).

Table 3.1 presents the results for the CFA analyses. Values for CFI and TLI indicated that the bifactor models generally showed a very good fit whereas RMSEA values were acceptable across developmental period and reporters, while the second-order models fit adequately and the one-factor models showed poor fit overall. Chi Square difference testing for WLSMV estimator was used to statistically compare the nested models, with significant values indicating worse model fit of the more restricted model. From these analyses, it can be concluded that the bifactor SDQ-DP models statistically described the data better than the second-order and one-factor models across developmental periods and regardless of informant.

Table 3.1. Fit Indices for the One-Factor, Second-Order, and Bifactor SDQ-DP Models in Three Developmental Periods across Three Different Reporters

Reporter	Developmental Period	Model	*N*	χ^2	*df*	*RMSEA*	*RMSEA 90% CI*	*CFI*	*TLI*	$\Delta\chi^2$
		Bifactor	498	231.901	76	.064	[.055 - .074]	.954	.937	
	Early Childhood	Second-Order	498	315.327	87	.073	[.064 - .081]	.933	.919	2 vs. 1 (11) = 79.451, $p < .001$
		One-Factor	498	697.866	90	.116	[.108 - .125]	.822	.793	3 vs. 2 (3) = 177.426, $p < .001$
		Bifactor	446	223.789	76	.066	[.056 - .076]	.953	.935	
Parents	Middle Childhood	Second-Order	446	280.757	87	.071	[.062 - .080]	.938	.925	2 vs. 1 (11) = 55.004, $p < .001$
		One-Factor	446	634.314	90	.116	[.108 - .125]	.826	.797	3 vs. 2 (3) = 163.070, $p < .001$
		Bifactor	352	144.659	76	.051	[.038 - .063]	.975	.966	
	Adolescence	Second-Order	352	182.130	87	.056	[.044 - .067]	.966	.959	2 vs. 1 (11) = .38.286, $p < .001$
		One-Factor	352	315.673	90	.084	[.074 - .095]	.919	.905	3 vs. 2 (3) = 63.568, $p < .001$
		Bifactor	678	327.900	76	.070	[.062 - .078]	.982	.975	
	Early Childhood	Second-Order	678	504.522	87	.084	[.077 - .091]	.969	.963	2 vs. 1 (11) = 125.433, $p < .001$
		One-Factor	678	1771.837	90	.166	[.159 - .173]	.877	.857	3 vs. 2 (3) = 427.096, $p < .001$
		Bifactor	528	277.347	75	.071	[.063 - .081]	.974	.964	
Teachers	Middle Childhood	Second-Order	528	565.903	87	.102	[.094 - .110]	.939	.927	2 vs. 1 (12) = 196.821, $p < .001$
		One-Factor	528	1274.537	90	.158	[.150 - .166]	.850	.825	3 vs. 2 (3) = 252.397, $p < .001$
		Bifactor	437	210.401	75	.064	[.054 - .075]	.978	.969	
	Adolescence	Second-Order	437	353.954	87	.084	[.075 - .093]	.957	.948	2 vs. 1 (12) = 114.941, $p < .001$
		One-Factor	437	752.857	90	.130	[.121 - .138]	.892	.875	3 vs. 2 (3) = 149.534, $p < .001$
		Bifactor	505	232.328	75	.064	[.055 - .074]	.944	.922	
Children	Adolescence	Second-Order	505	345.062	87	.077	[.068 - .085]	.908	.889	2 vs. 1 (12) = 97.898, $p < .001$
		One-Factor	505	647.086	90	.111	[.103 - .119]	.801	.768	3 vs. 2 (3) = 164.440, $p < .001$

Note. Degrees of freedom can differ due to restriction of factor loadings because of errors (see main text).

Factor Loadings

To further evaluate the quality and content of the models, factor loadings for the SDQ-DP bifactor models were inspected. Table 3.2 presents factor loadings for the bifactor SDQ-DP model at T1 (early childhood), T2 (middle childhood) and T3 (adolescence) using different reporters. Inspection of the standardized factor loadings showed that the DP factor loadings were all positive and statistically significant (all p <.001) and moderately high with an average loading of .58. For Emotional Symptoms, all scale-specific loadings were positive and statistically significant (p <.001), and moderately high (average = .59). The scale-specific loadings of Conduct Problems and Hyperactivity-Inattention were generally lower than the scales-specific loadings for Emotional Problems, and both scales also had several nonsignificant scale-specific loadings as well as some negative loadings (of which three were statistically significant at p < .05).

Within the bifactor model, the five items used to calculate the SDQ-DP 5-item measure (Holtmann, Becker, et al., 2011) had moderate to high DP-loadings averaging .56 across developmental periods and reporters, with averages ranging from .33 ('many worries') to .76 ('restless, overactive'). However, these items also had fairly high scale-specific loadings (average .53) compared to other items. For example, 'many worries' had an average (across developmental periods and reporters) scale-specific loading of .69 and an average DP-loading of .33, suggesting that this item better describes specific emotional symptoms than general dysregulation.

Table 3.2. Standardized Factor Loadings for the SDQ-DP Bifactor Models across Three Reporters and Developmental Periods

		T1 (Early Childhood)				T2 (Middle Childhood)				T3 (Adolescence)					
		Parents		Teacher		Parents		Teacher		Parents		Teachers		Youth	
		S-FL	DP-FL	S-FL	DP-FL	S-FL	DP-FL	S-FL	DP-FL	S-FL	DP-FL	S-FL	DP-FL	S-FL	DP-FL
Emotional Problems															
3.	Often complains of headaches	**.524**	**.224**	**.406**	**.230**	**.401**	**.305**	**.477**	**.411**	**.340**	**.520**	**.482**	**.467**	**.414**	**.333**
8.	Many worries	**.652**	**.330**	**.802**	**.176**	**.573**	**.333**	**.757**	**.277**	**.526**	**.544**	**.768**	**.301**	**.726**	**.330**
13.	Often unhappy, downhearted	**.581**	**.468**	**.642**	**.475**	**.365**	**.608**	**.644**	**.487**	**.417**	**.594**	**.604**	**.455**	**.666**	**.490**
16.	Nervous or clingy in new situations	**.487**	**.452**	**.611**	**.334**	**.525**	**.443**	**.745**	**.435**	**.345**	**.467**	**.669**	**.420**	**.483**	**.267**
24.	Many fears	**.659**	**.361**	**.820**	**.212**	**.692**	**.310**	**.813**	**.269**	**.527**	**.540**	**.815**	**.294**	**.565**	**.256**
Conduct Problems															
5.	Often has temper tantrums or hot tempers	**.429**	**.492**	**.477**	**.614**	.162	**.726**	**.514**	**.627**	-.012	**.732**	**.525**	**.732**	**.316**	**.609**
7.	Generally obedient (R)	.131	**.554**	**.373**	**.798**	.103	**.653**	**.234**	**.793**	.128	**.674**	.200	**.833**	.096	**.556**
12.	Often fights with other children	**.520**	**.582**	**.587**	**.678**	.285	**.741**	**.498**	**.688**	.272	**.775**	**.606**	**.737**	**.664**	**.488**
18.	Often lies of cheats	**.589**	**.558**	**.546**	**.615**	**.700**	**.643**	**.654**	**.628**	**.618**	**.666**	.155	**.827**	**.341**	**.593**
22.	Steals from home, school, or elsewhere	**.568**	**.510**	**.684**	**.527**	**.534**	**.526**	**.656**	**.575**	**.500**	**.581**	.269	**.628**	**.412**	**.521**
Hyperactivity-Inattention															
2.	Restless, overactive	-.109	**.830**	**.363**	**.868**	**.426**	**.688**	**.616**	**.720**	*.168*	**.801**	**.707**	**.708**	**.490**	**.685**
10.	Constantly fidgeting or squirming	-.116	**.850**	**.500**	**.855**	**.390**	**.708**	**.608**	**.727**	*.210*	**.758**	**.580**	**.669**	**.477**	**.591**
15.	Easily distracted, concentrating wanders	*.151*	**.796**	.063	**.855**	**.557**	**.566**	.214	**.826**	**.374**	**.683**	**.390**	**.740**	**.262**	**.768**
21.	Thinks things out before acting (R)	**.411**	**.512**	-.074	**.815**	**.468**	**.373**	*-.161*	**.856**	**.307**	**.596**	-.029	**.816**	**-.489**	**.710**
25.	Sees tasks through to the end (R)	**.700**	**.665**	-.083	**.864**	**.658**	**.462**	.048	**.856**	**.800**	**.581**	.091	**.871**	*-.150*	**.598**

Note. Factor loadings in bold are significant at p<.001 level, underlined at p<.01 level, and italicized at p<.05.
Note. S-FL stands for scale-specific factor loadings, DP-FL stands for factor loadings on the general DP bifactor.
Note. Items followed by (R) are reverse-coded.

Table 3.3 presents the factor loadings of the one-factor, second-order and bifactor models in early childhood (parent-report) side by side, to demonstrate changes in the salience of items from a one-factor model in which all items load on one factor, to grouping the items into specific factors (second-order model) and then adding a general Dysregulation factor (bifactor model). In the second-order model almost all loadings were high and significant, but in the bifactor model, especially the loadings of Conduct Problems and Hyperactivity-Inattention decreased in size. Two of the Hyperactivity-Inattention items ('restless, overactive', 'constantly fidgeting or squirming') and one Conduct Problems item ('generally obedient', reverse-coded) now had nonsignificant loadings, while they had moderate to high DP factor loadings, suggesting that these items more directly predict the underlying general factor of dysregulation.

Table 3.3. Standardized Factor Loadings for the SDQ-DP One-Factor, Second-Order and Bifactor Model for Parent-Reports in Early Childhood

		One-factor Model	Second-order Model		Bifactor Model	
		DP-FL	S-FL	S-O FL	S-FL	DP-FL
Emotional Problems				**.582**		
3.	Often complains of headaches	**.350**	**.505**		**.524**	**.224**
8.	Many worries	**.486**	**.672**		**.652**	**.330**
13.	Often unhappy, downhearted	**.599**	**.794**		**.581**	**.468**
16.	Nervous or clingy in new situations	**.547**	**.728**		**.487**	**.452**
24.	Many fears	**.516**	**.709**		**.659**	**.361**
Conduct Problems				**.858**		
5.	Often has temper tantrums or hot tempers	**.548**	**.644**		**.429**	**.492**
7.	Generally obedient (R)	**.541**	**.631**		.131	**.554**
12.	Often fights with other children	**.661**	**.769**		**.520**	**.582**
18.	Often lies of cheats	**.650**	**.756**		**.589**	**.558**
22.	Steals from home, school, or elsewhere	**.628**	**.716**		**.568**	**.510**
Hyperactivity						
2.	Restless, overactive	**.778**	**.822**	**.844**	-.109	**.830**
10.	Constantly fidgeting or squirming	**.800**	**.833**		-.116	**.850**
15.	Easily distracted, concentrating wanders	**.790**	**.823**		*.151*	**.796**
21.	Thinks things out before acting (R)	**.537**	**.588**		**.411**	**.512**
25.	Sees tasks through to the end (R)	**.679**	**.732**		**.700**	**.665**

Note. Factor loadings in bold are significant at p<.001 level, and italicized at p<.05.
Note. S-FL stands for scale-specific factor loadings, DP-FL stands for factor loadings on the general DP bifactor, and S-O FL stands for second-order factor loadings.
Note. Items followed by (R) are reverse-coded.

Measurement Invariance across Reporter, Gender, and Developmental Period

A series of measurement invariance analyses were conducted, examining configural versus scalar invariance in line with recommended procedures for testing MI with categorical indicators using WLSMV estimation and Delta parametrization (Muthén & Muthén, 2012). This procedure consists of testing two models. Model 1 was the least restrictive model that tested for configural invariance, in which factor loadings and thresholds were freely estimated, scale factors were fixed at one, and factor means were fixed at zero. Model 2 was the more restricted scalar invariance model constraining factor loadings (metric invariance) and thresholds (scalar invariance) jointly, and in which scale factors were fixed at one in one group and free in the other, and factor means were fixed at zero in one group and free in the other. Because in bifactor models factor indicators load on more than one factor (specific and general factor), and we set the metric of the factors by fixing factor variances to one, testing the metric model separately was not allowed (see Mplus User Guide version 7 page 486, or version 8 page 544). When needed (because or errors), factor loadings were constrained to values previously identified when testing the factor models. Results for these analyses are reported in Appendix A. Values of ΔRMSEA and ΔCFI indicated that measurement invariance across reporter, gender and developmental period was demonstrated.

Relations among SDQ-DP Measures

At each time point and for each reporter, (saved) SDQ-DP bifactor scores were most highly correlated with the SDQ-DP 15-item sum scores (mean r = .92, range = .90 - .96), while they were lower, but still highly correlated with the SDQ-DP 5-item score (mean r = .78, range = .68 - .83). Stability of all measures was moderate across an 8-year period, and highest for the SDQ-DP bifactor scores (r = .57 / .38 for parent- and teacher-report respectively), followed by the SDQ-DP 15-item measure (r = .55 / .40) and the SDQ-DP 5-item measure (r = .39 / .35). Interrater agreement for all measures was moderate and again highest for the DP bifactor scores (r = .36), followed by r = .35 for the SDQ-DP 15-item measure and r = .25 for the SDQ-DP 5-item measure. Boys consistently had significantly higher DP scores (regardless of operationalization), except for youth self-report when no significant differences emerged (tables for these analyses can be requested from the first author).

Construct and Longitudinal Validity

Construct validity results are presented in Table 3.4. For all SDQ-DP measures, lower ego-resiliency and effortful control similarly predicted higher DP, for both parent- and teacher-reports. In addition, ego-resiliency also predicted lower teacher-reported specific Emotional

Symptoms, Conduct Problems and higher Hyperactivity-Inattention, whereas effortful control predicted lower Emotional Symptoms also.

Longitudinal validity was examined by regressing all factors of the T1 bifactor model, 5-item SDQ-DP and 15-item SDQ-DP (in separate models) on disciplinary measures and antisocial behavior measured at T3 (for results see also Table 3.4). Higher levels of DP predicted more disciplinary measures and antisocial behavior, for all operationalizations of the DP and for both parent- and teacher-reports. For the bifactor model, significant associations between the specific factors and the outcomes emerged. For parent-reports, lower Emotional Symptoms predicted higher antisocial behavior, and higher Conduct Problems predicted both antisocial behavior and disciplinary measures. For teacher-reports, lower Emotional Symptoms and Hyperactivity-Inattention predicted higher antisocial behavior, whereas Conduct Problems predicted higher disciplinary measures.

Table 3.4. Regression Coefficients for Construct Validity Analyses

	Parent-Reports						Teacher-Reports					
			DP Bifactor Model						DP Bifactor Model			
	5-item DP	15-item DP	DP	ES	CP	H-I	5-item DP	15-item DP	DP	ES	CP	H-I
Construct Validity												
Ego-resiliency	**-.309**	**-.368**	**-.366**	-.032	-.084	-.099	**-.541**	**-.624**	**-.553**	**-.418**	**-.200**	**.251**
Effortful Control	-.164	*-.125*	-.132	-.043	-.095	.068	-.103	-.125	-.106	*-.107*	-.056	.038
Longitudinal Validity												
Disciplinary Measures	**.231**	**.274**	**.332**	-.152	*.231*	-.137	**.231**	**.286**	**.273**	-.095	**.270**	.009
Antisocial Behavior	**.249**	**.260**	**.286**	*-.151*	.228	-.045	**.138**	**.144**	**.262**	-.177	-.004	*-.169*

Note. ES = Emotional Symptoms, CP = Conduct Problems, H-I = Hyperactivity-Inattention.
Note. 5-item DP is the SDQ-DP 5-item measure, 15-item DP is a summed score of the items from the ES, CP and H-I scales.
Note. Estimates (STDYX standardized beta's) in bold are significant at p<.001 level, underlined at p<.01 level, and italicized at p<.05.

DISCUSSION

The objective of this study was to evaluate the Strengths and Difficulties Questionnaire - Dysregulation Profile (SDQ-DP), measuring a broad syndrome of child and adolescent difficulties in regulating affect, behavior and cognition that can reflect overall psychopathology severity and functional impairment (Holtmann, Buchmann, et al., 2011). Specifically, we examined the factor structure, reliability, measurement invariance, and construct and predictive validity of the SDQ-DP. We compared the best-fitting factor model with the previously developed 5 and 15-item SDQ-DP 5-item measures (Holtmann, Becker, et al., 2011; Winsper & Wolke, 2014) in order to recommend when to use which operationalization.

The results of this study replicate findings of previous studies on the Child Behavior Checklist - Dysregulation Profile (Deutz et al., 2016; Geeraerts et al., 2015), by demonstrating that a bifactor model described the SDQ-DP better than a one-factor or second-order model. This bifactor SDQ-DP model suggests that the DP reflects a broad syndrome of dysregulation that exists in addition to specific syndromes of emotional symptoms, conduct problems, and hyperactivity-inattention. Importantly, the bifactor model best described the data across three different developmental periods (early childhood, middle childhood, adolescence) and across different reporters (parents, teachers, youth). Measurement invariance across reporters, gender and developmental period was also demonstrated, showing that the DP bifactor model is constructed similarly regardless of reporter, gender or developmental period, adding to the generalizability of the findings.

Factor Loadings of the SDQ-DP Bifactor Models

Examination of the factor loadings gives further insight into the meaning of the underlying general Dysregulation factor. Symptoms of hyperactivity and inattention (e.g., 'restless, overactive', 'constantly fidgeting or squirming') seemed to contribute most directly to the underlying factor, while in research on CBCL-DP items concerning mood dysregulation (e.g., 'Stubborn, sullen, or irritable', 'Sudden changes in mood or feelings') seem to describe dysregulation most directly (Geeraerts et al., 2015). The brevity of the SDQ might explain these differences, as the SDQ includes only five key symptoms for emotional, conduct and attention problems each, while symptoms of mood dysregulation and irritability are considered to be transdiagnostic (e.g., Kring, 2008). The only item directly describing emotional lability in the SDQ is the item 'Often has temper tantrums or hot tempers', which loaded fairly high on the Dysregulation bifactor. One might also wonder whether symptoms of hyperactivity and inattention truly form a unique factor. However, research has shown that Attention Hyperactivity Disorder (ADHD) is under unique genetic influence (Dick, Viken, Kaprio, Pulkkinen, & Rose,

2005), and post-hoc analyses we conducted showed that models in which items of hyperactivity-inattention did not load on a specific factor but rather only directly on the Dysregulation factor, did not fit better. Furthermore, symptoms of hyperactivity and inattention have been previously found to strongly contribute to DP, next to symptoms of mood lability (Althoff, Ayer, et al., 2010; Geeraerts et al., 2015), showing that the DP reflects not only affective dysregulation, but also behavioral and cognitive dysregulation.

The SDQ-DP bifactor scores were most strongly related with SDQ-DP 15-item scores, and less strong, but still highly related with scores on the most often used SDQ-DP 5-item measure (Holtmann, Becker, et al., 2011), regardless of reporter and developmental period. Stability and interrater agreement were moderate and highest for the SDQ-DP bifactor scores and lowest for the SDQ-DP 5-item scores. Furthermore, reliability of the SDQ-DP 5-item measure was low in our and previous studies (Holtmann, Becker, et al., 2011). Inspection of factor loadings showed that the 5 items that make up the SDQ-DP 5-item measure did not necessarily load very highly on the Dysregulation bifactor and/or contribute most directly to the Dysregulation bifactor (as would be indicated by low scale-specific factor loadings), further questioning the validity of the SDQ-DP 5-item measure.

Construct and Longitudinal Predictive Validity

The SDQ-DP was concurrently associated with lower ego-resiliency and lower effortful control, for both teacher- and parent-reports and regardless of operationalization of the SDQ-DP. This evidence for construct validity was rather robust since the self-regulation measures were quite distinct. Effortful control was assessed with behavioral tasks tapping into more cognitive aspects of self-regulation, primarily slowing down motor control. Ego-resiliency was teacher-reported and tapping into emotional self-regulation with items such as 'Rapid mood shifts, emotionally labile'. The DP furthermore predicted more disciplinary measures and antisocial behavior seven years later, behaviors of which dimensions of emotion and self-regulation are thought to be disrupted (Hyde, Shaw, & Hariri, 2013), demonstrating longitudinal validity (again for both parent- and teacher-report and for all operationalizations of the DP). This study is one of the few so far providing empirical evidence for the notion that the Dysregulation Profile is indeed related to self- and emotion regulation difficulties. Concurrent construct and longitudinal predictive validity of the SDQ-DP bifactor, 5-item and 15-item measures was generally comparable across operationalizations, but associations between the specific factors and correlates were controlled for in the bifactor model, possibly attenuating the strength of these associations. In addition, significant associations between the specific factors of the SDQ-DP bifactor model and the external correlates emerged, with especially the specific Conduct Problems factor predicting additional variance in the longitudinal outcomes.

Unexpectedly, ego-resiliency positively predicted specific Hyperactivity-Inattention, which could be the result of cross-over suppression (Paulhus, Robins, Trzesniewski, & Tracy, 2004). In the early childhood teacher-reported SDQ-DP bifactor model, items representing symptoms of hyperactivity-inattention contributed most directly to dysregulation, with several scale-specific factor loadings being non-significant. Thus, while ego-resiliency and hyperactivity-inattention are generally negatively related (Martel & Nigg, 2006), after accounting for general dysregulation, specific hyperactivity-inattention (for T1 teacher-report primarily defined by being restless and fidgety), might no longer be positively related with ego-resiliency.

Implications and Conclusions

A bifactor model best described the SDQ-DP, conceptualizing the DP as a broad syndrome of dysregulation that exists next to specific problems of emotional symptoms, conduct problems and hyperactivity-inattention. This research adds to the growing notion that different types of emotional and behavioral problems can be (largely) explained by one underlying factor of dysregulation (or general psychopathology, see e.g.; Caspi et al., 2014; Patalay et al., 2015). This is consistent with recent findings showing that different psychiatric conditions partly share the same genetic origin (Pettersson, Larsson, & Lichtenstein, 2016). Given increasing consensus on the presence of a general factor of dysregulation/psychopathology already at an early age (e.g., Geeraerts et al., 2015; Olino, Dougherty, Bufferd, Carlson, & Klein, 2014), the availability of the SDQ as a short and freely available well-validated measure of core symptoms of psychopathology, including those that are central to the CBCL-DP, across developmental age-groups is highly important, for both research and clinical purposes.

The consistency of our results with previous work on the CBCL-DP furthermore shows that the Dysregulation Profile is constructed similarly regardless of which questionnaire is used to measure behavioral and emotional symptoms. This suggests that the DP is indeed a unique phenotype that can probably be established with any broad behavioral screening measure. Future research could examine whether Severe Mood Dysregulation (SMD) and the Disruptive Mood Dysregulation Disorder (DMDD), aimed at capturing patterns of severe dysregulation as expressed in symptoms such as hyperarousal, mood instability, temper outbursts, and chronic irritability (Althoff, 2010; Leibenluft, 2011; Zepf & Holtmann, 2012), represent the extreme end of the dimensional spectrum of the DP, as the DP is thought to capture symptoms broadly overlapping with these clinical presentations (Dougherty et al., 2014; Legenbauer et al., 2016; Zepf & Holtmann, 2012).

While the three different SDQ-DP operationalizations were more alike than different, the bifactor SDQ-DP scores were consistently best in terms of stability, reliability and validity, while the 5-item measure persistently performed poorest. Use of all 15 items representing emotional

symptoms, conduct problems and hyperactivity-inattention within a bifactor model, or using summed scores (Winsper & Wolke, 2014) is thus recommended as this might result in a more reliable and stable assessment of the DP. When possible in sufficiently large samples, we advise using bifactor modeling. Bifactor models are highly useful in psychopathology research (Snyder & Hankin, 2017), as etiology factors and outcomes can be examined in a more refined way. The SDQ-DP 5-item measure might, however, be a simple and efficient screening measure of dysregulation in practice, which could aid in early identification of children at risk for serious psychopathology, after which a more in-depth clinical assessment can be done. Also, the SDQ-DP 5-item measure could be used as an identifier in clinical populations (e.g., children with ADHD) to identify children at greater risk for difficulties with treatment adherence and recovery (Caro-Cañizares et al., 2017). It would be useful to examine whether a shorter set of CBCL-items could similarly be developed and used as a screening measure of dysregulation.

Limitations and Future Directions

Strengths of this study include the systematic approach adopted to evaluating the SDQ-DP by examining competing factor models across different developmental periods and different reporters in a longitudinal sample, as well as testing statistically whether the best-fitting model was equivalent across gender, reporters and developmental period by examining measurement invariance. These factors strengthen the generalizability of the results. However, several limitations must also be noted. First, no direct comparison was possible with the CBCL - Dysregulation Profile as the CBCL was not assessed in the study from which the data were derived. However, previous research showed high overlap between the CBCL-DP and SDQ-DP (albeit not operationalized within a bifactor model), and good correspondence between the CBCL and SDQ generally (Goodman & Scott, 1999; Stone et al., 2010). For determination of the Dysregulation Profile specifically it might however be relevant to examine the impact of the presence of items describing more transdiagnostic emotional regulatory problems (e.g., 'Stubborn, sullen, or irritable'), that are known to strongly contribute to the DP (e.g., Geeraerts et al., 2015) in the CBCL. A systematic comparison of the CBCL-DP and the SDQ-DP in the same dataset would thus be useful.

Second, although we validated the SDQ-DP with measures of self-regulation and antisocial outcomes, future research should also validate the SDQ-DP bifactor model using clinical diagnostic measures of psychopathology such as in-depth diagnostic interviews. Such research is needed to determine the usefulness of the SDQ-DP bifactor model in clinical research and to further validate the specific factors. Third, children in the study were selected based on their below-median performance on literacy. In that sense, this was not a true community study, which likely explains that the prevalence rate of children exceeding the recommended clinical

threshold of the SDQ-DP 5-item measure was around 10%, which is higher than previously reported numbers of 2.6% for SDQ-DP (Holtmann, Becker, et al., 2011), and around 1% for CBCL-DP (Holtmann et al., 2007; Hudziak et al., 2005). Children scoring below the median of a statewide literacy measure however do still form a large portion of the children in schools, but nonetheless, replication of our findings in large epidemiological samples as well as clinical samples is desirable.

The DP might have its roots in infant and toddler regulatory problems as expressed in sleeping and feeding problems and excessive crying (Winsper & Wolke, 2014). Future research could examine these early predictors of dysregulation to prevent maladaptive pathways resulting in dysregulation and eventually psychopathology. Given that the SDQ is brief and can be filled out in about five minutes, this measure has great potential to determine a Dysregulation Profile.

APPENDIX A

Table A1. Measurement Invariance of the Bifactor SDQ-DP Models across Reporters

		χ^2	*df*	*RMSEA*	*RMSEA 90% CI*	*CFI*	*TLI*	*Δdf*	*ΔCFI*	*ΔRMSEA*
Early Childhood	Parents – Teacher									
	Model 1: Configural Invariance	654.818*	356	.034	[.030-.038]	.980	.976			
	Model 2: Scalar Invariance	696.300*	378	.034	[.030-.038]	.979	.976	22	-.001	.000
Middle Childhood	Parents – Teacher									
	Model 1: Configural Invariance	623.485*	356	.035	[.030-.039]	.972	.966			
	Model 2: Scalar Invariance	661.209*	378	.035	[.030-.039]	.971	.966	22	-.001	.000
Adolescence	Parents – Teacher									
	Model 1: Configural Invariance	440.846*	356	.022	[.014-.028]	.984	.980			
	Model 2: Scalar Invariance	484.080*	378	.024	[.017-.030]	.980	.977	22	-.004	.002
	Parents – Youth									
	Model 1: Configural Invariance	520.081*	357	.029	[.024-.035]	.967	.960			
	Model 2: Scalar Invariance	540.851*	378	.029	[.023-.034]	.967	.962	21	.000	.000
	Teacher – Youth									
	Model 1: Configural Invariance	555.236*	356	.033	[.027-.038]	.973	.967			
	Model 2: Scalar Invariance	615.200	379	.034	[.029 - .039]	.968	.964	23	-.005	.001

Table A2. Measurement Invariance of the Bifactor SDQ-DP Model across Gender for All Reporters

			χ^2	*df*	*RMSEA*	*RMSEA 90% CI*	*CFI*	*TLI*	*Δdf*	*ΔCFI*	*ΔRMSEA*
Early Childhood	Parents	Model 1: Configural Invariance	337.356	150	.071	[.061-.081]	.942	.918			
		Model 2: Scalar Invariance	342.324	187	.058	[.048-.067]	.952	.946	37	.010	.013
	Teachers	Model 1: Configural Invariance	380.403	150	.067	[.059-.076]	.981	.973			
		Model 2: Scalar Invariance	360.827	187	.052	[.044-.060]	.985	.984	37	.004	-.015
Middle Childhood	Parents	Model 1: Configural Invariance	284.826	150	.063	[.052-.075]	.955	.937			
		Model 2: Scalar Invariance	291.548	187	.050	[.039-.061]	.965	.961	37	.010	.013
	Teachers	Model 1: Configural Invariance	334.247	150	.068	[.058-.078]	.977	.967			
		Model 2: Scalar Invariance	350.206	187	.057	[.048-.067]	.979	.977	37	.002	.011
Adolescence	Parents	Model 1: Configural Invariance	217.791	150	.051	[.035-.065]	.976	.966			
		Model 2: Scalar Invariance	256.472	187	.046	[.031-.059]	.975	.972	37	.001	.005
	Teachers	Model 1: Configural Invariance	285.714	150	.064	[.053-.076]	.978	.969			
		Model 2: Scalar Invariance	300.234	187	.053	[.041-.063]	.982	.979	37	.004	-.011
	Youth	Model 1: Configural Invariance	246.063	152	.050	[.038 - .061]	.952	.934			
		Model 2: Scalar Invariance	280.724	173	.050	[.039 - .060]	.945	.933	21	.007	.000

Note: For the Youth-report T3 model, the third response category for item 22 was not endorsed for girls, so dichotomized data had to be used.

Table A3. Measurement Invariance of the Bifactor SDQ-DP Model across Time using Parent- and Teacher-Reports

			χ^2	*df*	*RMSEA*	*RMSEA 90% CI*	*CFI*	*TLI*	*Δdf*	*ΔCFI*	*ΔRMSEA*
Parent-Report	Early Childhood – Middle Childhood	Model 1: Configural Invariance	629.160	357	.036	[.031 - .041]	.962	.954			
		Model 2: Scalar Invariance	639.412	378	.034	[.030 - .039]	.964	.958	21	.002	.002
	Middle Childhood – Adolescence	Model 1: Configural Invariance	554.646	357	.033	[.028 - .039]	.968	.960			
		Model 2: Scalar Invariance	556.326	379	.031	[.025 - .036]	.971	.967	22	.003	.002
	Early Childhood – Adolescence	Model 1: Configural Invariance	508.871	358	.027	[.022 - .032]	.975	.969			
		Model 2: Scalar Invariance	545.130	379	.028	[.022 - .033]	.972	.968	21	.003	.001
Teacher-Report	Early Childhood – Middle Childhood	Model 1: Configural Invariance	734.510	357	.038	[.034 - .042]	.980	.976			
		Model 2: Scalar Invariance	744.430	378	.036	[.032 - .040]	.981	.978	21	.001	.002
	Middle Childhood – Adolescence	Model 1: Configural Invariance	612.163	356	.034	[.029 - .038]	.978	.973			
		Model 2: Scalar Invariance	632.523	378	.033	[.028 - .037]	.978	.975	22	.000	.001
	Early Childhood – Adolescence	Model 1: Configural Invariance	659.077	357	.034	[.030 - .038]	.982	.978			
		Model 2: Scalar Invariance	698.141	378	.034	[.030 - .038]	.981	.978	21	.001	.000

CHAPTER 4

General Psychopathology and Dysregulation Profile in a Longitudinal Community Sample: Stability, Antecedents, and Outcomes

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Author contributions

M. Deutz, S. Geeraerts and P. Patalay conceptualized the study and analyzed the data. M. Deutz wrote the manuscript. J. Belsky was involved in the data collection. All authors provided feedback on the analyses and manuscript.

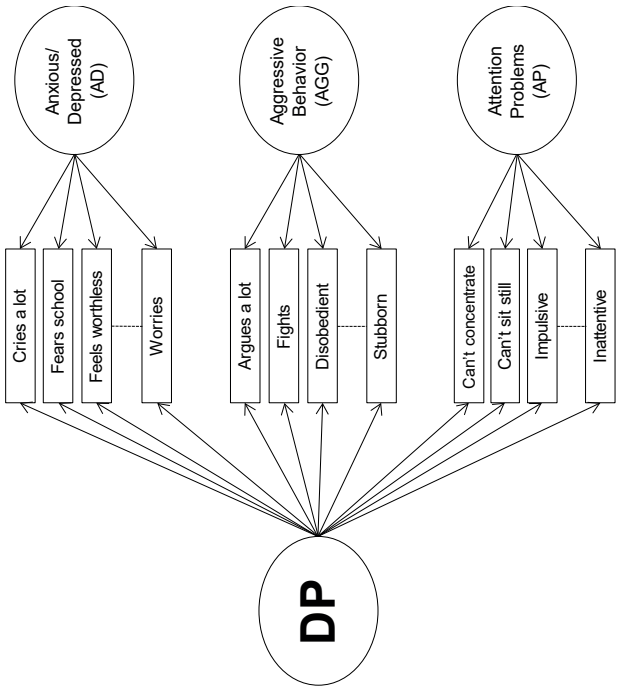
ABSTRACT

The General factor of Psychopathology (GP) and the Dysregulation Profile (DP) are two conceptually similar, but independently developed approaches to understand psychopathology. GP and DP models and their antecedents and outcomes are studied in a longitudinal sample of 1,073 children (49.8% female). GP and DP models were estimated at ages 8 and 14 years using the parent-reported Child Behavior Checklist (CBCL) and the Youth Self Report (YSR). Early childhood antecedents and adolescent outcomes were derived using a multi-method multi-informant approach. Results showed that the general GP and DP had similar key symptoms and were similarly related to early-childhood antecedents (e.g., lower effortful control, higher maternal depression) and outcomes at age 15 (e.g., reduced academic functioning, poorer mental health). This study demonstrates that GP and DP are highly similar constructs in middle childhood and adolescence, both describing a general vulnerability for psychopathology with (emotional) dysregulation at its core. Scientific integration of these approaches could lead to a better understanding of the structure, antecedents and outcomes of psychopathology.

INTRODUCTION

Traditionally, child and adolescent psychopathology has mainly been conceptualized in terms of a two-dimensional structure of externalizing (i.e., aggression, rule-breaking behavior) and internalizing (i.e., anxiety, depression) problems. However, externalizing and internalizing problems are highly correlated in childhood, reciprocally influence each other and specific etiology and outcomes for either are still poorly understood (Achenbach, Ivanova, Rescorla, Turner, & Althoff, 2016; Patalay, Moulton, Goodman, & Ploubidis, 2017; Rhee, Lahey, & Waldman, 2015). Recently, studies using confirmatory factor analysis have documented a 'general psychopathology factor' (GP, or 'p factor') that underlies the externalizing and internalizing spectra (Caspi et al., 2014; Lahey et al., 2012). Other factor-analytic studies yield similar results, highlighting the Dysregulation Profile (DP), composed of the most common symptoms of psychopathology from both the externalizing and internalizing spectrum (Deutz et al., 2016; Geeraerts et al., 2015; Haltigan et al., 2018). Scales from the widely-used Child Behavior Checklist and Youth Self Report are often used as indicators for both GP and DP in young people, although GP generally is measured with a broader range of scales.

Despite many conceptual as well as statistical similarities, research and thinking about GP and DP developed independently. Determining whether—and how—they similarly define co-occurring psychopathology is important to advance understanding of the structure and etiology of psychopathology. One study estimated both GP and DP models in a sample of clinically referred children and adolescents, showing that both models can be estimated and that both are clinically meaningful constructs linked to self-harm and suicidality (Haltigan et al., 2018). However, more evidence is needed to determine the similarity of GP and DP models. Therefore, after describing the origins, similarities, and differences of GP and DP, we evaluate these approaches (as depicted in Figure 4.1) conceptually and statistically, using parent- and youth-reported symptoms in middle childhood and adolescence. By comparing the two models on a broad range of early-childhood antecedents and adolescent outcomes that have been linked to GP and/or DP in previous research, we aim to explore the extent to which the meaning, predictive validity and developmental appropriateness of GP and DP overlap or differ.



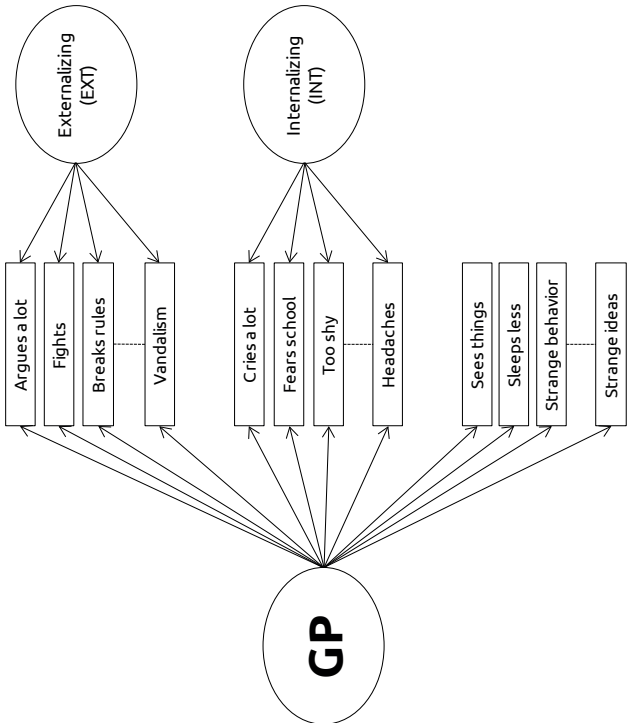


Figure 4.1. The bifactor GP model (left) and the bifactor DP model (right).

Origins of the General Factor of Psychopathology and the Dysregulation Profile

Observations that different forms of adult psychopathology are highly interrelated stimulated recent investigations of the underlying transdiagnostic structure of psychopathology leading to the emergence of the GP. Using a factor-analytic approach, commonly observed patterns of comorbidity were best described by a bifactor model, indicating that common associations between different domains of psychopathology could be explained by GP as well as by domain-specific externalizing and internalizing factors (Caspi et al., 2014; Lahey et al., 2012). The bifactor GP model has been tested against alternative models, including correlated-factors and one-factor models, and was found to best describe the structure of adult psychopathology (Caspi et al., 2014; Lahey et al., 2012) as well as child and adolescent psychopathology (Haltigan et al., 2018; Laceulle et al., 2015; Olino et al., 2014; Patalay et al., 2015; Tackett, Lahey, et al., 2013b).

In contrast to GP, research on DP originated in the study of child psychopathology, specifically, in efforts to identify childhood precursors of bipolar disorder (Biederman et al., 1995). DP reflects a profile of elevated scores on the Anxious/Depressed, Aggressive Behavior and Attention Problems syndrome scales of the widely used Child Behavior Checklist. No longer considered a proxy for bipolar disorder (Diler et al., 2009; Holtmann et al., 2008), DP is now conceptualized as a broad syndrome of difficulties in regulating affect, behavior, and cognition (Althoff, Verhulst, et al., 2010). This claim is consistent with research showing that a bifactor model also best describes the structure of DP (Deutz et al., 2016; Geeraerts et al., 2015; Haltigan et al., 2018).

Thus, GP and DP are similarly derived using bifactor models, in which general factors (GP or DP) exist over and above specific factors of Internalizing (INT) and Externalizing (EXT) difficulties in the GP model or Anxiety/Depression (AD), Aggression (AGG), and Attention Problems (AP) in the DP model (see Figure 4.1). Previous studies have demonstrated significant homotypic continuity (e.g., GP predicting GP at a later time point) as well as hetero-typic continuity (e.g., GP predicting later EXT and vice versa) (e.g., McElroy, Belsky, Carragher, Fearon, & Patalay, 2018; Olino et al., 2018). For DP however, only homotypic continuity has been examined (and established) (Boomsma et al., 2006; Deutz, Shi, et al., 2018). A comparison of the stability of GP and DP is needed to determine which one would be more susceptible to developmental change.

Research linking GP or DP models to external correlates indicates that both are associated with a myriad of etiological correlates (e.g., family history of psychiatric disorder) and developmental consequences (e.g., self-harm, psychosocial problems, poor academic functioning) (Caspi et al., 2014; Deutz et al., 2016; Geeraerts et al., 2015; Lahey et al., 2015; Patalay et al., 2015). These associations emerge even when specific psychopathology factors are controlled for, or different informants are used. The specific factors in the GP and DP models show differentiated associations. This underscores the major advantage of bifactor models being

positioned to disentangle common and unique dimensions of psychopathology, along with their common and unique risk factors and outcomes.

Concerns expressed about bifactor models include their tendency to show superior goodness of fit in model comparison studies, and several authors have stressed the need for validation (Bonifay, Lane, & Reise, 2017; Snyder & Hankin, 2017). Extensive evidence of the criterion validity of both models, and further evidence that they do not reflect evaluation bias (Tackett, Lahey, et al., 2013a) however, reveals GP and DP bifactor models as meaningful and parsimonious ways of examining the etiology and consequences of psychopathology. In sum, both GP and DP models capture general vulnerability for developing psychopathology. Work into the meaning and underlying factors of both has pointed mostly to constructs related to self- and emotion-regulation, e.g., effortful control and negative affectivity (Hankin et al., 2017; Neumann et al., 2016), poor constraint over reactions to emotion (Carver, Johnson, & Timpano, 2017), emotional reactivity and irritability (Geeraerts et al., 2015), and negative emotionality (Tackett, Lahey, et al., 2013a).

Notwithstanding the highly similar ways in which GP and DP models are derived, there are key differences in how they are operationalized, especially with regard to the content of the item domains and specific factors in the models. The extent to which these differences in specification affect these models is unknown. First, a broader range of scales and instruments and often a far larger battery of items are included in GP models (Laceulle et al., 2015; Snyder, Young, & Hankin, 2017), while the DP is usually assessed with only three scales of either the Child Behavior Checklist or the Strengths and Difficulties Questionnaire (Deutz, Shi, et al., 2018). It is unknown whether the size of the item battery affects predictive validity or whether DP, as a more parsimonious measure, might be just as useful. Further, although both models include symptoms from the externalizing and internalizing domains, there is no consensus regarding whether, and how, to handle attention problems. Although modeled as a specific latent factor within the bifactor DP model, in GP models attention problems are not included at all (e.g., Caspi et al., 2014; Patalay et al., 2015) or are included as a part of the externalizing domain (e.g., Laceulle et al., 2015; Lahey et al., 2015). In one recent study symptoms of attention problems loaded on the GP factor directly rather than being subsumed in the externalizing factor, although, notably, the authors did not consider modeling attention problems as a specific factor (Snyder et al., 2017). Finally, thought-problem symptoms are only included in GP models, generally not as a unique factor but rather contributing directly to the general GP factor (e.g., Caspi et al., 2014; Laceulle et al., 2015).

In the present study, we extend work on the two models, as their core components, stability, potential early-childhood etiological factors, and outcomes in adolescence are evaluated within one study. Our overarching goal is to determine whether GP and DP approaches on the structure of psychopathology can be integrated.

METHOD

Participants

Participants were from the NICHD Study of Early Child Care and Youth Development (SECCYD), a diverse US longitudinal cohort study of children born in 1991. Parents were recruited through hospital visits, and 1,364 participants with healthy newborns were enrolled in the study (for details see: https://www.icpsr.umich.edu/icpsrweb/ICPSR/series/233). The SECCYD research protocol was approved by each of the 10 participating university's ethical review boards. All participating families provided written informed consent at the start of the study. The current study included 1,073 participants (78.7% of the original sample) with psychopathology data available at age 8 or 14 years. Of this subsample, 49.8% (n = 534) were female, 81.6% (n = 875) were White, 8.2% of mothers did not complete high school and 19% were living in poverty.

Instruments and Measures

Symptoms of psychopathology. The Achenbach System of Empirical Based Assessment (ASEBA; Achenbach & Rescorla, 2001) was used to assess symptoms of psychopathology with the parent-reported Child Behaviour Checklist (CBCL) when children were 8 and 14 years of age and the Youth Self-Report (YSR) when the child was 14. The 1991-version of the CBCL was available for the 8-year old models, and the 2001-versions of the CBCL and YSR for the 14-year old models, but for all models the 2001-configuration was used to the extent possible. Mother-reported CBCL was available for 1,026 participants at age 8 years and 975 at 14 years; 957 adolescents completed the YSR at age 14 years.

Antecedents and outcomes. A range of antecedents pertaining to the child (e.g., temperament, executive functioning) and the family (e.g., parenting, maternal depression) from birth to 54 months was examined using mother- and teacher- reported questionnaires, observations, and laboratory tasks. Outcomes were assessed at age 15 and mainly youth-reported, and included measures of academic functioning, mental health, psychosocial outcomes and risk-taking. Given the large number of antecedents and outcomes included in this study, detailed information on the measurements as well as reliability measures in the current study are provided in Table B1 in Appendix B.

Statistical analyses

Confirmatory Factor Analyses were conducted in Mplus 7.31 (Muthén & Muthén, 2012) using Weighted Least Squares Means and Variances adjusted estimator (WLSMV) with delta parameterization. Separate bifactor GP and DP models were estimated with the CBCL at ages 8 and 14 years and the YSR at age 14 years. Model fit was evaluated using the root mean square error of approximation (RMSEA), the Comparative Fit Index (CFI), and the Tucker-Lewis index

(TLI). Values of RMSEA ≤.06 and CFI and TLI ≥.95 indicate very good model fit (Cheung and Rensvold, 2002; Hu and Bentler, 1999).

To examine antecedents and outcomes, regression analyses were conducted with the derived factor scores from both sets of models. Both the antecedents and the future outcomes variables were standardized to allow for easier interpretation and comparison of the size of coefficients. A conservative alpha level of .01 was adopted to account for multiple testing. Overall missing cells of antecedents and outcomes were 10.7% of the total, with missingness varying from 0% for birth weight to 36.3% for school attendance. Little's MCAR test indicated that data of the antecedents and outcomes were missing at random, χ^2 (15278) = 7764.490, p = 1.000. Twenty sets of multiple imputation were conducted in STATA14 and all regression analyses were conducted in the imputed datasets.

RESULTS

Model fitting

Items with little (<1% endorsement) or no variation were excluded, resulting in specific items being excluded from the rule-breaking and thought problems subscales (e.g., 'Drinks alcohol without parents' approval' at age 8; 'Sees things that aren't there', at age 14). For the GP bifactor model, items from the Anxious/Depressed (n_{items}=13), Withdrawn/Depressed (n_{items}=7-8) and Somatic Problems (n_{items}=10-11) syndrome scales loaded on the specific Internalizing (INT) factor (total n_{items}=31). Items from the Aggressive Behavior (n_{items}=17-18) and Rule-breaking (n_{items}=8-15) syndrome scales loaded on the Externalizing (EXT) specific factor (total n_{items}=26-31). All items additionally loaded onto the GP factor, and items from the Thought Problems scale (n_{items}=11-14) were estimated to load directly onto GP (and not on a specific thought problems factor, following Caspi *et al.*, (2014), resulting in a total number of items for the GP models ranging from 71 to 76 for different measures at the different ages. For the DP bifactor model, items loaded both on the specific factors of either Anxious/Depressed (AD, n_{items}13), Aggressive Behavior (AGG, n_{items}=17-18), or Attention Problems (AP, n_{items}=8-10), as well as on DP (total n_{items}=39-41).

Fit statistics of all factor models were adequate to good (see Table 4.1). Model fit was comparable for the GP and DP models. Fit indices for the YSR models were lower than for the CBCL models.

Table 4.1. Fit Indices for the Bifactor GP and DP Models in Middle Childhood and Adolescence

Model	x^2	*df*	*RMSEA*	*RMSEA 90% CI*	*CFI*	*TLI*
Middle Childhood						
Mother-reported GP	3216.888	2357	.019	[.017 - .020]	.947	.945
Mother-reported DP	1296.084	663	.031	[.028 - .033]	.961	.956
Adolescence						
Mother-reported GP	3415.340	2564	.018	[.017 - .020]	.950	.947
Mother-reported DP	1262.831	738	.027	[.024 - .030]	.967	.964
Youth-reported GP	4277.891	2637	.025	[.024 - .027]	.921	.917
Youth-reported DP	1695.353	663	.040	[.038 - .043]	.912	.901

Note. GP = General Psychopathology, DP = Dysregulation Profile

Parent-youth concurrent agreement at age 14 was modest (mean r = .26, range = .17 - .36). All factor loadings for the general GP- and DP-factors were significant in all models (nearly all, p < .001), and loadings of the shared items were comparable. The items representing thought problems all loaded significantly on the GP factors (most >.40). Items that most consistently showed the highest factor loadings on the general GP and DP factors were 'Stubborn, sullen, or irritable', and 'Sudden changes in mood or feelings'. In the CBCL models, 'Sulks a lot' also consistently showed high factor loadings (this item is not present in the YSR.) As these items also had nonsignificant or negative specific factor loadings, they seem to most directly contribute to GP and DP. To illustrate, the, factor loadings for the age 8 GP and DP models are presented in Appendix B (Table B2).

Stability

There were no apparent differences between the GP and DP models regarding homotypic stability. When mothers reported at age 8 and 14 years, the GP and DP general factors were moderately stable (r = .58 / .61, p < .001), and the specific factors were weakly to moderately stable (r range from .28 for AGG to .45 for EXT, p < .001). When mothers reported at age 8 and youth at age 14, stability was weaker for both the GP and DP general factors (r = .19 / .19, p<.001), and for the specific factors (r range .12-.21, p <.01/.001).

Evidence for heterotypic continuity was also present, both from the general (GP/DP) to specific factors (r range .09-.22, only DP at age 8 to AD at age 14 n.s.) as from the specific to the general factors (r range .08 - .20, all significant). When mothers reported at age 8 and youth at age 14, only 3 out of 10 correlations were significant. Heterotypic continuity seems slightly larger for the GP models. A full correlation table can be found in Table B3 (see Appendix B).

Antecedents

Demographic predictors. Gender was not related to the GP or DP general factors, but being female was associated with more INT and AD and fewer EXT, AGG, and AP. Higher maternal education was associated with lower levels of GP and DP and EXT/AGG, while income disadvantage was only related to higher GP and DP at age 8. Later-born children had lower levels of GP, INT and AD at age 8, and GP and DP at age 14. In all subsequent analyses of antecedents, we controlled for socio-demographic factors (gender, ethnicity, income, maternal education, and birth order).

Early childhood antecedents of the general GP and DP factors. GP and DP based on maternal reports at age 8 (Table 4.2) and age 14 (Table B4 in Appendix B) were similarly associated with child and family characteristics. Regarding child attributes, higher negative affectivity, lower cognitive ability, and less self-control were associated with more general problems (higher GP and DP). With regard to family factors, similarly, higher maternal depression, lower positive maternal parenting and poorer quality of the home environment were associated with higher GP and DP. Notably, GP and DP based on youth reports at age 14 were unrelated to all antecedents (see Table B5 in Appendix B).

Early childhood antecedents of specific factors. Greater EXT and AGG were associated with lower effortful control and self-control and lower quality of the home environment. Greater INT and AD were associated with higher child negative affectivity and maternal depression. AP was associated with lower effortful control and poorer executive functioning (e.g., delay of gratification). Again, all measured antecedents proved unrelated to youth reported specific factors.

In summary, the general factors from the GP and DP bifactor models were associated similarly with early childhood antecedents. Conceptually similar specific syndromes (e.g., EXT and AGG) showed comparable associations with early childhood antecedents, while the AP factor was uniquely related to measures of executive functioning.

Table 4.2. Antecedents predicting all factors from the mother-reported GP and DP models with the CBCL at Age 8

		CBCL General Psychopathology			CBCL Dysregulation Profile			
		GP	Ext	Int	DP	AD	AGG	AP
Child Individual Predictors	Birth weight	.01 (.03)	.01 (.02)	.04 (.02)	.01 (.03)	.02 (.02)	-.01 (.02)	.00 (.02)
	Attachment (SS) B vs A	.07 (.08)	.03 (.07)	.00 (.07)	.07 (.08)	-.01 (.07)	-.02 (.06)	.01 (.06)
	Attachment (SS) B vs C	-.01 (.10)	.11 (.08)	-.08 (.08)	.02 (.10)	-.05 (.09)	.03 (.07)	-.11 (.08)
	Attachment (SS) B vs D	-.03 (.08)	-.13 (.07)	.07 (.07)	-.13 (.08)	.18* (.07)	-.01 (.05)	-.06 (.06)
	Attachment (SS) B vs U	-.12 (.15)	.04 (.12)	-.08 (.12)	-.05 (.15)	-.17 (.12)	-.06 (.10)	-.03 (.12)
	Negative affectivity	.26** (.03)	.03 (.02)	.07* (.02)	.24** (.03)	.11** (.02)	-.03 (.02)	.00 (.02)
	Effortful control	-.22** (.03)	-.19** (.02)	.06 (.02)	-.28** (.03)	.06 (.02)	-.09** (.02)	-.12** (.02)
	Cognitive ability	-.10** (.03)	-.04 (.03)	-.04 (.03)	-.09* (.03)	-.04 (.03)	-.04 (.02)	-.07* (.03)
	Delay of gratification	-.10 (.06)	-.04 (.05)	-.07 (.05)	-.10 (.06)	-.11 (.05)	-.06 (.04)	-.15* (.05)
	Impulsivity	.01 (.03)	.04 (.03)	-.03 (.02)	.03 (.03)	-.03 (.03)	.02 (.02)	.00 (.02)
	Planning/problem-solving	-.03 (.03)	-.02 (.02)	-.01 (.02)	-.03 (.03)	.00 (.02)	-.03 (.02)	-.09** (.02)
	Self-control	-.12** (.03)	-.09** (.02)	.01 (.02)	-.14** (.03)	.01 (.02)	-.06* (.02)	-.04 (.02)
Family Domain Predictors	Positive Maternal Parenting	-.11** (.03)	-.05 (.03)	-.01 (.02)	-.11** (.04)	-.03 (.03)	-.05 (.02)	-.07* (.03)
	Harsh control	.05 (.03)	.06 (.03)	-.04 (.03)	.08 (.03)	-.06 (.03)	.03 (.02)	.04 (.02)
	Maternal depression	.20** (.03)	.01 (.02)	.05 (.02)	.17** (.03)	.08** (.02)	-.01 (.02)	.01 (.02)
	Home environment	-.16** (.03)	-.16** (.03)	.03 (.03)	-.20** (.03)	.06 (.03)	-.11** (.03)	-.06 (.03)

Note. CBCL = Child Behavior Checklist, GP=General Psychopathology, Ext=Externalizing, Int=Internalizing, DP=Dysregulation Profile, AD=Anxious/Depressed, AGG=Aggressive Behavior, AP=Attention Problems
Note. *p<.01, **p<.001

Developmental Outcomes

Outcomes of the general GP and DP factors. Table 4.3 presents the outcomes of GP and DP based on maternal reports at age 8, indicating that higher GP and DP bifactor scores at age 8, were similarly associated with impaired academic functioning (i.e., lower average grade), more mental health issues (i.e., higher levels depression and sleep problems), poorer psychosocial functioning (i.e., more loneliness, less psychosocial maturity), and greater risk-taking. GP and DP based on maternal-reports at age 14 (see Table B6 in Appendix B) also predicted less school days attended, and higher instrumental and reactive aggression. Youth-reported GP and DP at age 14 (see Table B7 in Appendix B), additionally predicted higher relational aggression, psychopathy and risk-taking propensity, and lower friendship quality psychosocial maturity (but not less school days attended). When not taking into account the specific factors (i.e., when antecedents predicted the GP or DP general factors only), results were similar.

Outcomes of specific factors. Table 4.3 and Tables B6 and B7 in Appendix B present coefficients of regression analysis using the specific factors as predictors of outcomes *over and above* the general GP and DP factors. The EXT (GP) and AGG (DP) factors were mainly associated with higher levels of aggression, risk-taking, psychopathy and lower average grade. EXT at age 14 was more strongly associated with age-15 outcomes than AGG at the same age, and also predicted more outcomes such as lower school days attendance. The INT (GP) and AD (DP) factors were mainly associated with more depression and less psychopathy at age 15. Although they significantly predicted a few different outcomes, coefficients of these effects were similar. Finally, AP was most consistently related with a lower average grade and less psychosocial maturity.

In sum, the general GP and DP factors similarly predicted a range of negative outcomes in adolescence, even when controlling for the specific factors. Conceptually comparable syndromes again were similar in their predictions.

Table 4.3. Future functioning outcomes at age 15 predicted by all factors of the mother-reported GP and DP models with the CBCL at Age 8

		CBCL General Psychopathology			CBCL Dysregulation Profile			
		GP	EXT	INT	DP	AD	AGG	AP
Academic Functioning	Average Grade	-.18** (.04)	-.23** (.05)	.10 (.05)	-.24** (.04)	.11 (.05)	-.17* (.06)	-.22** (.05)
	% Days Attended	-.10 (.05)	-.09 (.05)	-.01 (.05)	-.12* (.05)	.00 (.05)	-.07 (.06)	.04 (.05)
Mental Health	Instrumental Aggression	.07 (.04)	.17** (.05)	.04 (.05)	.14** (.04)	.01 (.05)	.14 (.06)	.00 (.05)
	Relational Aggression	.05 (.04)	.18** (.05)	.06 (.05)	.12* (.04)	-.02 (.05)	.14 (.06)	.00 (.05)
	Reactive Aggression	.11 (.04)	.21** (.05)	-.03 (.05)	.16** (.04)	-.05 (.05)	.23** (.06)	.04 (.05)
	Depression	.15** (.04)	-.01 (.05)	.14* (.05)	.13* (.04)	.11 (.05)	-.02 (.06)	.00 (.05)
	Psychopathy	.08 (.04)	.17** (.05)	-.14* (.05)	.11 (.05)	-.09 (.05)	.21** (.06)	.10 (.05)
	General Sleep Problems	.17** (.04)	-.02 (.05)	.03 (.05)	.14** (.04)	.06 (.05)	-.02 (.06)	-.07 (.05)
Psycho-social	Friendship Quality	-.03 (.04)	-.05 (.05)	.00 (.05)	-.05 (.04)	-.01 (.05)	-.05 (.06)	-.06 (.05)
	Loneliness	.17** (.04)	-.02 (.05)	.09 (.05)	.13* (.04)	.11 (.05)	.01 (.06)	.08 (.05)
	Psychosocial Maturity	-.20** (.04)	-.08 (.05)	.02 (.05)	-.20** (.04)	-.02 (.05)	-.10 (.06)	-.12 (.05)
Risk-taking	Any Risk-taking	.08 (.04)	.24** (.05)	-.01 (.05)	.15** (.04)	-.05 (.05)	.25** (.06)	.07 (.05)
	Risk-taking Propensity	-.08 (.04)	.04 (.05)	.03 (.05)	-.06 (.04)	-.03 (.05)	.06 (.06)	.04 (.05)
	Resistance to Peer Influence	-.09 (.04)	-.02 (.05)	.05 (.05)	-.10* (.04)	.03 (.05)	.00 (.06)	.01 (.05)

Note. CBCL = Child Behavior Checklist, GP=General Psychopathology, EXT=Externalizing, INT=Internalizing, DP=Dysregulation Profile, AD=Anxious/Depressed, AGG=Aggressive Behavior, AP=Attention Problems
Note. *p<.01, **p<.001

DISCUSSION

This study examined conceptual and statistical similarities between two recent, but independently developed approaches which concern the structure of (child and adolescent) psychopathology: General Psychopathology (GP) and the Dysregulation Profile (DP). Our conceptual analysis revealed that GP and DP are described and derived very similarly and are similarly associated with a broad range of early-childhood antecedents and adolescent outcomes. The ways in which the models differ - mainly via inclusion of an Attention Problems factor in the DP model and that of thought and rule-breaking problems in the GP model – apparently does not have a large bearing on relations with antecedents and outcomes, suggesting that both operationalizations result in similar formulations of general vulnerability for psychopathology. Interestingly, it has been suggested that a GP factor without thought problems can be better referred to as a "general behavioural/emotional dysregulation dimension" (Castellanos-Ryan et al., 2016). Future research needs to examine both GP and DP models in relation to measures and indicators of thought problems to further establish whether thought problems are key to general vulnerability of psychopathology (Caspi & Moffitt, 2018)

Inspection of factor loadings indicates that mood regulation difficulties and irritability lie at the core of both GP and DP, as items such as 'Stubborn, sullen, or irritable' and 'Sudden changes in mood or feelings' most directly contributed to the general factors. Emotion dysregulation is central to many clinical conditions, and difficulties in emotion regulation (e.g., with selecting and implementing regulatory strategies) can underlie various forms of psychopathology (Sheppes, Suri, & Gross, 2015). Many ways of thinking about psychopathology have long had emotion dysregulation at its core and the central role of emotional dysregulation in GP and DP has been previously highlighted (Caspi et al., 2014; Masi, Muratori, Manfredi, Pisano, & Milone, 2015). It is noteworthy that the abovementioned items together with 'Temper tantrums or hot temper' (that especially had high loadings on DP) have been used together previously as an index of irritability (Stringaris, Zavos, Leibenluft, Maughan, & Eley, 2012).

Both GP and DP were moderately stable from 8 to 14 years, in line with previous research on GP (McElroy, Belsky, et al., 2018; Murray et al., 2016; Olino et al., 2018; Snyder et al., 2017) and DP (Boomsma et al., 2006; Deutz, Vossen, et al., 2018). The specific factors showed only weak to moderate stability, however. This suggests that while general psychopathology remains fairly stable, specific problems (or symptom presentations) are more susceptible to change. Furthermore, evidence for both homotypic and heterotypic continuity was found, suggesting that general vulnerability for psychopathology predicts specific symptom presentations as well as vice versa. One recent study that, to the best of our knowledge, is the only study that examined stability of the GP model in adults, examined three- to four-year stability of a general

psychopathology bifactor model in in a large (n = 43.093) sample of adults, using an DSM-IV interview schedule (Greene & Eaton, 2017). Stability was high for both the GP factor (β =.67) and specific factors of Fear, Externalizing. And Distress (βs ranged from .53-.87). It thus might be that while specific symptom profiles are (relatively) susceptible to change in childhood and adolescence, they become more stable in adulthood. No studies yet however have examined developmental stability of DP/GP from childhood into adulthood, which would be needed to examine this hypothesis.

The general GP and DP factors were similarly associated with early childhood antecedents. Socio-demographic precursors were consistent with previous research as follows (Caspi et al., 2014; Patalay et al., 2015). General risk for the development of psychopathology, operationalized as either the general GP or DP factors, did not differ for boys and girls. Specific INT and AD were higher for girls, however, whereas EXT, AGG and AP were higher for boys. Furthermore, greater economic disadvantage and lower maternal education were most strongly related to higher scores on the general GP and DP factors. Stable child factors, such as temperament and lower cognitive ability, as well as family factors, such as maternal depression, proved to be similarly associated with the general GP and DP factors. Child and family antecedents of conceptually comparable specific syndromes (EXT and AGG, and INT and AD) yielded similar associations. Generally, lower effortful control, lower self-control and a lesser quality home environment predicted higher EXT or AGG, while higher child negative affectivity and maternal depression predicted more INT. This result makes clear that the specific and general factors should be distinguished, and it also demonstrates the unique utility of bifactor models to do so.

As research on childhood antecedents of GP and DP is scarce, several findings are discussed in more detail. Executive functioning measures were not related to GP and DP, which is surprising given that EF has widespread associations with psychopathology and his been linked to general psychopathology as well as dysregulation in previous research (Bloemen et al., 2018; Geeraerts et al., 2015; Martel et al., 2017). This could be a consequence of the measures used in the present study, which mostly tapped into non-emotional ("cool") executive functioning. As EF measures did show associations with AP it could be that AP drives the link between EF and psychopathology. Attachment problems, which also have been associated with a general vulnerability for psychopathology (Ein-Dor, Viglin, & Doron, 2016), did not emerge as a significant predictor. Surprisingly, no early-childhood antecedents were associated with youth-reported symptoms. As most early-childhood antecedents were parent-reported (e.g., temperament, maternal depression), shared method variance might partly explain the presence of associations with parent-reported symptoms and lack of associations with youth-reported psychopathology. Other studies have also documented a lack of associations between early antecedents such as socio-economic deprivation and cognitive ability and youth-reported, but not parent-reported,

mental health (Johnston, Propper, Pudney, & Shields, 2014; Patalay & Fitzsimons, 2016). Given that youth-reported GP and DP were good predictors of many adolescent outcomes, and parent-youth agreement was in line with what is generally reported (Rescorla et al., 2013) these findings are unlikely to reflect peculiarities of youth reported symptoms in this dataset. This failure to detect potential determinants of youth-reported symptoms merits attention in future research.

Higher general GP and DP bifactor scores predicted adolescent outcomes similarly, irrespective of age of measurement and reporter, including poorer academic functioning, mental health, psychosocial functioning, and greater risky behavior and susceptibility to peer influence. Notably, most associations remained significant even when controlling for the specific factors. Again, the specific factors from the GP and DP models were more differentiated in their associations with adolescent outcomes. EXT and AGG generally predicted higher levels of different forms of aggression, while INT and AD mostly predicted higher depression and (lower levels of) psychopathy. AP uniquely predicted lower average grade and lower psychosocial maturity, indicating that difficulties in attention (cognition) regulation specifically, negatively impact adolescent's academic achievement, as well as capacity for responsible self-management.

In the past decade, great progress has been made in understanding the nature of psychopathology, and it has become clear that substantial overlap exists between different psychiatric symptoms or disorders, at both behavioral and genetic levels (Pettersson, Anckarsäter, Gillberg, & Lichtenstein, 2013; Pettersson et al., 2016). Our study adds to a growing body of research which provides support for the conceptualization of GP and DP as general syndromes, ones which exist over and above more specific syndromes of psychopathology. The GP and DP bifactor models provide an elegant way to explain interrelatedness between different forms of psychopathology, and offer a refined way to parse out shared and common etiologies and outcomes and are thus highly useful in psychopathology research (Caspi & Moffitt, 2018; Lahey, Krueger, Rathouz, Waldman, & Zald, 2017; Reise, 2012; Snyder & Hankin, 2017). Alternative emerging classifications, such as the Hierarchical Taxonomy of Psychopathology (HiTOP; Kotov et al., 2017) and the Research Domain Criteria (RDoC; National Institute of Mental Health), also view psychological disorders as dimensions of underlying cognitive and neurophysiological systems instead of separate and categorical entities. More research is needed to better define what GP and DP reflect (Tackett, Lahey, et al., 2013b).

The DP model proved more parsimonious than the GP, as it required a much smaller set of items. The GP model thus requires larger samples, which makes the DP model more practical for research purposes. The DP bifactor model was further differentiated from the GP bifactor model by the unique role of the AP factor. One of the main differences between the GP and DP models is that only in the DP model symptoms of Attention Problems are modeled as a specific factor. In the research reported and the practices implemented in adult studies on GP (Caspi

et al., 2014; Lahey et al., 2012), symptoms of attention problems were not included in the GP model. AP and EXT were at best weakly associated in the current report, and AP was uniquely predicted by early-childhood measurements, especially of executive functioning, and uniquely predicted adolescent functioning (e.g., average grade). The specific AP factor demonstrated clear additional value and we thus recommend researchers, especially in youth psychopathology, to model attention problems as a unique factor. Given the high occurrence of attention problems in childhood, its inclusion would be developmentally appropriate. Including a specific attention problems in GP models, as has been done recently in McElroy, Belsky, et al. (2018) is therefore highly recommended.

Lastly, there is robust evidence for GP and DP as broad developmental risk-markers, given the broad range of maladaptive outcomes reported in this and other studies. Future research should prioritize examining antecedents and neurobiological underpinnings as well as potentially malleable environmental factors (e.g., parenting) that are related to GP and DP, to identify possible targets for treatment and prevention.

In summary, the GP and DP factors were similarly stable and associated in very similar ways to putative antecedents and outcomes, derived in this multi-method multi-informant study. GP and DP areas of research that have been developing independently so far, would thus benefit from integration. Integrating research on the included syndromes, statistical approaches and findings will help increase our understanding of the relevance of a general psychopathology dimension, likely contributing to understanding the neurological correlates, biomarkers and environmental factors that predict greater risk of mental disorders through the life course.

APPENDIX B

Table B1. Description of instruments and measures used to assess antecedents and outcomes

Antecedents Domain		
Child Individual Antecedents	***Birth weight***	Birth weight in grams (converted from weight reported in pounds and ounces) was reported by mothers during study enrollment.
	Attachment	The Strange Situation (Ainsworth et al., 1978) was conducted in the 15-month laboratory visit. Mother and child were videotaped during a typical Strange Situation procedure that took place in an unfamiliar playroom. The procedure consisted of a series of 3-minute episodes designed to increase the child's stress and activate the child's attachment system. Videotapes were coded by trained coders. Four child behaviors were rated: proximity and contact seeking, contact maintaining resistance, and avoidance. The organization of the child's attachment and exploratory behaviors, especially in the reunion episodes, were analyzed and classified into one of five classifications: secure (B), or insecure (A: insecure-avoidant, C: insecure-resistant, D: disorganized, U: unclassifiable). Dummy variables were created in which each of the insecure classifications were contrasted with the secure classification.
	Temperament	The Children's Behavior Questionnaire (CBQ; Rothbart et al., 1994) was filled out by mothers when their child was 54 months. Only 80 items from 8 scales of the original measure were used. Mothers rated items describing their child's reactions to different situations on a 7-point scale ranging from 1 (extremely untrue) to 7 (extremely true). Scores for three common broad temperamental dimensions can be obtained, namely for: Negative Affectivity, Effortful Control and Surgency. Because of low reliability, Surgency scores were not used in the current study. Negative Affectivity (α = .60) was computed by averaging scores of the subscales Fear (α = .64), Anger/Frustration (α = .76), and Sadness (α = .60), with higher levels indicating more negative affect. Effortful Control (α = .69) was computed by averaging mean scores on the subscales Inhibitory Control (α = .75) and Attentional Focusing (α = .74), with higher levels indicating better capacities to maintain attentional focus and plan and suppress inappropriate approach responses.
	Cognitive ability	Five subscales of the Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R; McGrew et al., 1991) were individually administered at the 54-month lab-assessment to obtain a global assessment of the child's cognitive aptitude and achievement. Cognitive ability was assessed in three subscales: Memory for Sentences (short-term memory), Incomplete Words (auditory processing), and Picture Vocabulary (comprehension-knowledge). Achievement was assessed in two subscales: Letter-Word Identification (reading), and Applied Problems (mathematics). A mean score indicating higher cognitive ability was computed from standardized scores of five subscales. These scores were moderately interrelated (range = .370 - .534), and a combined score was highly reliable (α = .81).

	Executive functioning	At the 54-month lab visit, children completed two tasks indicative of different aspects of executive functioning. ***Delay of gratification***. A delay procedure was conducted in the form of a self-imposed waiting task, the "waiting game" (Mischel, 1974; Mischel et al., 1989). After identifying which of three type of foods a child liked most (M&M's, animal crackers, pretzels), a small and large portion of the food was placed in front of the child. The child was offered a choice between (a) waiting on his or her own (for 7 minutes) until the experimenter returned to the lab room and receiving a larger quantity of the food preferred food, or (b) ringing a bell to bring the experimenter back to the room and thus receiving a smaller amount of food. Data was scored as pass (waiting the full 7 minutes) or fail (i.e., ringing the bell, eating the food, becoming distressed). ***Impulsivity.*** The Children's Stroop test (Gerstadt et al., 1994) required children to inhibit their normal response of saying "day" to white cards with a bright sun, and "night" to black cards with a moon and stars (after ensuring the child understood the instructions with practice trials). The adult Stroop test is widely used as a measure of impulsivity. Scores indicate the percentage of incorrect responses out of the total number of non-missing responses and therefore signal impulsivity. The items used to create this variable had adequate internal consistency (α = .79).
	Self-control	Kindergarten classroom teachers rated how often social behaviors such as volunteering to help peers occurred for the child using the Social Skills Rating System - Teacher Form (Gresham & Elliot, 1990). The self-control subscale (10 items) was used in this study. The Self-Control scale includes child behaviors that emerge in conflict situations, such as responding to teasing and receiving criticisms well, and controlling temper. Teachers rated how often a social behavior occurred on a 3-point scale (0 = never, 1 = sometimes, 3 = very often). Higher scores indicated better self-control. The items used to create this variable had high internal reliability (α = .87).
Family Domain Antecedents	***Positive maternal caregiving***	Mother-child interaction at the 54-month lab-visit was videotaped in semi-structured 15-minute lab observations and rated by trained coders using global rating scales (7-point scales ranging from 1 = very low to 7 = very high). These rating scales were modified from Egeland & Hiester (1993) to be task- and age-appropriate. A composite score (α = .91) was created representing positive maternal caregiving that consisted of: supportive presence, respect for autonomy, reversed hostility, cognitive stimulation, quality of assistance and confidence. Higher scores indicated more positive caregiving. An interrater reliability estimate of .90 (indicating high reliability) was computed for a part of the sample (*n* = 242) based on ANOVA procedures as described in Winer (1971).
	Harsh control	The Harsh Control subscale (6 items) from the Raising Children Questionnaire (an extensive revision of the Raising Children Checklist; Shumow et al., 1998) was filled out by parents when children were 54 months, asking for example about spanking. The items described parenting strategies, and response categories ranged from 1 (definitely no) to 4 (definitely yes). Higher scores represented more harsh control. Mother's self-reported harsh control was used, of which internal consistency was α = .71.
	Maternal depression	An adapted version of the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1997) was used to assess maternal depressive symptoms when the child was 54 months. The CES-D included 20 statements describing how people sometimes feel about themselves, and respondents were asked to circle one of four responses that best described how they felt during the past week (ranging from 1 = rarely or none of the time (less than once a week) to 4 = most or all of the time (5-7 days a week). A sum score was calculated, with higher scores representing higher levels of maternal depressive symptomatology. Cronbach's α was .90, indicating good internal consistency.

	Home environment	The H.O.M.E. Inventory (Caldwell & Bradley, 1984) is a combination of direct observation and semi-structured interview and was assessed at home when the child was 54 months, with higher scores indicating higher levels of stimulation and support in the child's home environment. Each item was scored on a binary scale, with a score of 1 indicating the behavior is observed during the home visit or the parent reports that the conditions or events are characteristic of the home environment, and a score of 0 indicating the behavior is not observed or reported. Cronbach's α for the total score was .93. Inter-observer agreement was >90%.
Outcomes		
Domain		
Academic Functioning	***Average grade***	Adolescent's average grade in 4 core subjects (math, science, English, history/social studies) was computed as the average of the numerical equivalent of the letter grades of the current school year (reported by the principal).
	% days attended	Percentage of days attended in the current school year reported by the principal.
Mental Health	***Aggression***	To differentiate both the underlying forms and the functional expressions of aggression, pure relational aggression, over-reactive aggression, and over-instrumental aggression were assessed. Items for these three scales (i.e., Instrumental Overt Aggression (6 items, α = .82), Pure Relational Aggression (6 items, α = .68), and Reactive Overt Aggression (6 items, α = .81)), were derived from measures used by Dodge and Coie (1987) and Crick and Grotpeter (1995). Mean scores were used with higher scores indicating more aggressive behavior. Participants rated how true each item was for them on a 4-point scale from "not at all true" to "completely true".
	Depression	The Children's Depression Inventory (Short Form; Kovacs, 1992) is a 10-item questionnaire widely used to assess adolescent depression symptoms. Ten sets of three statements were presented and adolescents selected the one that best described the way (s)he felt over the last two weeks. The items tap dysphoric mood, lack of pleasure, and low self-esteem. Internal reliability was moderate (α = .81). A sum score of all ten items was used (after recoding some items), with higher scores indicating more child depression.
	Psychopathy	A subset of 15 items from the Youth Psychopathic Traits Inventory (Andershed et al., 2002) measured affective (rather than behavioral) psychopathic characteristics (remorselessness, unemotionality, and callousness). Participants responded to each item on a 4-point Likert scale ranging from 1 (does not apply at all) to 4 (applies very well). A total score was computed by summing all items to examine the overall affective traits that are characteristic of psychopathy (α = .82). Higher scores indicated more psychopathy.
	Sleep problems	Adapted from the Child Sleep Habits Questionnaire (CSHQ; Owens et al., 2000), nine items assessed sleep problems as night waking and tiredness, with answer categories ranging from 1 (never) to 5 (always). A sum score was computed, with higher scores indicating more sleep problems. Internal reliability was moderate (α = .78).
Psycho-social	***Friendship quality***	The Friendship Quality Questionnaire designed by Parker and Asher (1993) assessed adolescent's perceptions of their friendship with their very best friend. Adolescents were asked to rate how true 28 statements were of their relationship with their best friend on a 5-point Likert scale ranging from 1 (not at all true) to 5 (really true).A total friendship quality score (α = .92) was computed as a mean on all items (after reverse-coding several items), with higher scores indicating more positive friendship behaviors from and with the best friend.
	Loneliness	The sum of 16 items (α = .91) from the Loneliness and Social Dissatisfaction Questionnaire (Asher et al., 1984) was used to measure adolescent's feelings of loneliness and social dissatisfaction. Adolescents answered using a 5-point Likert scale ranging from 1 (not at all true) to 5 (always true). Higher values indicate more loneliness.

	Psychosocial maturity	The 30-item Psychosocial Maturity Inventory (Greenberger & Bond, 1976), measured adolescent's capacity for responsible self-management as an aspect of psychosocial development. Items were answered on a 4-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree). Internal consistency was high (α = .87). A mean score was computed, with higher scores indicating more psychosocial maturity.
Risk taking	***Resistance to peer pressure***	Children's resistance to peer influence was measured as the sum of nine items derived and adapted from a measure by Steinberg and Monahan (2007). The original questionnaire was changed to a traditional 4-point scale with items written in the first person (e.g., "I go along with my friends just to keep them happy)". Adolescents responded using a 4-point Likert scale, ranging from 1 (Not at all true) to 4 (Very true). Internal consistency was modest (α = .69). Higher scores indicated a greater resistance to peer pressure.
	Risk-taking propensity	The Balloon Analogue Risk Task (BART; Lejuez et al., 2007) is a computerized, laboratory-based measure to assess risk-taking propensity. The computer screen showed a small simulated balloon accompanied by a balloon pump, a reset button labeled 'Save Points', and a permanent points-earned display labeled 'Total Earned'. Each click on the pump was worth one point. When a balloon was pumped past its individual explosion point, a "pop" sound effect was generated from the computer. When a balloon exploded, all points in the temporary bank were lost, and the next uninflated balloon appeared on the screen. At any point during each balloon trial, the participant could stop pumping the balloon and click the 'Save Points' button. Clicking this button would transfer all points from the temporary bank to the permanent bank, during which the new total earned would be incrementally updated while a slot machine payoff sound effect played. After each balloon explosion or points collection, the participant's exposure to that balloon ended, and a new balloon appeared until a total of 20 balloons (i.e., trials) had been completed. Each balloon had a different probability of exploding, and the average explosion point was 64 pumps across the first set of 10 balloons and the second set of 10 balloons. Participants were given no detailed information about the probability of an explosion, and they were not informed that different balloons had different probabilities of exploding. They were told that at some point each balloon would explode and that this explosion could occur as early as the first pump all the way up to the point at which the balloon had expanded to fill the entire computer screen. A total index of riskiness was computed as the average number of pumps only on balloons that were not exploded in Trials 1-20 (range: 4.5-78). Higher scores therefore indicate a higher propensity to take risks.
	Any risk-taking	Adolescents were asked how many times in the past year they have engaged in any of 55 different risky behaviors such as tobacco use. The questionnaire was newly developed, but based on the work from Conger & Elder (1994). The following response scale was used: 0 (Not at all), 1 (Once or twice), and 2 (More than twice), which was recoded into 0 (never) and 1 (once or twice or more than twice). The items used to create the 'any risk-taking' had high internal reliability (α = .89). A sum score was created, with higher scores indicating more risk-taking.

Table B2. Standardized factor loadings for the bifactor GP and DP models at age 8 using mother-reported CBCL

Item	Description	DP			GP	
		Scale-specific	DP		Scale-specific	GP
Anxious/Depressed (AD)						
14	Cries	.172**	.630***	Internalizing (INT)	.008	.675***
29	Fears	.307***	.310***		.237***	.380***
30	Fears school	.361***	.402***		.266***	.461***
31	Fears do bad	.634***	.366***		.483***	.435***
32	Perfect	.614***	.176***		.479***	.260***
33	Unloved	.190***	.596***		.071	.649***
35	Worthless	.498***	.565***		.377***	.632***
45	Nervous	.434***	.577***		.236***	.697***
50	Fearful	.639***	.543***		.450***	.637***
52	Feels too guilty	.710***	.401***		.575***	.448***
71	Self-conscious	.490***	.419***		.470***	.493***
91	Talks about suicide	.343***	.626***		.166***	.683***
112	Worries	.767***	.345***		.585***	.454***
Withdrawn/Depressed						
42	Prefers alone				.242***	.302***
65	Won't talk				.189**	.549***
69	Secretive				.206***	.628***
75	Shy				.457***	.237***
102	Lacks energy				.145	.392***
103	Sad				.364***	.692***
111	Withdrawn				.362***	.506***
Somatic Complaints						
47	Nightmares				.224***	.416***
49	Constipate				.389***	.305***
51	Dizzy				.355***	.475***
54	Tired				.277***	.577***
56A	Aches				.479***	.330***
56B	Headaches				.409***	.345***
56C	Nausea				.630***	.433***
56D	Eye problems				.077	.463***
56E	Skin problems				.313***	.243***
56F	Stomach				.653***	.318***
56G	Vomit				.305***	.385***

Aggressive Behavior (AGG)						
3	Argues	.084	.675***	Externalizing (EXT)	.469***	.499***
16	Mean	.296***	.719***		.553***	.543***
19	Demands a lot of attention	-.027	.634***		.191***	.585***
20	Destroys own things	.634***	.672***		.716***	.502***
21	Destroys other	.633***	.694***		.796***	.490***
22	Disobedient at home	.241***	.783***		.579***	.605***
23	Disobedient at school	.369***	.627***		.595***	.406***
37	Fights	.365***	.689***		.564***	.518***
57	Attacks	.245**	.723***		.510***	.562***
68	Screams	-.002	.741***		.337***	.646***
86	Stubborn	-.228***	.811***		.190***	.779***
87	Mood changes	-.210**	.787***		.060	.813***
88	Sulks	.214**	.736***		.067	.751***
89	Suspicious	-.070	.718***		.169	.735***
94	Teases	.257***	.571***		.461***	.438***
95	Temper	.022	.772***		.397***	.644***
97	Threatens	.288***	.769***		.583***	.568***
104	Loud	.156*	.675***		.431***	.530***
Rule-breaking Behavior						
26	No guilt				.442***	.467***
39	Bad friends				.425***	.441***
43	Lies or cheats				.464***	.536***
63	Prefers older				.136**	.444***
81	Steals from home				.559***	.355***
82	Steals outside home				.602***	.323**
90	Swears				.509***	.478***
96	Thinks about sex				.227***	.562***
Attention Problems (AP)						
1	Acts too young	.265***	.515***			
8	Can’t concentrate	.627***	.551***			
10	Can’t sit still	.442***	.587***			
13	Confused	.680***	.444***			
17	Daydreams	.530***	.384***			
41	Impulsive	.282***	.717***			
61	Poor school work	.382***	.550***			
80	Stares	.596***	.445***			

Thought Problems		
9	Mind off	.573***
18	Harms self	.644***
40	Hears things	.527***
46	Twitches	.578***
58	Picks skin	.496***
60	Sex parts	.516***
66	Repeats acts	.660***
70	Sees things	.462***
76	Sleeps less	.496***
83	Stores up	.475***
84	Strange behavior	.693***
85	Strange ideas	.463***
92	Sleep walks	.275***
100	Sleep problems	.498***

Note. GP = General Psychopathology, DP = Dysregulation Profile
Note. *p < .05, ***p < .01, ***p <.001

Table B3. Longitudinal Homotypic and Heterotypic Continuity Correlations for All Factors of the GP and DP models

		Maternal-reported age 8						
		GP	**INT**	**EXT**	**DP**	**AD**	**AGG**	**AP**
Maternal-reported age 14	GP	**.58**	**.18**	**.20**				
	Int	**.13**	**.35**	**-.12**				
	Ext	**.18**	**-.21**	**.45**				
	DP				**.61**	.11	*.08*	**.12**
	AD				.04	**.42**	**-.21**	-.09
	AGG				**.22**	**-.14**	**.28**	-.03
	AP				.09	-.01	*.08*	**.41**
Youth-reported age 14	GP	**.19**	.10	.05				
	Int	.01	**.17**	**-.13**				
	Ext	.05	*-.08*	**.21**				
	DP	**.19**	.06	.11				
	AD					**-.17**	**-.14**	*-.08*
	AGG					-.11	**.16**	.02
	AP					-.06	*.07*	.12

Note. Correlations in **bold** are significant at p<.001 level, underlined at p<.01 level, and *italicized* at p<.05. GP=General Psychopathology, Ext=Externalizing, Int=Internalizing, DP=Dysregulation Profile, AD=Anxious/Depressed, AGG=Aggressive Behavior, AP=Attention Problems

Table B4. Antecedents predicting all factors from the mother-reported GP and DP models with the CBCL at age 14

		CBCL General Psychopathology			CBCL Dysregulation Profile			
		GP	EXT	INT	DP	AD	AGG	AP
Child Individual Predictors	Birth weight	.07 (.03)	.02 (.02)	.03 (.02)	.06 (.03)	.04 (.02)	.02 (.02)	.01 (.02)
	Attachment (SS) B vs A	.10 (.09)	-.02 (.07)	-.02 (.07)	.10 (.08)	-.05 (.06)	-.06 (.06)	.04 (.06)
	Attachment (SS) B vs C	.00 (.11)	.00 (.08)	.00 (.09)	-.04 (.10)	.04 (.08)	.01 (.07)	-.15 (.08)
	Attachment (SS) B vs D	.00 (.08)	-.07 (.07)	-.03 (.06)	-.07 (.08)	.07 (.06)	-.06 (.05)	-.01 (.06)
	Attachment (SS) B vs U	.00 (.15)	.10 (.12)	-.18 (.12)	-.02 (.14)	-.12 (.11)	.07 (.10)	-.09 (.11)
	Negative affectivity	.21** (.03)	.04 (.02)	.07* (.02)	.19** (.03)	.07* (.02)	.03 (.02)	-.02 (.02)
	Effortful control	-.17** (.03)	-.13** (.02)	.01 (.02)	-.21** (.03)	.05 (.02)	-.06* (.02)	-.09** (.02)
	Cognitive ability	-.06 (.03)	-.04 (.03)	-.03 (.03)	-.08* (.03)	-.01 (.02)	-.01 (.02)	-.04 (.03)
	Delay of gratification	-.03 (.06)	-.04 (.05)	-.04 (.05)	-.06 (.06)	-.01 (.04)	-.05 (.04)	-.05 (.05)
	Impulsivity	.03 (.03)	.02 (.02)	.01 (.03)	.03 (.03)	-.01 (.02)	.02 (.02)	-.02 (.02)
	Planning/problem-solving	-.04 (.03)	-.03 (.02)	-.02 (.02)	-.05 (.03)	-.03 (.02)	-.02 (.02)	-.08** (.02)
	Self-control	-.11** (.03)	-.06* (.02)	-.01 (.02)	-.12** (.03)	-.02 (.02)	-.04 (.02)	-.02 (.02)
Family Domain Predictors	Positive Maternal Parenting	-.09* (.03)	-.03 (.03)	.01 (.03)	-.10* (.03)	.01 (.02)	-.01 (.02)	-.02 (.02)
	Harsh control	.01 (.03)	.00 (.03)	.00 (.03)	.03 (.03)	-.02 (.02)	-.01 (.02)	.02 (.02)
	Maternal depression	.18** (.03)	.01 (.02)	.06* (.02)	.16** (.03)	.08** (.02)	-.02 (.02)	.02 (.02)
	Home environment	-.16** (.04)	-.10** (.03)	.03 (.03)	-.18** (.03)	.03 (.03)	-.03 (.02)	.00 (.03)

Note. CBCL = Child Behavior Checklist, GP=General Psychopathology, EXT=Externalizing, INT=Internalizing, DP=Dysregulation Profile, AD=Anxious/Depressed, AGG=Aggressive Behavior, AP=Attention Problems
Note. *p<.01, **p<.001

Table B5. Antecedents predicting all factors from the youth-reported GP and DP models with the YSR at Age 14

		YSR General Psychopathology			YSR Dysregulation Profile			
		GP	EXT	INT	DP	AD	AGG	AP
Child Individual Predictors	Birth weight	.07 (.03)	.02 (.03)	.00 (.02)	.06 (.03)	.01 (.02)	.04 (.02)	.00 (.02)
	Attachment (SS) B vs A	.10 (.09)	.02 (.08)	-.02 (.07)	.07 (.09)	-.02 (.07)	-.01 (.06)	.02 (.06)
	Attachment (SS) B vs C	.05 (.11)	.04 (.10)	.00 (.09)	.01 (.10)	.06 (.08)	.07 (.08)	-.07 (.08)
	Attachment (SS) B vs D	.12 (.09)	.14 (.08)	-.03 (.07)	.11 (.08)	-.01 (.07)	.12 (.06)	-.06 (.06)
	Attachment (SS) B vs U	.01 (.16)	.16 (.13)	-.06 (.12)	.05 (.15)	-.03 (.12)	.09 (.11)	-.09 (.11)
	Negative affectivity	.05 (.03)	-.01 (.03)	.04 (.02)	.05 (.03)	.02 (.02)	.01 (.02)	.00 (.02)
	Effortful control	-.01 (.03)	-.05 (.03)	.06 (.03)	-.03 (.03)	.05 (.03)	-.04 (.02)	-.01 (.02)
	Cognitive ability	.00 (.04)	.07 (.03)	-.01 (.03)	.00 (.03)	.01 (.03)	.04 (.03)	-.01 (.02)
	Delay of gratification	-.12 (.07)	.03 (.05)	-.05 (.05)	-.08 (.06)	-.05 (.05)	.03 (.05)	.02 (.05)
	Impulsivity	-.03 (.03)	-.01 (.03)	-.01 (.03)	-.03 (.03)	.00 (.02)	.00 (.02)	-.03 (.02)
	Planning/problem-solving	.01 (.03)	-.03 (.03)	.01 (.03)	-.01 (.03)	.02 (.02)	-.02 (.02)	.01 (.02)
	Self-control	-.05 (.03)	-.03 (.03)	-.01 (.03)	-.06 (.03)	-.01 (.02)	-.01 (.02)	.02 (.02)
Family Domain Predictors	Positive Maternal Parenting	.02 (.04)	.03 (.03)	.02 (.03)	.04 (.03)	.01 (.03)	.01 (.03)	.01 (.02)
	Harsh control	.02 (.03)	.00 (.03)	-.06 (.03)	.01 (.03)	-.04 (.03)	.05 (.02)	.02 (.02)
	Maternal depression	.07 (.03)	.01 (.03)	.03 (.03)	.05 (.03)	.02 (.00)	.02 (.02)	-.01 (.02)
	Home environment	.04 (.04)	-.01 (.03)	.04 (.03)	.03 (.04)	.05 (.03)	.00 (.03)	.00 (.03)

Note. YSR = Youth Self Report, GP=General Psychopathology, EXT=Externalizing, INT=Internalizing, DP=Dysregulation Profile, AD=Anxious/Depressed, AGG=Aggressive Behavior, AP=Attention Problems
Note. *p<.01, **p<.001

Table B6. Future functioning outcomes at age 15 predicted by all factors of the mother-reported GP and DP models with the CBCL at Age 14

		CBCL General Psychopathology			CBCL Dysregulation Profile			
		GP	EXT	INT	DP	AD	AGG	AP
Academic Functioning	Average Grade	-.13** (.04)	-0.40**(.05)	.03 (.05)	-.28** (.04)	.28** (.05)	-.09 (.06)	-.31** (.06)
	% Days Attended	-.10 (.04)	-.25** (.05)	-.16* (.05)	-.15* (.05)	.02 (.06)	-.13 (.07)	-.01 (.06)
Mental Health	Instrumental Aggression	.15** (.04)	.17** (.05)	-.08 (.05)	.18** (.04)	-.06 (.05)	.17* (.06)	.01 (.05)
	Relational Aggression	.09 (.04)	.14* (.05)	.00 (.05)	.15* (.04)	-.07 (.05)	.10 (.06)	.00 (.05)
	Reactive Aggression	.12* (.04)	.28** (.05)	-.09 (.05)	.18** (.04)	-.14* (.05)	.23** (.06)	.09 (.05)
	Depression	.29** (.04)	-.08 (.05)	.13* (.05)	.24** (.04)	.22** (.05)	-.06 (.06)	-.13 (.05)
	Psychopathy	.07 (.04)	.26** (.05)	-.20** (.05)	.10 (.04)	-.19** (.05)	.26** (.06)	.18** (.05)
	General Sleep Problems	.18** (.04)	.01 (.05)	.15* (.05)	.19** (.04)	.13 (.05)	-.07 (.06)	-.07 (.05)
Psycho-social	Friendship Quality	-.11* (.04)	.03 (.05)	.08 (.05)	-.04 (.04)	-.01 (.05)	-.08 (.06)	-.10 (.05)
	Loneliness	.17** (.04)	-.02 (.05)	.09 (.05)	.13* (.04)	.11 (.05)	.01 (.06)	.08 (.05)
	Psychosocial Maturity	-.23** (.04)	-.14* (.05)	-.02 (.05)	-.28** (.04)	.04 (.05)	-.02 (.06)	-.20** (.05)
Risk taking	Any Risk-taking	.13** (.04)	.45** (.04)	-.04 (.05)	.27** (.04)	-.23** (.05)	.19* (.06)	.16* (.05)
	Risk-taking Propensity	-.03 (.04)	.00 (.05)	-.03 (.05)	-.04 (.04)	-.05 (.05)	.04 (.06)	.09 (.05)
	Resistance to Peer Influence	-.08 (.04)	-.12* (.05)	.02 (.05)	-.12* (.04)	.02 (.05)	-.10 (.06)	-.02 (.05)

Note. CBCL = Child Behavior Checklist, GP=General Psychopathology, EXT=Externalizing, INT=Internalizing, DP=Dysregulation Profile, AD=Anxious/Depressed, AGG=Aggressive Behavior, AP=Attention Problems
Note. *p<.01, **p<.001

Table B7. Future functioning outcomes at age 15 predicted by all factors of the youth-reported GP and DP models with the YSR at Age 14

		YSR General Psychopathology			YSR Dysregulation Profile			
		GP	EXT	INT	DP	AD	AGG	AP
Academic Functioning	Average Grade	-.16** (.04)	-.23** (.05)	.23* (.05)	-.24** (.05)	.30** (.05)	-.16* (.06)	-.10 (.06)
	% Days Attended	-.09 (.04)	-.14* (.05)	-0.02 (.05)	-.11 (.05)	.03 (.06)	-.09 (.06)	.03 (.07)
Mental Health	Instrumental Aggression	.30** (.03)	.38** (.04)	.00 (.04)	.36** (.04)	.00 (.05)	.44** (.05)	-.01 (.05)
	Relational Aggression	.35** (.03)	.35** (.04)	.13** (.04)	.43** (.04)	.11 (.04)	.40** (.05)	-.06 (.05)
	Reactive Aggression	.40** (.03)	.53** (.03)	-.09 (.04)	.41** (.03)	-.06 (.04)	.68** (.04)	-.01 (.04)
	Depression	.49** (.03)	.03 (.03)	.56** (.03)	.56** (.03)	.48** (.04)	-.07 (.04)	-.18** (.04)
	Psychopathy	.19** (.03)	.30** (.04)	-.40** (.04)	.17** (.04)	-.39** (.05)	.37** (.05)	.01 (.05)
	General Sleep Problems	.48** (.03)	.09 (.04)	.24** (.04)	.49** (.04)	.22** (.05)	.05 (.05)	.01 (.05)
Psycho-Social	Friendship Quality	-.17** (.04)	-.07 (.04)	.00 (.05)	-.18** (.04)	.02 (.05)	-.09 (.05)	.02 (.06)
	Loneliness	.48** (.03)	.00 (.04)	.38** (.04)	.50** (.04)	.33** (.04)	-.02 (.04)	-.09 (.05)
	Psychosocial Maturity	-.18** (.03)	-.40** (.04)	-.14* (.04)	-.33** (.04)	.00 (.05)	-.13* (.05)	-.07 (.05)
Risk-taking	Any Risk-taking	.48** (.03)	.00 (.04)	.38** (.04)	.50** (.04)	.33** (.04)	-.02 (.04)	-.09 (.05)
	Risk-taking Propensity	.33** (.03)	.67** (.03)	-.10* (.03)	.42** (.03)	-.16** (.04)	.49** (.04)	.06 (.05)
	Resistance to Peer Influence	-.01 (.04)	.05 (.04)	-.10 (.05)	-.02 (.04)	-.09 (.05)	.04 (.05)	.09 (.06)

Note. YSR = Youth Self Report, GP=General Psychopathology, EXT=Externalizing, INT=Internalizing, DP=Dysregulation Profile, AD=Anxious/Depressed, AGG=Aggressive Behavior, AP=Attention Problems
Note. *p<.01, **p<.001

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CHAPTER 5

Normative Development of the Child Behavior Checklist – Dysregulation Profile from Early Childhood to Adolescence: Associations with Personality Pathology

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AUTHOR CONTRIBUTIONS

M. Deutz conceptualized the study. M. Deutz and A. de Haan analyzed the data. M. Deutz wrote the manuscript P. Prinzie was responsible for the data collection. All authors provided feedback on the conceptualization, analyses and manuscript.

ABSTRACT

The Dysregulation Profile (DP), is a broad indicator of concurrent affective, behavioral and cognitive dysregulation, often measured with the Anxious/Depressed, Aggressive Behavior, and Attention Problems syndrome scales of the Child Behavior Checklist. Despite an expanding body of research on the DP, knowledge of the normative developmental course of the DP from early childhood to adolescence is lacking. Furthermore, although we know that the DP longitudinally predicts personality pathology, no research yet has examined whether next to the DP in early childhood, the rate of change of the DP across development predicts personality pathology. Therefore, using cohort-sequential latent growth modeling in a population-based sample (N=668), we examined the normative developmental course of mother-reported DP from ages 4 to 17 years and its associations with a wide range of adolescent-reported personality pathology dimensions three years later. The results demonstrate that the DP follows a nonlinear developmental course with a peak in early adolescence. The initial level of the DP at age four and, to a lesser extent, the rate of change in the DP predicted a range of personality pathology dimensions in late adolescence. The findings suggest that the DP is a broad developmental precursor of personality pathology in late adolescence.

INTRODUCTION

The Dysregulation Profile, or DP, can be characterized as a broad syndrome of dysregulation in childhood and adolescence, measuring a relatively stable pattern of difficulties in regulating affect (emotion), behavior, and cognition (Boomsma et al., 2006; Caro-Canizares et al., 2015; Deutz et al., 2016; Geeraerts et al., 2015). The DP predicts a variety of negative outcomes, such as psychosocial impairment, substance use, suicidality, and a range of psychiatric disorders in young adulthood, like personality disorders, mood disorders, and anxiety disorders (e.g., Althoff, Verhulst, et al., 2010; Halperin et al., 2011; Holtmann, Buchmann, et al., 2011; Jucksch et al., 2011).

A reliable and valid approach to measure the Dysregulation Profile is with the Anxious/Depressed, Aggressive Behavior and Attention Problems scales (the so-called AAA-scales) of the well-established parent-report Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001). The DP is different from a high CBCL Total Problems score, in that having a high Total Problems score but not belonging to the DP class was associated with different adult outcomes (Althoff, Verhulst, et al., 2010). Furthermore, behavioral-genetic studies have shown that different genetic markers are associated with the DP than with bipolar disorder, depression, and attention problems (McGough et al., 2008), or with anxiety/depression, aggression and attention problems alone (Boomsma et al., 2006; Hudziak et al., 2005), showing that the DP is not linked to one specific disorder and that the DP is more than the sum of its components. Therefore, the robustness of the Dysregulation Profile has been demonstrated, and the DP has been signified as a potential developmental profile indicating major psychopathology (Bellani et al., 2012), and as an "antecedent and a vulnerability profile of a persisting and trans-diagnostic emotional and behavioral dysregulations" (Masi, Muratori, et al., 2015, p. 192).

Despite a vastly expanding body of research on the DP, we know very little about its normative development from early childhood to adolescence. With the establishment of a normative developmental course of the DP, a baseline would be provided that can be used to indicate potentially important clinical deviations warranting attention. Furthermore, not just initial levels but also the rate of change of the DP might predict negative outcomes. Therefore, the aim of the present study was twofold: 1) to examine the normative developmental course of the DP from age 4 to age 17 in the general population, and 2) to examine whether and to what extent the developmental course (both the initial level and the rate of change) of the DP predicted personality pathology in late adolescence.

Normative Development of the Dysregulation Profile

Whereas research examining the course of development of the DP from childhood to adolescence is lacking, medium to high (rank-order) stability of the DP between two time points has been

reported. For example, within-person stability coefficient correlations from age 7 to 12 were r = .66 in a population-based twin-study (Boomsma et al., 2006), and r = .33 across a nine-year period from childhood to late adolescence (Halperin et al., 2011).

Notwithstanding high relative stability, i.e., rank-order consistency, a group as a whole can still change. Such mean-level changes of the DP have been reported: the DP was found to decrease from early to late adolescence (Nobile et al., 2016) and from childhood to late adolescence (Halperin et al., 2011). These findings fit with the notion that children's ability to self-regulate generally increases across development (e.g., Gestsdottir & Lerner, 2008; Raffaelli, Crockett, & Shen, 2005).

The development of dysregulation from early childhood to late adolescence might however be nonlinear: as the turmoil period of early adolescence is known for a diminished ability of self-control (Casey, 2015), a peak in emotional instability (Van den Akker, Deković, Asscher, & Prinzie, 2014) as well as a smaller repertoire of emotion regulation strategies (Zimmermann & Iwanski, 2014). If development of the DP is indeed nonlinear, then a sufficient number of assessments is needed to detect such a developmental course. Because in the current study a cohort-sequential design was employed in which children were assessed at six measurement occasions, both the form of change (mean-level decrease or increase) as well as the shape of change (linear, non-linear) in DP from ages 4 to 17 years could be examined.

Predictive Validity of the DP for Personality Pathology

The DP has been found to predict a wide range of categorical personality disorders (e.g., Althoff, Verhulst, et al., 2010; Halperin et al., 2011; Meyer et al., 2009), but fewer studies have examined associations between the DP and dimensional personality pathology. The numerous limitations of the categorical approach such as excessive co-occurrence and heterogeneity within personality disorders are well recognized (Widiger & Simonsen, 2005), and a dimensional approach in which symptoms of personality dysfunction can vary along a gradient of severity has gained more interest (Oldham, 2015). These limitations have led to the development of a dimensional empirically based model of maladaptive personality traits. In this alternative dimensional model for personality pathology, that has been added as an addendum to the DSM-5 (American Psychiatric Association, 2013), personality pathology dimensions are grouped into five domains: 1) Negative Affectivity (frequent and intense experiences of negative emotions), 2) Antagonism (exaggerated sense of self-importance and callous antipathy toward others), 3) Disinhibition (impulsive behavior), 4) Detachment (avoidance of socio-emotional experience) and 5) Psychoticism (odd, eccentric, or unusual behaviors and cognitions).

The Personality Inventory for DSM-5 (Krueger, Derringer, Markon, Watson, & Skodol, 2012) has been developed as a measure for the alternative dimensional DSM-5 model of

personality pathology. The Personality Inventory for DSM-5 has been used to compare a group with no psychopathology symptoms and groups of children with different combinations of psychopathology (i.e., dysregulated, mild internalizing), on personality pathology dimensions (De Caluwé et al., 2013). Results indicated that, compared to the 'no symptoms'-group, dysregulated children scored higher on dimensions from the Negative Affect (e.g., emotional lability), Antagonism (e.g., callousness), Disinhibition (e.g., impulsivity) and Psychoticism (suspiciousness) domain. Children with a dysregulated profile also showed higher levels of personality pathology in comparison to groups of children with different psychopathology profiles, namely: 'moderate attention problems with anxious-depressed and social problems', 'mild internalizing' and 'severe anxious-depressed and thought problems'.

These findings are in line with other studies demonstrating associations between the DP and self-harm and suicidality (e.g., Deutz et al., 2016; Holtmann, Buchmann, et al., 2011), mood disorders (e.g., Holtmann, Buchmann, et al., 2011; Masi, Muratori, et al., 2015), narcissism (Masi, Muratori, et al., 2015), impulsivity (Masi, Muratori, et al., 2015), sensation seeking (Althoff et al., 2012) and thought problems (e.g., Althoff, Verhulst, et al., 2010; Biederman et al., 2012; Diler et al., 2009). However, while De Caluwé et al. (2013) did not find associations between the DP and dimensions of the Detachment domain (e.g., intimacy avoidance), other studies have documented links between the DP and psychosocial dysfunction and social anxiety (Biederman et al., 2012; Jucksch et al., 2011), and poorer socialization skills in preschoolers (Kim et al., 2012). Furthermore, children with dysregulation were found to be more harm avoidant, which contains elements of shyness and reluctance to engage with peers (Althoff et al., 2012). Generally, parent-adolescent agreement is low on the less visible internalizing behaviors such as withdrawn behavior (Rescorla et al., 2014; Rubin, Althoff, Walkup, & Hudziak, 2013), and intimacy problems (Tromp & Koot, 2012) and therefore detachment features should also be examined using adolescent self-report.

Furthermore, all previous research has focused on assessment of the DP at one time point, and therefore knowledge about how *developmental changes* in the DP affect personality pathology is still lacking. However, not only the initial level but also the developmental course of the DP itself might be important for personality pathology. For example, children who decrease in DP more slowly might experience more negative outcomes later on. It is important to examine such associations in order to improve our understanding of *how* the DP is associated with personality pathology, and what deviations from a normative developmental course could warrant treatment.

The current study is based on several important characteristics that distinguishes it from previous research. First, a categorical (or cut-off) approach has often been used to define the DP and/or personality dysfunction. For example: in several studies children were classified as

either having dysregulation problems or not having such problems, and consequently groups were compared on personality disorders or dimensions (e.g., Althoff et al., 2012; De Caluwé et al., 2013). These studies have shown that dysregulation is uniquely related to personality pathology and temperamental dimensions relative to other psychopathology profiles. However, such an approach does not inform us on relationships that might exist between the severity of the DP and the severity of personality pathology. We therefore adopt a dimensional perspective in this study, by using a latent variable approach to define the DP in combination with the dimensional model for personality pathology of the DSM-5 (American Psychiatric Association, 2013). Second, nearly all the discussed studies were conducted using selected samples such as children with attention-deficit/hyperactivity disorder (ADHD: Halperin et al., 2011), disruptive behavior disorders (DBD: Masi, Muratori, et al., 2015), children oversampled on externalizing behavior (Althoff et al., 2012), and children from mothers with depression and bipolar illness (Meyer et al., 2009). However, these very different and specific samples might have contributed to inconsistent patterns of findings. Replication in population-based samples is needed to elaborate existing theory on the DP and to generate findings that are generalizable to the wider population. Furthermore, examining associations between the DP and personality pathology in a population-based sample will better inform policymakers on whether it might be important to screen for dysregulation in the general population.

In sum: the main question in our study concerned the normative developmental course of mother-reported DP from ages 4 to 17 years in a population-based sample, and its associations with a wide range of adolescent-reported personality pathology dimensions.

METHOD

Procedure and Participants

This study is part of the longitudinal Flemish Study of Parenting, Personality and Development (Prinzie, Onghena, & Hellinckx, 2005; Prinzie et al., 2003). In 1999, a proportional stratified sample was randomly selected from children attending regular primary schools in Flanders (Belgium). Strata were based on geographical location (province), sex and age. For each classroom, children whose birthday was before March 31 were arranged alphabetically, and the second and the last but one child were selected. Parents of the selected children received an invitation to participate in a study concerning child development. Of the 800 invited families, 682 (85.3%) families agreed to participate. In this study, only participants for whom mother-reported CBCL-data was available for at least one of the six measurement waves used to assess the Dysregulation Profile were included, resulting in a total sample of 668 children.

All parents signed informed consent, and confidentiality was guaranteed. All parents had the Belgian nationality. Educational levels for mothers and fathers respectively were: 1.4%/2.8% elementary school, 42.6%/43.3% secondary education, 43.8%/35.3% non-university higher education, and 12.2%/18.4% university education.

A cohort-sequential, or accelerated longitudinal, design was employed (Nesselroade & Baltes, 1979; Prinzie & Onghena, 2005), in which four independent age-cohorts were examined, who were aged 4 (N = 162), 5 (N = 172), 6 (N = 167) and 7 (N = 167) years at Time 1 (50.5% girls). See Table 5.1 for an overview of the ages at which the cohorts were assessed.

Table 5.1. Overview of Ages (Years) at Which the Four Cohorts Were Assessed

Cohort	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 (*n* = 162)	1999	2000	2001			2004			2007		2009			
2 (*n* = 172)		1999	2000	2001			2004			2007		2009		
3 (*n* = 167)			1999	2000	2001			2004			2007		2009	
4 (*n* = 167)				1999	2000	2001			2004			2007		2009

By combining partly age-overlapping cohorts, we were able to approximate a longitudinal study in which development of the DP could be modeled from age 4 to age 17. Data of six measurement waves were used to assess the Dysregulation Profile: T1 (1999; N = 663, 0.7% missing), T2 (2000; N = 601, 10% missing), T3 (2001; N = 581, 13% missing), T4 (2004; N = 506, 24.3% missing), T5 (2007; N = 467, 30.3% missing), T6 (2009; N = 426, 36.2% missing); numbers indicating participants for whom mother-reported CBCL-data were present. Data of the seventh measurement wave (2012; Mage = 18.48, SD = 1.11, range = 17-20 years) was used to assess adolescent personality pathology. At T7, 416 adolescents (51.9% girls) participated (62.3% of the total study sample).

Participants for whom mother-reported CBCL-data was available at all waves did not statistically differ from participants who had missing data on any of the waves on sex, age, or mother-reported T1 scores on the Anxious/Depressed, Aggressive Behavior and Attention Problem CBCL-scales. They differed only in maternal education level ($t(658) = -3.661$, $p < .001$), with mothers who participated at each wave of data collection being slightly higher educated than mother who did not participate at all waves of data collection (3.56 versus 3.88 on a 6-point scale).

Measures

The Dysregulation Profile (DP). Mothers completed the CBCL (Achenbach, 1991a) from T1 to T6. The three AAA syndrome scales according to the 1991 profile were used to assess the DP: Anxious/Depressed (14 items, mean α = .81; e.g., "Cries a lot"), Aggressive Behavior (CBCL: 20 items, mean α = .88; e.g., "Argues a lot"), and Attention Problems (10 items, mean α = .71; e.g., "Can't sit still, restless, or hyperactive"). Mothers were asked to rate to what extent each statement described their child's behavior in the past six months. Items were rated on a 3-point scale (0 = *not true*, 1 = *somewhat or sometimes true*, 2 = *very true or often true*). To acknowledge potential unequal contributions of the AAA-scales, a (latent) DP factor was estimated underlain by the mean observed scores of the three AAA-scales. The factor loadings of the AAA-scales onto the DP-factor were significant at all time points (all $p < .001$). Factor loadings were highest for Aggressive Behavior (mean loading over six time points = .84, range: .76-.92), then Attention Problems (mean loading = .72, range: .72-.73) and lowest for Anxiety/Depression (mean loading = .62, range: .60-.65).

Personality pathology. AT T7, adolescents filled out the Dutch translation of the adolescent self-report version of the Dimensional Assessment of Personality Pathology – Short Form for Adolescents (DAPP-SF-A; Tromp & Koot, 2012), which is derived from the Dimensional Assessment of Personality Pathology – Basic Questionnaire (DAPP-BQ; Livesley & Jackson, 2009). The DAPP-SF-A is designed for youth from 12 to 23 years of age and consists of 136 items asking adolescents to what extent a statement described them in general, for example: "I am constantly looking for adventure". Answer categories ranged from 1 (*very unlike me or not applicable*) to 5 (*very like me*). The 136 items measure 18 lower-order dimensions of personality pathology that are comparable to personality traits facets of the five DSM-5 personality pathology domains. The following DAPP dimensions are in line with the DSM-5 *Negative Affectivity* domain: Affective Instability (8 items, α = .87), Anxiety/Worry (6 items, α = .86), Identity Problems (6 items, α = .86), Insecure Attachment (6 items, α = .86), Intimacy Problems (8 items, α = .80), Oppositionality (10 items, α = .85), Self-harm (6 items, α = .87), and Submissiveness (8 items, α = .84). The DAPP dimensions Callousness (10 items, α = .83), Conduct Problems (8 items, α = .71), Narcissism (8 items, α = .80), and Rejection (8 items, α = .81) were consistent with the DSM-5 *Antagonism* domain. The DSM-5 dimension *Detachment* best described the DAPP-dimensions Restricted Expression of Emotion (8 items, α = .87), and Social Avoidance (6 items, α = .86). Finally, the DAPP-dimensions Cognitive Distortion (6 items, α = .78), and Suspiciousness (8 items, α = .86) were most in line with the DSM-5 *Psychoticism* domain.

Statistical Analyses

As Little's MCAR test indicated that data was missing completely at random, $\chi^2(766) = 819.470$, $p = .088$, missing values were imputed at scale-level (to keep the number of variables <100) using Expectation Maximization to maximize sample size (Graham, 2009; Schafer & Graham, 2002).

Cohort-sequential Latent Growth Modeling (LGM) was used to examine the developmental course of the DP from age 4 to 17 years. All analyses were performed in Mplus version 7.4 (Muthén & Muthén, 2012), using full-information maximum likelihood estimation with robust standard errors (MLR), which is robust to non-normality. Model fit was evaluated with three primary indices, the Root Mean Square Error of Approximation (RMSEA), the comparative fit index (CFI), and the Tucker-Lewis index (TLI). Values of RMSEA ≤.08 indicate acceptable fit while values ≤.05 indicate good fit. Values of CFI and TLI between .90 and .95 indicate acceptable fit, and values ≥.95 indicate good fit (Cheung & Rensvold, 2002; Hu & Bentler, 1999). Although Chi-Square is reported, it is not interpreted, as it is nearly always significant in larger samples and/or complex models (Kline, 2005).

A prerequisite to examining developmental changes in DP is measurement invariance of the Dysregulation latent factor model across cohorts, and across measurement waves. Measurement invariance was examined by increasingly constraining parameters to be equal across cohorts and consequently across measurement waves (e.g., factor loadings, intercepts, residual variances, see Van de Schoot, Lugtig, & Hox, 2012). To compare nested models for measurement invariance, changes in CFI (ΔCFI) and RMSEA (ΔRMSEA) were used as indicators for measurement invariance, as they are independent of both model complexity and sample size (Cheung & Rensvold, 2002). Values of ΔCFI ≤ 0.01 and ΔRMSEA ≤ .015 indicate that the invariance hypothesis should not be rejected (Chen, 2007; Cheung & Rensvold, 2002). Details and fit statistics of these analyses can be obtained from the first author.

To determine the developmental course of the DP, LGMs were tested. Unequal distances between measurement waves (e.g., 1 year between T1 and T2, and 3 years between T3 and T4) were accounted for by setting time scores as the difference in years between measurement waves divided by 10. This procedure for cohort-sequential latent growth modeling is recommended to avoid large time scores which can lead to convergence problems. Running the models without dividing the time scores by 10, however, led to identical conclusions regarding the shape of the growth and associations with personality pathology dimensions (Muthén & Muthén, 2012, p. 145). The first model was a "no-growth" or strict-stability model, which specified that no growth occurred over the course of the study (i.e., only an intercept factor was estimated). The second model was a linear trajectory model, in which a linear slope was estimated in addition to the intercept. In the third model, we examined whether adding a quadratic slope, indicating non-linear changes (U-shaped or inverse U-shaped), significantly improved model

fit. All models included covariances between intercept and slope factors. Satorra-Bentler scaled Chi-Square difference testing for MLR estimation was used to compare nested models, with the intercept-only model being the most restricted model nested under the other models in Table 5.2. Significant Chi-Square difference values indicate that the less restricted model provided significant incremental fit over the more restricted model (Satorra & Bentler, 2001). To determine relations between the DP and personality pathology, the lower-order DAPP-SF-A personality pathology dimensions were regressed simultaneously on the latent growth factors (intercept and slope(s)) for the latent Dysregulation factor.

RESULTS

Preliminary Analyses

Measurement invariance analyses indicated that full uniqueness (strong) measurement invariance held across cohorts and partial scalar invariance across time. Furthermore, the latent factor variances could be constrained across cohorts. Thus, the Dysregulation Profile could be measured similarly across measurement waves and cohorts. The final measurement model of the DP fitted well (χ^2 = 803.935, *RMSEA* = .066, *CFI* = .955, *TLI* = .940).

Stability of the DP

The regression coefficients of the Dysregulation Profile from wave to wave, indicating relative stability, were high. One-year stability was highest as expected: r = .88 from wave 1 to 2, and from wave 2 to 3. When time between measurement waves increased, stability decreased, although ten-year stability from wave 1 to wave 6 was still high at r = .67.

The Normative Developmental Course of the Dysregulation Profile

The first aim of the study was to investigate the developmental course of the DP from age 4 to age 17. Model comparisons using Chi Square difference testing are presented in Table 5.2, and indicate that the linear model provided a better fit than the no-growth model, and that the quadratic model further improved model fit. This conclusion was supported by improvement in fit statistics and significant means of the quadratic slope factors. Therefore, the quadratic model was selected as the final model. Examination of the modification indices showed that the few across-cohort parameter estimates differences were trivial that would not result in a substantial improvement in model fit. Chi-square difference testing showed that imposing cross-cohort constraints did not significantly worsen fit ($\Delta\chi2(27)$ = 36.310, p = .109), and only

minimally affected model fit indices, which supports convergence as the more parsimonious model in which parameters are constrained to be equal across cohorts is to be preferred (Duncan, Duncan, & Strycker, 2006). Thus, the four cohorts could be staggered to examine one developmental quadratic trajectory from age 4 to age 17.

Table 5.2. Model Fit Statistics of the No-Growth, Linear, and Quadratic Growth Models of the Dysregulation Profile

Model	x^2	*df*	*RMSEA*	*RMSEA 90% CI*	*CFI*	Difference Testing	Δx^2 *(df)*[1]	*p*
Intercept-only	988.27	542	.070	[.063 - .077]	.940			
Linear	944.94	539	.067	[.060 - .074]	.946	I vs. L	33.72 (3)	.000
Quadratic	892.99	535	.063	[.056 - .071]	.952	Q vs. L	40.25 (4)	.000

Note. [1] Satorra-Bentler adjusted Chi Square difference testing for MLR was used.

The mean intercept was fixed at 0 for all cohorts. The linear slope factor mean (M_{ls}= .173, p < .001), and the quadratic slope mean (M_{qs} = -.124, p < .001) were significantly different from 0. The quadratic developmental course of the DP (see Figure 5.1) can be described as initially increasing from age 4 to age 11 (at which estimated means of the DP were highest) followed by a decrease from age 11 to age 17 (the final age measured in this study), until reaching a slightly higher level than the starting point. There were significant individual differences in the initial level, and change rate of DP, as indicated by significant variances around the intercept (D_i = .034, p < .001), linear slope (D_s = .101, p = .019), and quadratic slope (D_s = .055, p = .031) factors. The intercept was not significantly related to either the linear slope (b = .003, p = .732) or the quadratic slope (b = -.010, p = .182), which showed that the initial level of the DP was not related to the consequent developmental course of dysregulation.

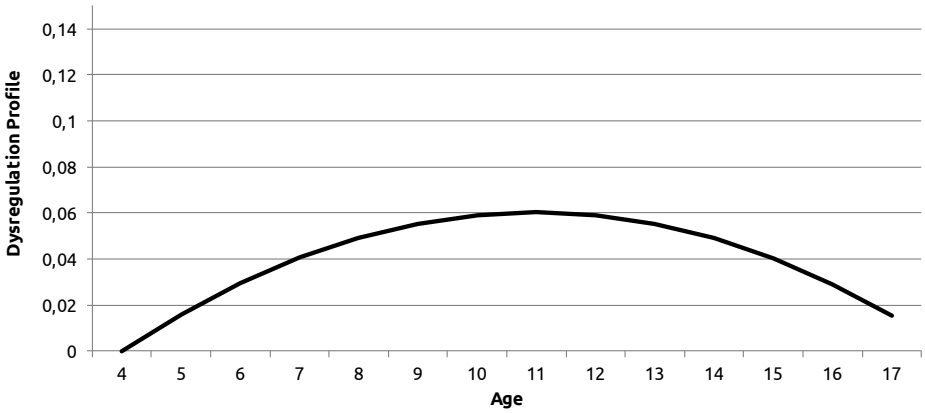

Figure 5.1. Developmental nonlinear course of latent Dysregulation Profile scores from age 4 to age 17, drawn from unstandardized estimates.

The Developmental Course of Dysregulation and Personality Pathology Dimensions

The second aim of the study was to examine whether the initial level and the rate of change in the latent DP factor from childhood to adolescence were associated with late adolescent personality pathology. Therefore, each of the DAPP-SF-A lower-order personality pathology dimensions were regressed onto the intercept, linear and quadratic slope of the DP. A conservative alpha level of .01 was adopted to correct for multiple testing and avoid Type I errors. Each of these 18 models showed adequate fit (χ^2_{range} = 974.476 – 1063.413, $RMSEA_{range}$ = .061-.067, CFI_{range} = .941-.951, TLI_{range} = .933-.945). The results of these analyses are presented in Table 5.3.

Higher mother-reported initial levels on the DP in childhood predicted higher levels of 12 out of 18 adolescent-reported personality pathology dimensions. Specifically, a higher intercept of the DP predicted higher levels of affective instability, anxiety/worry, identity problems, oppositionality, self-harm and submissiveness from the *Negative Affectivity* domain; restricted expression of emotion and social avoidance from the *Detachment* domain; compulsivity and stimulus seeking from the *Disinhibition* domain; and cognitive distortion and suspiciousness from the *Psychoticism* domain. Initial DP did not predict any personality pathology dimensions from the *Antagonism* domain (i.e., callousness, conduct problems, narcissism, and rejection), and did also not predict two of the dimensions from the *Negative Affectivity* domain (insecure attachment and intimacy problems).

Over and above associations between the intercept/initial level of DP and personality pathology dimensions, changes in DP were associated with three personality pathology dimensions of the *Negative Affectivity* domain. The linear slope was negatively related to identity problems, self-harm and submissiveness, whereas the quadratic slope was positively related to identity problems, and self-harm. As relations between the linear and quadratic factors and outcomes are to some extent confounded, relations between slope factors and outcomes should be interpreted in tandem. These results indicate that a slower (linear) increase of the DP, combined with a less pronounced (quadratic) decline of the DP, predicted higher levels of identity problems, and self-harm. In other words, for late adolescents with higher scores on identity problems and self-harm, there was a slower growth in dysregulation and less of a peak of dysregulation in early adolescence (resulting in a less steep inverted u-shape). As the quadratic slope was not significant for submissiveness, this means that for submissiveness primarily slower linear increases of the DP were predictive.

Table 5.3. Unstandardized Regression Coefficients of Intercept, Linear and Quadratic Slope of the DP on Personality Pathology Dimensions

		Intercept		Linear Slope		Quadratic Slope	
		B	*S.E.*	*B*	*S.E.*	*B*	*S.E.*
Negative Affectivity	Affective Instability	.059**	.016	-.036	.041	.041	.030
	Anxiety/Worry	.069**	.015	-.067	.039	.035	.028
	Identity Problems	.065**	.016	-.147**	.040	.096*	.029
	Insecure Attachment	-.008	.013	-.023	.039	.027	.028
	Intimacy Problems	.036	.019	.012	.052	-.006	.040
	Oppositionality	.091**	.018	-.092	.049	.074	.035
	Self-Harm	.065*	.023	-.201*	.064	.134*	.048
	Submissiveness	.082**	.019	-.149*	.054	.084	.038
Antagonism	Callousness	.032	.024	.051	.059	-.004	.042
	Conduct Problems	.036	.025	.074	.078	-.006	.057
	Narcissism	.021	.020	.053	.051	-.023	.038
	Rejection	.009	.022	.119	.052	-.036	.037
Disinhibition	Compulsivity	.056*	.019	-.014	.035	-.009	.035
	Stimulus Seeking	.057**	.016	.012	.045	.017	.033
Detachment	Restricted Expression	.080**	.018	-.065	.043	.029	.031
	Social Avoidance	.080**	.017	-.074	.042	.028	.032
Psychoticism	Cognitive Distortion	.101**	.023	-.137	.058	.070	.042
	Suspiciousness	.117**	.023	-.097	.056	.072	.038

Note. * $p < .01$. ** $p < .001$

DISCUSSION

Overall, the results demonstrate that the Dysregulation Profile is highly stable over time, but also follows a non-linear developmental course with a peak in early adolescence. The initial level of the DP at age four predicted a wide range of personality pathology dimensions in late adolescence of the Negative Affectivity, Detachment, Disinhibition and Psychoticism DSM-5 domains, but none from the Antagonism domain. In addition, rates of change of the DP were also predictive for personality pathology albeit to a much lesser extent.

The Dysregulation Profile followed a quadratic, inverse U-shaped, developmental course with, as expected, a peak in early adolescence. The DP increased from age 4 to around age 11, and then decreased, although at age 17 still (slightly) higher than at age 4. This is in contrast with research showing a general decrease of the DP from childhood to adolescence (Halperin et al., 2011), but in line with studies demonstrating a decrease of the DP from early to mid- and

late adolescence (Ayer et al., 2013; Nobile et al., 2016). Perhaps, because Halperin and colleagues (2011) started with an older sample (7-to-11 year old at the first measurement), they were not able to detect the initial increase of dysregulation from age 4 to age 11 that we found.

The DP peaked in early adolescence, a time characterized by many changes in brain, behavioral and cognitive systems at different maturity rates, resulting in increased vulnerability for emotional and behavioral problems (e.g., Becht, Prinzie, Deković, van den Akker, & Shiner, 2016; Prinzie, van Harten, Deković, van den Akker, & Shiner, 2014; Steinberg, 2005). Demands on children's impulse control and response inhibition grow in early adolescence. However, adequate regulatory competence is not yet completely developed, causing a disjuncture that has also been described as "*starting an engine without yet having a skilled driver behind the wheel*" (Steinberg, 2005, p. 70). Taken together with findings that show a similar, but mirrored, developmental course of emotional stability (Van den Akker et al., 2014), early adolescence might especially be a time in which children have trouble regulating affect, behavior and cognition. Our, and other findings (Ayer et al., 2013; Nobile et al., 2016), indicate that a decrease of the Dysregulation Profile from early to late adolescence is normative. There were however significant interindividual differences in the rate of change, suggesting that some youngsters might remain high, or even increase in dysregulation during this developmental period. These youngsters might warrant clinical attention. Future research in larger samples could aim to examine these interindividual differences.

The Developmental Course of the Dysregulation Profile and Personality Pathology

In line with our expectations, higher initial levels of mother-reported DP at age four predicted 12 out of 18 adolescent-reported personality pathology dimensions from the Negative Affectivity, Detachment, Disinhibition and Psychoticism DSM-5 domains. In addition, the change of the DP over time predicted three Negative Affectivity personality pathology dimensions, therefore both the initial levels as well as the patterns of change are important.

The wide range of personality pathology dimensions in late adolescence (17-21) predicted by initial levels of the DP at age four is especially significant given that different informants were used to report on the DP (mothers) as on personality pathology (adolescents), and the significant time span (13 years) between assessment of the initial level of the DP and personality pathology (vs. 4 years in De Caluwé et al., 2013). Our findings therefore strengthen the idea that childhood dysregulation is a developmental precursor for personality pathology.

When we look more closely at associations between the initial level of the DP at age four and the 18 lower-order personality pathology dimensions measured in late adolescence, several findings are worth discussing in more detail. First, although the initial level of the DP predicted

12 out of 18 lower-order personality pathology dimensions: none from the Antagonism domain were predicted by the DP. Although previous research had found links between the DP and antagonistic traits such as callousness and narcissism (De Caluwé et al., 2013; Masi, Muratori, et al., 2015), other research had described the aggressive component of the DP to be mostly emotionally-driven and reactive (Althoff et al., 2012; Leibenluft, 2011). Given that the DP did predict dimensions such as anxiety, social avoidance, and sensation seeking, our findings are very much in line with the idea that children with dysregulation might enter new situations readily but once in them, feel frightened, shy, and uncomfortable (Althoff et al., 2012), which might lead to aggressive outbursts. As our study used a population-based sample instead of (enriched) clinical samples (De Caluwé et al., 2013; Masi, Muratori, et al., 2015), it might be that the predictive validity of the DP for antagonistic behaviors is limited to clinical samples focused on externalizing behaviors. Future research could further examine the distinction between reactive and proactive aggressive behavior in relation the DP. Another potential explanation of the lack of associations between the DP and personality pathology dimensions from the Antagonism domain might be that we used adolescents self-reports rather than parent-reports (as in De Caluwé et al., 2013; Masi, Muratori, et al., 2015), and social desirability might lead to under-reporting of antagonistic traits. However, adolescents have been found to be reliable reporters of psychopathic-like traits (Vahl et al., 2014), and self-reports of callous-unemotional traits have been found to show incremental value over maternal rated callous-unemotional traits (Decuyper, De Caluwé, De Clercq, & De Fruyt, 2014). Furthermore, parent and adolescents were not found to disagree more on the DAPP-dimensions representing Antagonism than on other dimensions (Tromp & Koot, 2010).

Regarding the Disinhibition domain, the DP predicted not only sensation seeking but also compulsivity, which can be explained through shared deficits in self-regulation of cognitions and behaviors. Previous research demonstrating links between the DP and obsessive-compulsive symptom severity (McGuire et al., 2013), and the notion that children with dysregulation were more often diagnosed with Obsessive- compulsive Disorder (Caporino et al., 2016), had suggested that engagement in compulsive rituals and obsessive thinking might increase frustration, attention problems, and anxiety when rituals cannot be executed. Future research could focus more specifically on the role of dysregulation in compulsivity.

Whereas previous research was inconclusive about whether the DP predicted personality pathology dimensions from the Psychoticism domain, concerned with odd, eccentric, and unusual behaviors and cognitions, in our study initial levels of the DP actually most strongly predicted cognitive distortion and suspiciousness in late adolescence. These findings are interesting in the light of previous research on a general factor of psychopathology ('p factor'), that similar to the DP, can be seen as a vulnerability marker describing liability to developing

psychopathology in general (e.g., Caspi et al., 2014). Thought problems appeared to be core symptoms of this a general psychopathology factor (e.g., Laceulle et al., 2015), and previous research indicating links between the DP and thought problems (e.g., Biederman et al., 2012) suggests that the DP might be similarly constructed.

In line with previous research (De Caluwé et al., 2013), the DP did not predict intimacy problems and insecure attachment. These personality pathology dimensions, characterized by fear of losing significant others, fear for (sexual) intimacy and avoidance of romantic relationships, might not have been fully developed yet in adolescence. Especially for Intimacy Problems, questions concerned romantic relationships and sexual experiences. The relative lack of experience of adolescents in these domains might have affected the assessment of intimacy problems. Psychometric analyses have furthermore shown that the Intimacy Problems scale had low test-retest reliability and poor accuracy (Tromp & Koot, 2012). Future research should examine DP in relation to these aspects of personality pathology in an adult sample and perhaps with different measures.

In addition to long-term predictive effects of initial levels of DP (at age 4 years) on personality pathology dimensions (measured more than 13 years later), rates of change in DP were also associated with personality pathology, although only with 3 out of 18 dimensions. Slower initial increases of the DP combined with less pronounced declines in the DP, predicted higher levels of identity problems, self-harm, and submissiveness. This suggests that a flatter developmental course of dysregulation is associated with an increased risk for the development of identity problems (poorly developed sense of self), self-harm (deliberate self-injury and suicidal thoughts) and submissiveness (dependent and non-assertive behavior). These results give rise to the question whether a less distinct peak of dysregulation in early adolescence is related to avoidance of emotional experience, as links between emotional avoidance and self-harm, identity problems and submissiveness have been reported before (e.g., Chapman, Gratz, & Brown, 2006).

Although the sample as a whole showed a nonlinear developmental course of the DP, the relative ranking of the individuals remained fairly stable over time. That is in line with previous reports on the high stability of the DP, potentially due to its neurobiological and genetic underpinnings (e.g., Boomsma et al., 2006). This might explain that when predicting personality pathology dimensions simultaneously from the initial level at age four, and the rates of change, the initial level emerged as the strongest predictor. Another potential explanation is that because we used a community sample, clinical levels of dysregulation and personality pathology are expected to be relatively low. It might be that more extreme, clinical deviations of normative dysregulation are more predictive for long-lasting personality pathology. Deviations from the normative trajectory of dysregulation might also be impacted by proximal, contextual factors

such as child maltreatment and victimization, which in turn might strengthen relations between the DP and personality pathology. Our findings however do indicate that it is informative to look beyond measuring DP at one time point and to consider change as well.

Clinical Implications and Suggestions for Future Research

Our findings indicate that child self-regulation difficulties in early childhood measured with the CBCL-Dysregulation Profile are a developmental precursor to personality pathology in late adolescence. Personality pathology, or enduring patterns of trouble regulating cognition, emotion, and behavior, already carries a considerable burden of disease in adolescence, reflected in high societal costs and lower quality of life (Feenstra et al., 2012). Therefore, it is deemed highly important to help youth with dysregulation problems from developing enduring personality pathology. Given that the DP at age 4 already strongly predicted personality pathology in late adolescence, our findings underscore the clinical relevance of early screening and treatment of dysregulation. Early screening for dysregulation might inform early intervention and consequently help youth from developing maladaptive pathways of dysregulation and eventually personality pathology. Given that the Dysregulation Profile can identify difficulties in self-regulation using only three scales of an established and often used instrument, this profile has much potential to be used as a screening instrument.

The heightened risk of engagement in alcohol, drug, cigarette, and marijuana use that has been reported for the DP (e.g., De Genna, Larkby, & Cornelius, 2013; Wilens, Martelon, Anderson, Shelley-Abrahamson, & Biederman, 2013), might be explained by the increased need for sensation seeking that was found in relation to the DP. Potential avenues for prevention of risk behavior resulting from dysregulation might therefore be to train inhibition capacities, or to redirect adolescents need for sensation seeking to less harmful behaviors such as sports.

To the best of our knowledge, no other studies have operationalized the DP as a latent variable underlying mother-reported Anxiety/Depression, Aggressive Behavior and Attention Problems. However, there are many studies adopting a similar dimensional approach in which scale scores (either raw scores or T-scores) of the Anxious/Depressed, Aggressive Behavior and Attention Problems are summed (e.g., Holtmann, Buchmann, et al., 2011; Hudziak et al., 2005; McGuire et al., 2013). This is a comparable approach to modeling a latent variable underlying these scale scores, but our approach has the advantage of incorporating different weights of the scales into the Dysregulation latent factor. Ideally however, we would have used bifactor longitudinal modeling, as previous research showed that the bifactor DP model was to be preferred (Deutz et al., 2016; Geeraerts et al., 2015). Unfortunately, however, conducting longitudinal bifactor latent growth modeling of the 44-item CBCL-DP over six waves of data collection was not possible in our cohort-sequential design of four cohorts, as our sample size

was too low for the number of parameters to be estimated with longitudinal bifactor modeling. Future research, in large longitudinal studies which do not employ a cohort-sequential design, could use a bifactor approach to get the purest possible domain-scores for dysregulation.

A potential important avenue for further research would be to examine whether training of young children's self-regulatory abilities or provision of more external regulatory guidance by parents and teachers for children with dysregulation problems, could decrease dysregulation and subsequent risk of personality pathology later in life. Also, examining potential moderators of the associations between the DP and personality pathology is necessary to identify potential targets for intervention.

As generally agreement between parents and teachers on children's emotional and behavioral problems is moderate, especially for less visible internalizing behaviors (e.g., Rescorla et al., 2014), the developmental course of the DP should be replicated with other reporters. In addition, although our study examined the development of the DP across a considerable age span (4 to 17), future research could extend the age span to examine to include toddlerhood and emerging adulthood as important developmental phases characterized by dysregulated behavior. The DP might have its roots in infant and toddler regulatory problems such as excessive crying and feeding problems (Winsper & Wolke, 2014). It would be clinically relevant to explore if such regulatory problems in infancy and toddlerhood are predictive for personality pathology.

Conclusion

This study demonstrated that the normative development of the Dysregulation Profile follows a nonlinear pattern in which the DP peaks in early adolescence. Initial levels of the DP at age four, predicted over the period of 13 years a wide range of personality pathology dimensions, characterized by the regulation of affect (e.g., affective lability), behavior (e.g., oppositionality), and cognition (e.g., cognitive distortion). The lack of associations between the DP and antagonistic dimensions of personality pathology such as callousness contributes to the validation and understanding of the construct of DP. Our study furthermore confirms the notion that the DP is not a marker for a specific personality disorder (such as bipolar disorder), but is a vulnerability profile, that potentially is a broad developmental precursor of personality pathology. This study therefore contributes to the validity of the DP as a broad syndrome of not only emotional, but also behavioral and cognitive dysregulation.

CHAPTER 6

Underlying Psychophysiology of Dysregulation: Resting Heart Rate and Heart Rate Reactivity in Relation to Childhood Dysregulation

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AUTHOR CONTRIBUTIONS

M. Deutz and S. Woltering conceptualized the study, H. Vossen, M. Deković, A. van Baar and P. Prinzie provided feedback. M. Deutz analyzed the data and wrote the manuscript. S. Woltering collected the data. S. Woltering, H. Vossen, M. Deković, A. van Baar and P. Prinzie provided feedback on the analyses and manuscript.

ABSTRACT

Objective: High co-occurrence of externalizing and internalizing problems may underlie inconsistent findings regarding the relation between heart rate and psychopathology. In this study, heart rate measures are examined in relation to a general dysregulation profile, studied from both a variable- and person-centered approach.

Method: The sample (N = 182) consisted of 8-12-year-old children referred for externalizing behaviors and typically-developing children (M_{age} = 9.70, SD = 1.26, 75.8% boys). Resting heart rate (HR_{rest}) was assessed during a 3-minute resting period. Heart rate reactivity ($HR_{reactivity}$) was assessed during an emotionally evoking Go/No-Go task.

Results: From a variable-centered approach, a bifactor model was fitted with a general factor of dysregulation underlying symptoms of anxiety/depression, aggression and attention problems. HR_{rest} was positively associated with dysregulation and specific aggression. From a person-centered approach, a latent profile analysis was used to identify different psychopathology classes: normative (n = 92), predominantly-aggressive (n = 69) and dysregulated (n = 14). The latter was characterized by co-occurring elevated levels of anxiety/depression, aggression and attention problems. HR_{rest} was elevated in the predominantly-aggressive class and $HR_{reactivity}$ was elevated in the dysregulated class.

Conclusions: High HR_{rest}, or (trait-like) overarousal seems to be associated with dysregulation rather than uniquely with low externalizing or high internalizing symptomatology. Additionally, HR_{rest} predicted higher aggression and HR_{rest} was elevated in the predominantly-aggressive class. High $HR_{reactivity}$, or enhanced emotional reactivity, might be characteristic for a clinically relevant dysregulated subgroup. Assessment of heart rate could provide additional knowledge on individual differences that can help refine diagnostics and intervention efforts.

INTRODUCTION

The autonomic nervous system (ANS), one of the main human stress regulating systems, indexes physiological reactivity, and is considered a major component of emotion regulation (Appelhans & Luecken, 2006; Kreibig, 2010). ANS dysfunction is evident in many psychiatric disorders, but it is unclear to what extent associations are general or specific to certain forms of psychopathology. Such knowledge could however elucidate underlying mechanisms of psychopathology. Two main indices of ANS functioning have been studied in relation to psychopathology: (1) resting heart rate (HR_{rest}), i.e., the amount of heart beats per minute (bpm) when a child is in a relaxed position and without distractions, reflecting relatively stable individual differences in baseline (trait-like) levels of arousal, and (2) heart rate reactivity ($HR_{reactivity}$), i.e., the amount of change in heart rate in response to a stressor (usually referring to increasing arousal from baseline, indexing individual differences in emotional reactivity, or (state-like) arousal in response to experimental stimuli (Kagan, Reznick, & Snidman, 1987; Lorber, 2004; Ortiz & Raine, 2004; Raine, 2002).

Lower HR_{rest} has often been associated with externalizing behaviors (e.g., aggressive, antisocial, conduct problems, see: Lorber, 2004; Ortiz & Raine, 2004; Portnoy & Farrington, 2015) and higher HR_{rest} with internalizing behaviors (e.g., anxiety, posttraumatic symptoms, see: Dietrich et al., 2007; Kagan et al., 1987; Latvala et al., 2016; Monk et al., 2001; Rogeness, Cepeda, Macedo, Fisher, & Harris, 1990). $HR_{reactivity}$ has been studied far less, with available evidence suggesting that lower $HR_{reactivity}$ is related to aggression and delinquency (Bimmel, van IJzendoorn, Bakermans-Kranenburg, Juffer, & De Geus, 2008; Fairchild et al., 2008; Herpertz et al., 2005; Popma et al., 2006; Sijtsema et al., 2013; Williams, Lochman, Phillips, & Barry, 2003), whereas higher $HR_{reactivity}$ has been linked to internalizing symptoms (Matthews, Manuck, & Saab, 1986; Rozenman, Sturm, McCracken, & Piacentini, 2017). These findings are often explained in terms of over- and under-arousal. Aggressive children are thought to be under-aroused, which they experience as an unpleasant state, prompting them to seek stimulating activities (sensation seeking theory; Eysenck, 1979), and not fearing the social consequences (e.g., punishment, rejection) of their aggressive actions (fearlessness theory; Raine, 1997). In contrast, disorders from the internalizing spectrum, such as anxiety, are thought to indicate behavioral (over-) inhibition (Kagan et al., 1987; Woltering & Shi, 2016) or enhanced stress reactivity (Monk et al., 2001), which could be expressed as 'over-aroused' fear and anxiety.

This field of research however has suffered from inconsistencies, with numerous studies failing to find divergent autonomic patterns for externalizing and internalizing behaviors (Bimmel et al., 2008; Dierckx et al., 2014; Posthumus, Böcker, Raaijmakers, van Engeland, & Matthys, 2009; Scarpa, Haden, & Tanaka, 2010; van Hulle, Corley, Zahn-Waxler, Kagan, & Hewitt, 2000). One potential explanation for these conflicting findings is that whereas externalizing

and internalizing behaviors are often considered as opposite ends of a spectrum, in reality, they are strongly related. Children who present co-occurring externalizing and internalizing behavioral problems are the norm rather than the exception (Achenbach et al., 2016; Rhee et al., 2015). These children have recently been described as 'dysregulated' (Althoff, 2010), as they are thought to have self-regulatory deficits across multiple domains (i.e., affect, attention, and behavior; Althoff, 2010; Althoff, Verhulst, et al., 2010; Ayer et al., 2009). The Child Behavior Checklist - Dysregulation Profile (DP; Ayer et al., 2009) is increasingly used to describe co-occurring affective, behavioral and cognitive dysregulation. The DP cuts across categorical disorders such as Attention Deficit Hyperactivity Disorder (ADHD) and Oppositional Defiant Disorder (ODD) as diagnosed using the Diagnostic Statistical Manual (DSM; American Psychiatric Association, 2013). Therefore it fits well within recent efforts to describe psychopathology dimensionally in terms of dysregulation and dysfunction (Research Domain Criteria, RDoC; Yee, Javitt, & Miller, 2015). One of the hallmarks of the RDoC project is examining the underlying physiology of psychopathology to better understand underlying mechanisms and eventually improve children's outcomes by improving diagnostics and intervention efforts (Sonuga-Barke, 2014). While physiological studies are challenging to conduct in childhood samples, let alone in clinically referred samples, such studies are essential for enhancing insights into (neurobiological) mechanisms of childhood psychopathology. As physiological measures might reveal unique insights into children's emotional functioning, it is valuable to examine physiology early in development when early intervention could potentially deter children from chronic problematic developmental trajectories.

Variable- and Person-Centered Approaches to Study Dysregulation

Dysregulation has been studied from both a variable-centered and a person-centered approach, using mostly three key syndrome scales (Anxious/Depressed, Aggressive Behavior and Attention Problems), from both the externalizing and internalizing domains of the Child Behavior Checklist (Althoff, 2010; Althoff, Verhulst, et al., 2010; Ayer et al., 2009). Variable-centered analyses focus on relations among variables within a given population. Our previous variable-centered work (Deutz et al., 2016; Geeraerts et al., 2015) demonstrated that a bifactor model (see Figure 6.1) best described the DP. In this bifactor model, a general factor of dysregulation reflects what is common among symptoms from both the externalizing and internalizing spectrum. Three additional specific factors of anxiety/depression, aggression, and attention problems (representing the three DP-scales; Deutz et al., 2016; Geeraerts et al., 2015), explain the unique coherence among the items within these scales. A bifactor model might be especially useful in determining specificity of HR_{rest} and $HR_{reactivity}$ in relation to psychopathology, as links with

specific anxiety/depression, aggression, and attention problems, as well as general underlying dysregulation can be estimated simultaneously. As such, the bifactor model might help clarify previously reported inconsistencies in links between ANS functioning and psychopathology.

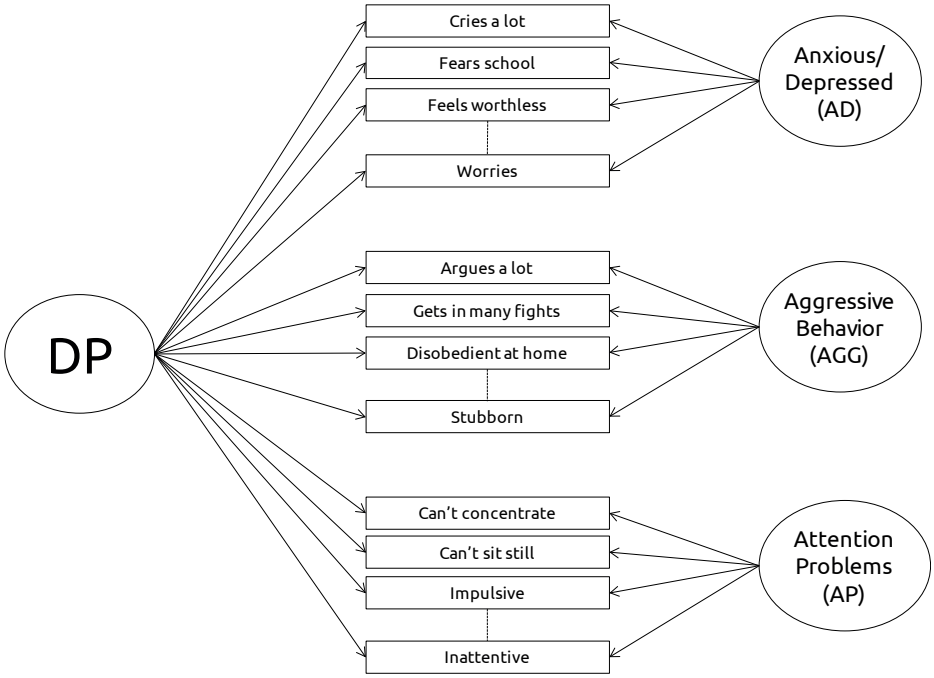

Figure 6.1. Graphical representation of the bifactor Dysregulation Profile (DP) model.

In addition to a variable-centered approach, dysregulation has been operationalized from a person-centered approach, in which groups (classes) are revealed of individuals with similar profiles on certain variables. Latent profile analysis has been used to derive homogeneous subgroups (or classes) with different psychopathology profiles, such as youths with normative scores on all scales, youths with elevated scores within the externalizing or internalizing domain only, and youths with co-occurring externalizing and internalizing problems. The latter group is often being referred to as 'dysregulated' (Althoff, Verhulst, et al., 2010; De Caluwé et al., 2013), since these children display concurrent disturbances in regulating attention, behavior and mood (Althoff, 2010; Althoff, Verhulst, et al., 2010). Latent profile analysis is a person-centered approach that results in empirically derived distinct groups (classes) with similar profiles on several variables. This empirical and holistic person-centered approach is of high clinical and practical use as it acknowledges heterogeneity within the population by identifying clusters

of children with similar psychopathology patterns that might show divergent patterns of ANS dysfunction and potentially benefit from different or differentiated treatments.

Thus, variable- and person-centered operationalizations of dysregulation have distinct theoretical bases. The variable-centered approach to psychopathology focuses on commonalities between different forms of psychopathology and with a complementary person-centered approach, we look for subgroups of children characterized by similar psychopathology patterns. Applying both approaches in one study to may result in a richer and more comprehensive understanding of ANS dysfunction and dysregulation. Summarizing, the present study examined two different measures of ANS functioning, HR_{rest} and $HR_{reactivity}$ in relation to dysregulation from both a variable-centered approach (DP bifactor model) and a person-centered approach (latent profile analysis) in a predominantly clinically referred sample of children aged 8-12. As the DP has been found to be highly stable and heritable (Boomsma et al., 2006; Deutz, Vossen, et al., 2018), examining markers of ANS functioning might help explain etiology of dysregulation versus more specific forms of psychopathology. For the variable-centered approach, we expected that HR_{rest} and $HR_{reactivity}$ would be positively associated with general dysregulated psychopathology and specific anxiety/depression, and negatively with specific aggressive behavior and attention problems. For the person-centered approach, we expected to identify a group of dysregulated children that would show elevated HR_{rest} and $HR_{reactivity}$ and a group of 'predominantly-aggressive' children that would show lower HR_{rest} and $HR_{reactivity}$ (as well as a normative group with scores in between).

METHOD

Sample

Data were derived from a larger study (2004-2012) on individual differences in neural and psychophysiological correlates of self-regulation (Woltering, Granic, Lamm, & Lewis, 2011; Woltering, Lishak, Elliott, Ferraro, & Granic, 2015). The study was approved by the Research Ethics board of the University of Toronto. Children aged 7-12 (n = 117) referred for externalizing behavior by mental health professionals, teachers and/or parents were recruited from two community mental health agencies in Canada. Additionally, (generally) typically-developing children aged 7-18 (n = 103) were recruited through newspaper ads. Parents and children lacking sufficient English language skills, and children with significant cognitive impairment were excluded. Children aged 7 years or 13 or older were excluded to have a more homogenous age group of children aged 8-12, representing middle childhood.

The final study sample consisted of 182 children (M_{age} = 9.70, SD = 1.26, 75.8% boys), of whom 115 were clinically referred (63.2%) and 67 were recruited through newspaper ads (36.8%).

Children lived mostly with both biological parents (40.9%) or with their mother only (35.2%). The sample was relatively diverse in terms of race, with the majority being Canadian-European (62.3%), and African/Caribbean-Canadian being the second largest group (15.4%). Educational levels for mothers and fathers respectively were 33%/41.9% high school or less, 33.5%/26.4% community college, and 30.7%/29.5% university degree or higher. A social adversity index was created (similar to Raine, Fung, Portnoy, Choy, & Spring, 2014) with one point each for father uneducated (no high school diploma, 13.7%, with 29.7% missing), mother uneducated (no high school diploma, 12.1%, with 3.3% missing), low income (annual income <40.000 Canadian dollars, 38.5%, with 6.6% missing), and child living with both parents vs other (57.1%, with 3.3% missing).

All measures reported in this study were taken 2 weeks before the start of treatment (a combined parent management and child-focused cognitive behavioral therapy). At this time, 44 of the clinically referred children (24.2% of all children, data were missing for 10 participants) received psychopharmacotherapy, mostly stimulants (n = 31).

Procedure

Children visited the university research lab with their mother where parental consent and child assent were obtained. Children first completed a series of computer tasks (see Woltering, Lishak, Hodgson, Granic, & Zelazo, 2016), while mothers completed questionnaires. Next, children and their mothers discussed neutral and emotional issues (reported in Woltering, Lishak, et al., 2015). They were asked to discuss, in this exact order, a randomly assigned - positive topic out of two topics ("You will be taken to live on an island paradise that has nothing on it - you can take anything you want with you - use your imagination to talk about what you would take"; "you have won the lottery, what are you both planning to do with the money?"); a personally relevant negative topic that both the parent and child independently listed using a modified version of the Issues Checklist (Robin & Weiss, 1980) that was anger-provoking and had not been resolved, and lastly, iii) another positive topic. Two minutes before the end of the discussions, a research assistant knocked on the door and reminded the subjects that there were two minutes left and that they should "try to end on a positive note" (which was also explained to participants beforehand). During these discussions both mother and child were connected to the ECG acquisition unit, but heart rate data collected during these discussions was not used in the present study (see Woltering, Lishak, et al., 2015 for more details). After a brief break of several minutes, the researcher would ensure good connectivity of the equipment and explain the HR_{rest} procedure. Following another short break, ECG measures were continued, and children were fitted with an electroencephalography (EEG) net (results not reported in this study) and seated in front of a computer to complete a Go/No-Go-task (Woltering et al., 2016). From this task, $HR_{reactivity}$ was derived.

Measures

Child Behavior Checklist - Dysregulation Profile. Dysregulation was assessed with the Child Behavior Checklist - Dysregulation Profile (CBCL-DP), consisting of items from the Anxious/Depressed (13 items, α = 84), Aggressive Behavior (18 items, α = .94), and Attention Problems (10 items, α = .89) scales from the Child Behavior Checklist (Achenbach, 1991a), using the 2007 scale assignments. T-scores were computed following Achenbach (1991a).

Early Adolescent Temperament Questionnaire – Revised. To validate the person-centered latent profile solution, mean scale scores derived from parent-reported the Early Adolescent Temperament Questionnaire – Revised (EATQ-R; Capaldi & Rothbart, 1992) were used. The EATQ-R consists of 62 items divided into 10 scales: Activation Control (7 items, α = .82), Affiliation (6 items, α = .70), Aggression (7 items, α = .82), Attention (6 items, α = .84), Depressive Mood (5 items, α = .76), Fear (6 items, α = .52), Frustration (6 items, α = .80), Inhibitory Control (5 items, α = .71), Shyness (5 items, α = .83), and Surgency (9 items, α = .62).

Physiology Measures. A BIOPAC MP150 psychophysiological recording system Biopac Systems Inc., Goleta, CA) was used to acquire ECG data at a sampling rate of 1000 Hz. Electrodes were positioned diagonally across the heart according to a standard Lead II configuration. Data were processed with ANSLab software (Wilhelm, Grossman, & Roth, 1999) and scored in 1-minute intervals.

Resting heart rate. HR_{rest} was measured during a three-minute resting period following a 14-minute period of mother-child discussions. During these discussions both mother and child were connected to the ECG acquisition unit; heart rate data collected during these discussions was not used in the present study (see Woltering, Lishak, et al., 2015). The protocol for the mother-child discussions was completed by 118 mother-child pairs (64.8%). After 35 participants completed the study, HR_{rest} assessment was added to the study, data thus being available for 83 participants (45.6%). After a small break, children were told to relax and sit still in a chair in an observation room with the parent present during which HR_{rest} was assessed. Video recordings were coded for movements, talking or other behaviors that might affect the HR assessment. The large majority of children were sitting quietly and calmly during the 3 minutes. One child was reluctant to participate and kicked feet and yelled, after which the assessment was stopped. For this child, available HR_{rest} was recoded into missing. Paired-samples t-tests indicated that mean HR did not differ significantly between the one-minute segments and were highly stable (rs > .95). Mean bpm for HR_{rest} was 88.92 (Range = 65.17 – 121.81, SD = 10.80). HR_{rest} did not significantly differ across sex ($t(80) = -.1484$, $p = .142$) or medication status ($t(71) = -1.220$, $p = .227$).

Heart rate reactivity. $HR_{reactivity}$ was assessed during an adapted version of a previously developed emotion induction Go/No-Go task (Stieben et al., 2007). The task was programmed using E-Prime software (Psychological Software Tools, Pittsburgh, PA). Children were shown a

series of letters and were instructed to press a button on a response pad with their index finger as fast as possible whenever a letter appeared on the screen (the Go condition) and withhold responding when the same letter appeared twice in a row (the No-Go condition). To ensure engagement and motivation, children received performance feedback periodically on-screen, and were told beforehand that if they accumulated enough points they could pick a prize (such as large action figures). A practice block was followed by three blocks (A, B, C), that each lasted three minutes. A dynamic adjustment of stimulus times based on performance was used in order to make the task challenging for all ages (for more details, see Woltering et al., 2016). In block A (200 trials, 66 No-Go trials) children steadily gained points, in block B (150 trials, 40 No-Go trials) they immediately began losing all or almost all their points (intended to induce negative emotion) because of a change in the point-adjustment algorithm and reduced stimulus times (as such, the task deviated from the typical Go/No-Go task in which generally no manipulation takes place). In block C (200 trials, 66 No-Go trials), the algorithms went back to normal and children were awarded their prize (see Supplement C1 in Appendix C). Analysis of manipulation checks confirmed that the Go/No-Go task was emotionally evoking as Block B (when children lost all their points) perceived negative emotions significantly increased and positive emotions decreased (see Figure C1 in Appendix C).

$HR_{reactivity}$ data was available for 149 participants (81.9%). HR increased significantly from 87.91 bpm in block A to 88.68 bpm in block B ($t(146) = -2.980$, $p = .003$) and then to 91.11 bpm in block C ($t(145) = -9.468$, $p < .001$). The difference between HR in the first minute of block B (the emotion induction block) and the last minute of block B (when participants were typically losing all their points and were most upset) was taken as an indication of $HR_{reactivity}$, with higher scores indicating a greater increase in HR during Block B suggesting greater $HR_{reactivity}$, a procedure in line with a previous study on this sample (Woltering et al., 2016). $HR_{reactivity}$ did not significantly differ across sex ($t(144) = .965$, $p = .336$) or medication status ($t(144) = -1.805$, $p = .073$).

RESULTS

Variable-Centered Approach

Bifactor Model. Using confirmatory factor analysis in Mplus 8 (Muthén & Muthén, 2017) with the WLSMV estimator for categorical indicators, a bifactor model (see Deutz et al., 2016) was estimated using available item-level CBCL data ($n = 160$, 12.1% missing). Each item loaded on a general Dysregulation Profile factor (DP) and on one orthogonal specific factor of Anxious/Depressed (AD), Aggressive Behavior (AGG), or Attention Problems (AP), see Figure 6.1. Fit indices for this model were good ($\chi 2(738) = 977.513$, $RMSEA = .045$, $CFI = .966$, $TLI = .963$). Based on

inspection of modification indices, item 41 'Impulsive or acts without thinking' (part of AP) was allowed to cross-load on AGG, which significantly improved model fit, $\Delta\chi2(1) = 22.482$, $p < .001$. Model fit indices for the final model were: $\chi2(737) = 952.964$, *RMSEA* = .043, *CFI* = .970, *TLI* = .966. Factor loadings (see Table C1 in Appendix C) on the general DP-factor were all significant (most >.60). Factor loadings on the specific factors were generally lower, and 10 out of 41 loadings (of which 7 for AGG) were not statistically significant. Factor scores were subsequently saved to use as input for regression analyses.

Regression Analysis. Children with and without either HR_{rest} or $HR_{reactivity}$ data did not differ significantly on age, sex, social adversity,factor scores from the bifactor DP, or CBCL T-scores. Therefore, regression analyses were conducted in Mplus 8 with saved factor scores using full information maximum likelihood (fiml), to optimally handle missing data and utilize the full sample. Bootstrapping (5000 replications) was used for all analyses because of relatively low sample size. HR_{rest} and $HR_{reactivity}$ were examined as predictors of DP, AD, AGG, and AP factor scores from the DP bifactor model (simultaneously) (Table 6.1).

Table 6.1. Regression Coefficients and Standard Errors (STDYX standardized) of HR_{rest} and $HR_{reactivity}$ Predicting Factors in the Dysregulation Profile (DP) Bifactor Model

	DP		AD		AGG		AP	
Sex	-.157*	(.079)	.089	(.076)	-.199*	(.085)	-.167	(.087)
Age	-.036	(.075)	-.003	(.083)	-.072	(.080)	-.116	(.070)
Social Adversity Index	.257**	(.076)	.092	(.080)	-.037	(.084)	.108	(.088)
Medication Status	.310***	(.083)	.061	(.095)	.108	(.104)	.148	(.086)
HR_{rest}	.285*	(.119)	-.217	(.136)	.342**	(.115)	.060	(.125)
$HR_{reactivity}$	-.011	(.089)	.044	(.109)	.081	(.103)	-.022	(.093)

Note. DP = Dysregulation Profile, AD = Anxious/Depressed, AGG = Aggressive Behavior, AP = Attention Problems (these all refer to factor scores derived from the bifactor DP model)
Note. $*p < .05$, $**p < .01$, $***p < .001$

Regarding the covariates, sex negatively predicted DP and AGG, meaning that boys had higher (factor) scores on these variables. Higher social adversity predicted higher DP only. Medication use predicted higher DP. Controlling for covariates, higher HR_{rest} predicted higher DP, and, also higher AGG. $HR_{reactivity}$ was not a significant predictor for DP, AD, AGG, or AP. HR_{rest} and $HR_{reactivity}$ were not significantly related ($r = -.005$, $p = .963$), and consequently results did not differ when HR_{rest} and $HR_{reactivity}$ were examined separately. Covariates did not affect patterns of results. R-square values were .298 for DP ($p < .001$) and .186 for AGG ($p < .05$). No significant variance was explained in AD (.062, $p = .267$) or AP (.085, $p = .096$). Cohen's f^2 effect size values (calculated as R^2 divided by 1- R^2) were small for AD (.07) and AP (.09), medium for AGG (.23) and large for DP (.42). As suggested by an anonymous reviewer, we did post-hoc analyses to examine whether

sex interacted with HR_{rest} and $HR_{reactivity}$ in predicting psychopathology in the variable-centered approach. No significant interactions with sex emerged.

Person-Centered approach

Latent Profile Analysis. To examine whether, and how many, homogeneous latent subgroups with different psychopathology profiles could be distinguished, latent profile analysis (LPA) was performed. Continuous T-scores for the Anxious/Depressed, Aggressive Behavior and Attention Problems scales (n = 175, 3.8% missing) were used rather than item-level data because of sample size limitations. Given high intercorrelations between the CBCL T-scores, covariances among latent profile indicators were allowed. Model fit was evaluated with the Lo-Mendell-Rubin (LMR) test, with significant values indicated better fit compared to a model with k-1 profiles (Lo, Mendell, & Rubin, 2001), lower values on the sample size adjusted Bayesian Information Criterion (adjBIC), and entropy levels of .80 or higher. LMR-results indicated that a 3-class solution fit best statistically, and had good entropy (.90), and lower AdjBIC values (3751.323) than a 1-class (3807.037) and 2-class solution (3783.682). Although the 4-class solution showed lower AdjBIC (3746.611), results of the LMR-test indicated that the 4-class solution fits significantly worse (p-value of the LMR-test was .108). As the 4-class solution also consisted of two very small classes (of 9 and 4 participants), the 3-class solution was chosen as the final solution. The classification of individuals in the 3-class solution was good as the average probabilities for the most likely class were high enough (>.924) and probabilities for the other two classes were low enough (<.076).

A graphic representation of the classes is presented in Figure 6.2. The largest class (n = 92), with mean T-scores in the normative range on AD, AGG and AP, was referred to as the *normative class*. The second largest class (n = 69), had mean T-scores in the clinical range for AGG, subclinical for AP, and normative for AD, and was labeled the *predominantly-aggressive class*. The third class (n = 14), had mean T-scores in the clinical range for AD, AGG, and AP, and was labeled the *dysregulated class*, in line with previous studies (Althoff, Ayer, et al., 2010; De Caluwé et al., 2013).

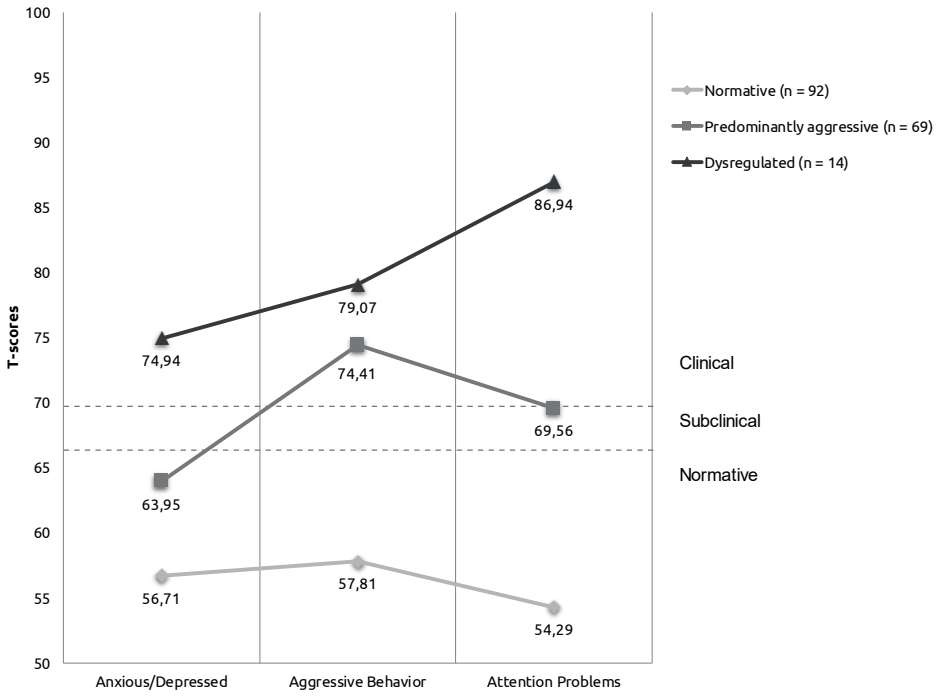

Figure 6.2. Graphical Representation of Average T-scores of the Anxious/Depressed, Aggressive Behavior and Attention Problems Syndrome Scales of the Child Behavior Checklist, Graphed for the Three Latent Profile Groups.

To examine the validity of the latent profile solution, the three classes were compared on means on 10 temperament dimensions (see Figure 6.3). The three classes did not differ significantly on affiliation, shyness and surgency. For five scales, the three classes all differed significantly from each other: with dysregulated children scoring highest on depressive mood, fear and frustration and lowest on activation control and attention. The predominantly-aggressive and dysregulated classes did not differ significantly on aggression and inhibitory control. These results confirm the validity of the profile solution since the degree of adjustment of the three classes was normative > predominantly-aggressive > dysregulated.

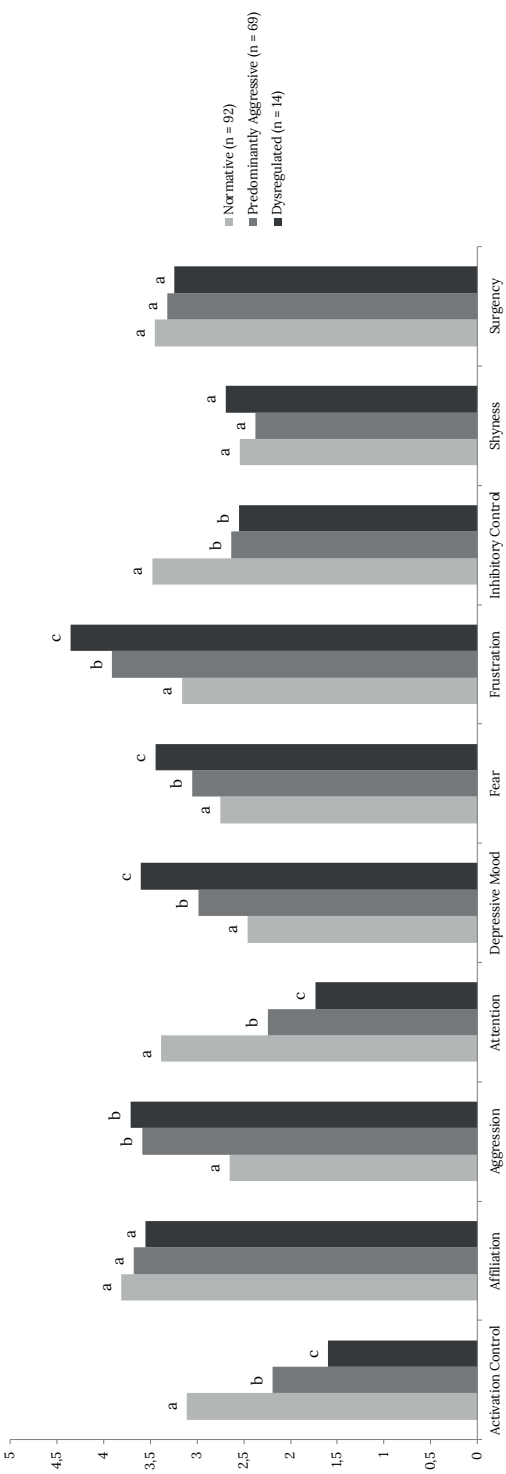

Figure 6.3. Means on the Subscales of the Early Adolescent Temperament Questionnaire – Revised across the Three Psychopathology Latent Profile Groups (Normative, n = 92, Predominantly Aggressive, n = 69, and Dysregulated, n = 14).

Note. Means that do not share identical subscripts (a, b or c) were significantly different from one another as indicated by Chi-Square equality tests of means across classes using the BCH procedure in Mplus 8.

Profile Comparisons. To compare the latent profiles on means (i.e., HR_{rest}, $HR_{reactivity}$ and covariates) the BCH procedure in Mplus was used for continuous variables and the DCATEGORICAL option for categorical variables (Muthén & Muthén, 2017). Mean T-scores of AD, AGG and AP differed significantly between classes, except levels of AGG that did not significantly differ between the predominantly-aggressive and dysregulated classes. There were no sex and age differences between classes. Children in the normative class had lower social adversity scores (.982) compared to the predominantly-aggressive class (1.491), $\chi^2 = 7.778$, $p < .01$ and the dysregulated class (1.887), $\chi^2 = 13.791$, $p < .001$) and they were less likely to use medication (.033 probability) compared to the predominantly-aggressive class (.495 probability), $\chi^2 = 38.690$, $p < .001$) and the dysregulated class (.527 probability), $\chi^2 = 9.020$, $p < .01$).

Next, the three psychopathology classes (normative, predominantly-aggressive, and dysregulated) were compared on mean levels of HR_{rest} and $HR_{reactivity}$. The predominantly-aggressive group had significantly higher HR_{rest} (93.30, S.E. = 2.12) compared to the normative (HR_{rest} = 86.07, S.E. = 1.61) group ($\chi^2 = 6.917$, $p < .01$), whereas the dysregulated group (HR_{rest} = 88.03, S.E. = 1.86) did not differ significantly from either group.

$HR_{reactivity}$ did not differ between the predominantly-aggressive ($HR_{reactivity}$ = 2.31, S.E. = .42) and normative ($HR_{reactivity}$ = 1.65, S.E. = .46) group, but was significantly higher in the dysregulated group ($HR_{reactivity}$ = 4.39, S.E. = 92) compared to the normative group ($\chi^2 = 7.147$, $p < .01$) and the predominantly-aggressive group ($\chi^2 = 4.117$, $p < .05$).

DISCUSSION

In this study, we examined HR_{rest} and $HR_{reactivity}$, two different markers of ANS (dys-)function in relation to psychopathology in a sample of 8 to 12-year old children, predominantly clinically referred for externalizing problem behavior. We used two approaches of considering commonalities between internalizing and externalizing behavior problems: a variable-centered and person-centered approach. For the variable-centered approach, we estimated a bifactor model with a general psychopathology factor of dysregulation underlying both externalizing and internalizing symptomatology that exists next to specific factors of anxiety/depression, aggression, and attention problems. For the person-centered approach, we used latent profile analysis to derive groups with different psychopathology profiles. The person-centered latent profile analyses revealed three distinct groups of children with different psychopathology profiles: (a) normative, (b) predominantly-aggressive, and (c) dysregulated (characterized by co-occurring anxiety/depression, aggression, and attention problems). These psychopathology profiles differed significantly on temperament dimensions, which confirmed that the normative group was well-adapted, while the dysregulated group was the least well-adapted (more so than

the predominantly-aggressive group). The dysregulated group showed an overall temperamental pattern of increased negative affect (aggression, depressive mood, frustration), reduced effortful control (attention, activation control) and increased fear. This is in line with previously reported patterns of personality pathology predicted in late adolescence by early childhood DP (Deutz, Vossen, et al., 2018).

As our relatively low sample size in relation to model complexity prohibited formal statistical comparisons of the variable- and person-centered approach, only convergent findings across the approaches can be interpreted with some degree of certainty, while differences must be interpreted with caution as they could result from model differences.

Resting Heart Rate

Results from the variable-centered analyses revealed that, as expected, HR_{rest} was positively related to dysregulation, suggesting that high(er) HR_{rest} might reflect a more general predisposition for developing psychopathology rather than being a precise marker for specific internalizing symptomatology. Bifactor models, in which a general factor of dysregulation or psychopathology explains common interrelatedness between externalizing and internalizing symptomatology, have been recognized as highly useful in variable-centered psychopathology research, especially since they offer a refined way to disentangle shared versus specific associations with etiologies and outcomes (Reise, 2012; Snyder & Hankin, 2017). Using this approach our study demonstrated shared biopsychological mechanisms and showed that higher HR_{rest} indicates elevated emotional arousal that might affect a broad expression of psychopathological symptoms going beyond the internalizing spectrum. HR_{rest} was not significantly elevated in the dysregulated class, but the relatively large coefficient size suggests that the small group size (n = 14) could have affected the non-significance of this result.

Unexpectedly, HR_{rest} was also positively associated with specific aggression and it was elevated in a subgroup of children characterized as predominantly-aggressive. Although low HR_{rest} is often described as a biomarker for antisocial behavior (Ortiz & Raine, 2004; Portnoy & Farrington, 2015), several studies have failed to demonstrate links between low HR_{rest} and externalizing behaviors. (Bimmel et al., 2008; Dierckx et al., 2014; Posthumus et al., 2009; Scarpa et al., 2010; van Hulle et al., 2000). There are several possible explanations for our findings. First, the Aggressive Behavior scale from the CBCL consists of a heterogeneous set of behaviors, and it has been proposed that low HR_{rest} is an autonomic risk factor for proactive (goal-directed, intentional) psychopathic-like aggression rather than for reactive (or impulsive, emotional) aggression (Raine et al., 2014; Scarpa, Tanaka, & Chiara Haden, 2008; Schoorl, van Rijn, De Wied, van Goozen, & Swaab, 2016). Autonomic overarousal has been associated with internalizing subtypes of conduct disorder (Fanti, 2018) and has been suggested to explain the co-occurrence between reactive aggression and anxiety (Bubier & Drabick, 2009). In

our study, given the high degree of comorbid internalizing problems in children referred for externalizing behaviors, this implies that the aggressive behaviors reported might have been primarily reactive. Another explanation can be found in sample characteristics, with several other clinical studies also reporting that children with disruptive behavior disorders had *higher* HR_{rest} compared to controls (De Wied, Boxtel, Posthumus, Goudena, & Matthys, 2009; Schoorl et al., 2016; Zahn & Kruesi, 1993). Our convergent findings from two different approaches to examine (comorbid) psychopathology substantiate a previous notion that the link between low HR_{rest} and externalizing behavior link might be primarily encountered in community samples (Dietrich et al., 2007).

As comorbidity of internalizing problems in children with disruptive behavior disorders is generally high (Maughan, Rowe, Messer, Goodman, & Meltzer, 2004), comorbid anxiety might drive elevated HR_{rest}, which shows the usefulness of measures such as the DP that cut across spectra. Our findings corroborate earlier reports of neural hypervigilance in externalizing disorders (Woltering, Liao, Liu, & Granic, 2015; Woltering & Shi, 2016), in line with a theoretical model proposing that anxiety, typically associated with too much inhibitory control, is not merely an auxiliary phenomenon, but rather drives and maintains aggression (Granic, 2014). Larger clinical samples would offer the opportunity to identify additional subtypes of externalizing behavior with different neurobiological correlates, potentially identifying a subgroup of 'aggressive-only' children, for whom fearlessness would be a key differentiating symptom. Including children with internalizing disorders in such studies could further refine results.

Heart Rate Reactivity

$HR_{reactivity}$ as a marker of ANS dysfunction has received much less attention in research, with the few available studies suggesting underreactivity being associated with externalizing behaviors (Bimmel et al., 2008; Fairchild et al., 2008; Herpertz et al., 2005; Popma et al., 2006; Sijtsema et al., 2013; Williams et al., 2003) and overreactivity with internalizing behaviors (Matthews et al., 1986; Rozenman et al., 2017). Our findings showed that HR_{rest} and $HR_{reactivity}$ were not related. Relations with $HR_{reactivity}$ and psychopathology did not converge across the variable- and person-centered analyses, and therefore findings should be interpreted cautiously. No associations emerged between $HR_{reactivity}$ and psychopathology in the variable-centered approach. For the person-centered approach, a distinct group of dysregulated children appeared to have slight elevated $HR_{reactivity}$ in response to emotional induction (in our study: losing points during a game). This could point to greater emotional reactivity, especially downregulating negative emotions such as anger and frustration, in dysregulated children, in line with studies demonstrating greater ANS reactivity in children with comorbid disorders (Waschbusch et al., 2002). Our

predominantly-aggressive group did not show the previously reported blunted $HR_{reactivity}$ (Bimmel et al., 2008; Fairchild et al., 2008; Herpertz et al., 2005; Popma et al., 2006; Sijtsema et al., 2013; Williams et al., 2003), possibly because of their elevated levels of anxiety/depression and sub-clinical levels of attention problems. Attenuated $HR_{reactivity}$ could be specific for proactive aggression (Hubbard, McAuliffe, Morrow, & Romano, 2010), but a subtype of children displaying proactive aggression only, is quite rare. Another explanation might lie in task characteristics. A wide range of stimulus types has been used to measure $HR_{reactivity}$ in previous research, such as psychosocial stress tasks in which participants need to deliver a speech (Popma et al., 2006; Sijtsema et al., 2013), or games aimed to elicit stress or frustration (Bimmel et al., 2008; Fairchild et al., 2008) and peer provocations (Williams et al., 2003), which could influence the relationship between $HR_{reactivity}$ and psychopathology (Obradović, Bush, & Boyce, 2011). In our study, $HR_{reactivity}$ was measured during an emotionally evoking Go/No-Go task, in which children were led to believe they would not receive a desirable gift. Future studies with preferably a more extensive $HR_{reactivity}$ protocol with different tasks or stimuli are needed (Kagan et al., 1987).

Strengths of this study concern examination of autonomic dysfunction in relation to dysregulation, rather than with externalizing and internalizing problems separately. HR_{rest} and $HR_{reactivity}$ proved to be unrelated independent measures and including them simultaneously revealed unique insights into autonomic dysfunction of dysregulation. By using both a variable- and person-centered approach to operationalize dysregulation, this study revealed differentiated associations with autonomic functioning depending on operationalization. This finding has important implications as both variable-centered and person-centered approaches have been used in previous research, often without acknowledging how such approaches are different. This presents a drawback in current research and limits the ability to draw comparisons among studies (Deutz et al., 2016). Research into formal comparisons of person- and variable-centered approaches to dysregulation is required to determine the impact of the different approaches.

Limitations of our study also need to be considered. Ideally HR_{rest} reflects autonomic activity in the absence of any affecting external stimuli. In our study we cannot rule out that the presence of the parent affected the child. However, meta-analytic evidence showed that the relationship between HR_{rest} and aggression was highly generalizable across different study designs and samples. This relationship was also not affected by method of HR assessment as well as a range of other potential covariates such as age (Ortiz & Raine, 2004; Portnoy & Farrington, 2015), BMI, pubertal stage and physical health status (Dietrich et al., 2007), and crying and muscle tone of the child during the HR_{rest} assessment (Raine, Venables, & Mednick, 1997). Regarding the role of medication use in ANS functioning: in our study HR_{rest} and $HR_{reactivity}$ were not significantly different for children with and without medication (similarly to De Wied et al., 2009; Schoorl

et al., 2016). Furthermore, adding medication status as a covariate in the regression analyses did not affect the results. However, to rule out effects of medication completely, participants would need to refrain from medication use before assessment. This was however ethically not feasible in this clinical sample. Another limitation is the relatively low sample size overall, which prohibited formal comparisons of the results from the variable-centered and person-centered approach. Additionally, especially the low size of the dysregulated subgroup (which consisted of only 14 children), lowered power to detect group differences. Nonetheless, very few studies have examined ANS functioning in clinical samples, especially in children, and we look forward for future research to complement our findings. Finally, causality cannot be determined from this study. However, it seems that altered ANS functioning predicts subsequent psychiatric problems rather than vice versa (Latvala et al., 2016) as it is generally stated that HR_{rest} not only co-occurs with psychopathology but also precedes it (Portnoy & Farrington, 2015).

It must be noted that associations between HR_{rest} and psychopathology were relatively modest. Future research should focus further on elucidating underlying mechanisms of ANS dysfunction in dysregulation, as these are still poorly understood. For example, it is unclear whether HR_{rest} might be a marker of other processes that are implicated in dysregulated behavior such as prefrontal cortex dysfunction (Raine, 2002), or whether HR_{rest} and dysregulation are influenced by the same genetic factors since both are (at least in part) genetically determined. As our study shows that ANS dysfunction is especially related to dysregulated behavior, early patterns of disrupted ANS functioning may constrain the acquisition of self-regulatory abilities. More research is needed, especially in younger samples given their higher neural plasticity. Future research in larger samples could further examine potential differences between boys and girls.

To conclude, this study offers new insights into links between ANS (dys-)function and externalizing, internalizing, and underlying dysregulated symptomatology. Rather seeing higher HR_{rest}, or (trait-like) overarousal as a unique risk factor for low externalizing and high internalizing symptomatology, we might conceptualize such heart rate characteristics better as a general risk factor for the development of psychopathology. In addition, high $HR_{reactivity}$, or enhanced emotional reactivity, might be characteristic for a clinically relevant subgroup of dysregulated children. Our findings are exploratory rather than explanatory, and replication in different samples is needed. HR can be assessed with relatively inexpensive and easy-to-use equipment and could provide incremental knowledge on individual differences that can help refine diagnostic assessments and intervention efforts.

APPENDIX C

Supplement C1

Manipulation Checks Go/No-Go task

When the Go/No-Go task was finished, all children were told they would receive the big prize (independent of performance). Next, a self-report emotion induction check was administered, in which children were asked to rate on a 10-point Likert scale how they experienced 5 different emotions (upset, mad, nervous, satisfied, excited) for each of the three blocks. Composite (sum) scores were created for the negative emotions (upset, mad, nervous) and the positive emotions (satisfied, excited) to create two global measures of experienced positive and negative emotions, as no differences within the positive and negative emotion domains for the different emotions were found.

A repeated-measures analysis of variance (ANOVA) showed that for negative emotions, there was a quadratic main effect of block, $F(2,44) = 26.34$, $p < .001$, $\eta 2 = .55$. Pairwise comparisons showed that Block B was rated as significantly more negative than Block A or C ($p < .001$), while no differences were found between Block A and C ($p = .545$). For positive emotions, there was a linear main effect of block, $F(2, 18) = 7.56$, $p = .004$, $\eta 2 = .56$, with pairwise comparisons showing a significant increase in positive emotions in Block C compared to Block A and B (all p's < .05). In figure C1 (see Appendix C), the emotional intensity of positive and negative emotions is graphed for each of the three blocks, again showing that Block B is rated significantly more negative and less positive. Therefore, we can classify the Go/No-Go task as emotionally arousing. We do note that assessment of the emotional intensity was asked after the task was completed, as to not disturb the task assessment and focus too much on experiences emotions. However, this might have biased answers to be more positive as participants at this point were aware that they had won the big prize.

Table C1. Standardized Factor Loadings for the Bifactor Child Behavior Checklist Dysregulation Profile (DP) Model

Item	Description	Scale-specific	DP
Anxious/Depressed (AD)			
14	Cries	.222**	.727***
29	Fears	.353***	.220*
30	Fears school	.658***	.480***
31	Fears do bad	.622***	.395***
32	Perfect	.620***	.251**
33	Unloved	.191*	.709***
35	Worthless	.357***	.698***
45	Nervous	.298***	.654***
50	Fearful	.649***	.463***
52	Feels too guilty	.652***	.276**
71	Self-conscious	.416***	.567***
91	Talks about suicide	.115	.583***
112	Worries	.505***	.599***
Aggressive Behavior (AGG)			
3	Argues	.378***	.750***
16	Mean	.402***	.776***
19	Demands a lot of attention	.033	.807***
20	Destroys own things	.459***	.659***
21	Destroys other	.547***	.675***
22	Disobedient at home	.480***	.745***
23	Disobedient at school	.481***	.593***
37	Fights	.365***	.743***
57	Attacks	.574***	.619***
68	Screams	.183*	.624***
86	Stubborn	.069	.850***
87	Mood changes	.066	.867***
88	Sulks	-.158	.829***
89	Suspicious	-.108	.836***
94	Teases	.161	.748***
95	Temper	.327***	.754***
97	Threatens	.522***	.673***
104	Loud	.071	.788***
41†	Impulsive	.459***	.713***
Attention Problems (AP)			
1	Acts too young	.221*	.635***
4	Fails to finish	.376***	.696***
8	Can’t concentrate	.742***	.633***

10	Can't sit still	.597***	.608***
13	Confused	.171	.614***
17	Daydreams	.340***	.431***
41	Impulsive	.392***	.713***
61	Poor school work	.413***	.640***
78	Inattentive	.564***	.689***
80	Stares	.097	.707***

Note. For full item descriptions please check the official Child Behavior Checklist (CBCL) forms.
Note. †Item 41 is part of Attention Problems but was set to cross-load on Aggressive Behavior.
Note. *$p < .05$, ***$p < .01$, ***$p < .001$

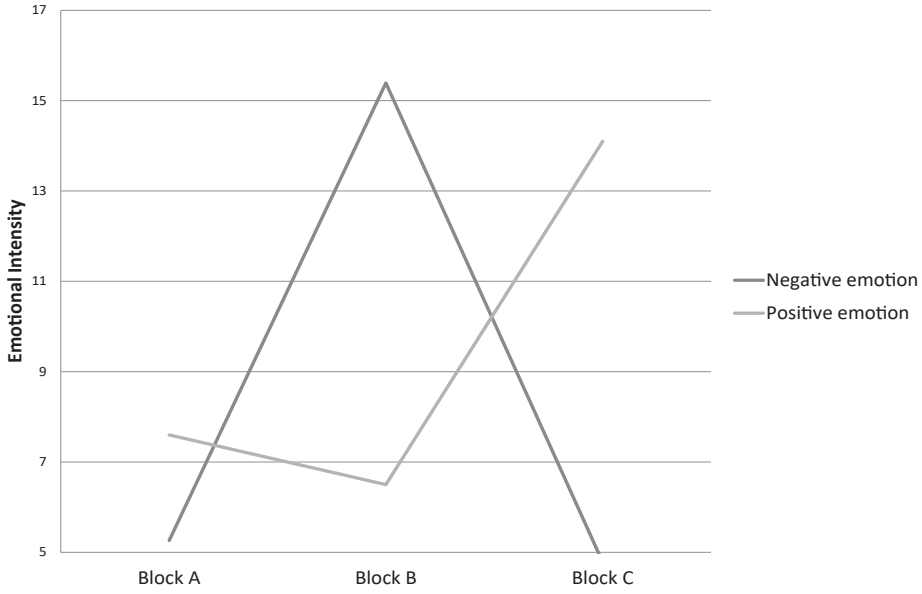

Figure C1. Emotional intensity for negative and positive emotions across block A, B (the emotion induction block), and C.

CHAPTER 7

General Discussion

The aims of this dissertation were threefold. The *first aim* was to examine the conceptualization and operationalization of dysregulation (i.e., concurrent problems in regulation of affect, behavior and cognition), as manifested in the Dysregulation Profile (DP). The *second aim* was to examine stability and change of the DP across different developmental periods (from early childhood to adolescence), including the normative developmental course of the DP. The *third aim* was to examine early childhood antecedents, adolescent outcomes and psychophysiological correlates of the DP. These three aims were addressed in five empirical studies, utilizing four different data sets from three countries (Belgium, Canada, United States), and by adopting a multi-method multi-informant approach. This concluding chapter provides a discussion of the main findings (see also Table 7.1), theoretical and clinical implications, strengths and limitations, directions for future research, and concluding remarks.

Aim 1: Conceptualization and Operationalization of the DP

To examine the conceptualization and operationalization of the DP, we first examined how scales measuring dysregulation of affect, behavior and cognition were interrelated. We used confirmatory factor analysis as the main analytical approach, and tested models across different samples (community, clinical), countries (Belgium, United States, Canada), instruments (CBCL, TRF, YSR, SDQ,) reporters (fathers, mothers, teachers, youths), and developmental periods (early childhood, middle childhood, adolescence). Results in multiple chapters in this dissertation empirically support the bifactorial structure of the DP, indicating that DP is best conceptualized as a broad syndrome of dysregulation, which exists in addition to specific syndromes related to the regulation of affect, behavior and cognition. In *Chapters 2 and 3*, the bifactor model was compared with competing models, namely a one-factor model, in which symptoms (items) loaded onto one DP factor (representing the DP as a one-dimensional syndrome), and a second-order factor model, in which specific first-order factors represented distinct problems of anxiety/depression, aggression, and attention problems, with a second-order DP factor that accounted for the commonalities between these factors (representing the DP as comorbidity). In *Chapters 2 and 3* we also demonstrated that the bifactor structure could be applied to mother, father, teacher, and youth reports, and in early childhood, middle childhood and adolescence. In addition, we found the model to be invariant across developmental period, and across parents. This further demonstrates the robustness of the bifactor structure. The superiority of the bifactor model suggests that, while anxiety/depression, aggression and attention problems are unique syndromes, a general dysregulation syndrome explains their significant interrelatedness.

Our results from *Chapter 4* furthermore suggest that the recently exponentially grown body of research on a 'general psychopathology (GP) factor' (Caspi et al., 2014; Caspi & Moffitt, 2018; Lahey et al., 2012), that describes a general common liability to all forms of psychopathology,

is very similar to the general dysregulation factor described in this dissertation. We examined both GP and DP models in the same dataset, and concluded that a general factor, which existed next to underlying externalizing and internalizing symptomatology, in both models described a similar general vulnerability for psychopathology. Specifically, although the specifics of the models differed, the general dysregulation factor of the more succinct and parsimonious DP model (with 41 items compared to 82 items for the GP), was similarly stable across time, and showed similar associations with antecedents and outcomes as the GP factor. The DP models examined in *Chapter* 3, measured with the Strengths and Difficulties Questionnaire (SDQ), included even fewer items, namely 15. These models also showed a good fit to the data, and comparable associations with self-regulation measures and longitudinal adjustment outcomes, indicating that even with a limited number of items measuring emotional and behavioral problems, a general dysregulation factor can be derived.

Indications that the DP and GP are comparable have also emerged from person-centered studies, concerned with how variables group within individuals. These studies differ from the variable-centered approach used in all the studies in this dissertation, which consider how variables are related to each other. In person-centered studies on the DP, generally latent profile analyses have been used to derive homogenous subgroups with similar psychopathology patterns. Most often only the three AAA-scales, instead of all CBCL scales, are used in person-centered studies on DP, with a subgroup scoring high on all three scales being labeled the dysregulated group (e.g., Althoff et al., 2012; Althoff, Rettew, et al., 2010). However, studies with a person-centered approach in which all CBCL-scales were used, as opposed to only the AAA-scales generally did not derive a subgroup of children with *only* elevations on the Anxious/Depressed, Aggressive Behavior and Attention Problems scales (the DP-scales). Instead, a subgroup with not only elevations on the AAA-scales but also elevations on other problem scales such as Thought Problems and Rule-Breaking Behavior for the CBCL6/18 (Althoff, Verhulst, et al., 2010; De Caluwé et al., 2013) and Emotionally Reactive for the CBCL 1.5-5 emerged from these analyses (Basten et al., 2013). Hence, person-centered approaches also suggest that the DP, based on only 3 scales and 44 items, could be a more parsimonious way of measuring co-occurring psychopathology compared to the GP, which is generally based on much more items. Specific differences in measurement are likely largely negligible, as long as both externalizing and internalizing symptoms are included in the model. Combined with the results from this dissertation, it can be stated that the DP, just like GP, most likely describes a general liability to most forms of psychopathology.

Emotional dysregulation is most likely at the core of both DP and GP, a conclusion that emerged from the patterns of factor loadings of the DP bifactor models in *Chapters* 3, 4 *and* 6 and of the GP bifactor model in *Chapter* 4. Generally, all items contributed to the general DP

or GP factor, as demonstrated by significant factor loadings in all samples. As most items also loaded significantly on their respective specific factors, this demonstrated the appropriateness of differentiating between the DP and specific syndromes. Interestingly, across chapters we observed that items describing (mood) dysregulation more directly often loaded high on the DP/GP (≥ .60) while low(er) on their respective specific factor (≤ .30). Three of these items, "temper tantrums or hot temper," "stubborn, sullen or irritable," and "sudden changes in mood or feelings" have previously been grouped as an index of irritability, described as a dimensional trait in the general population as well as a common and impairing symptom of both externalizing and internalizing psychopathology (Stringaris et al., 2012; Wiggins, Mitchell, Stringaris, & Leibenluft, 2014), and could therefore be key to the DP. For the SDQ-DP models in *Chapter* 3 however, items most indicative for the DP were symptoms of hyperactivity and inattention ("restless and overactive", "constantly fidgeting or squirming"). The SDQ includes only five key symptoms for emotional, conduct, and attention problems, while symptoms of mood dysregulation and irritability are considered to be transdiagnostic (e.g., Kring, 2008). Consequently, the only item in the SDQ describing mood dysregulation is "often has temper tantrums or hot temper", which generally also loaded high on the DP. Future research is desired to compare the CBCL-DP and SDQ-DP in the same sample to determine the impact of the presence of multiple "irritability items" in the CBCL on the general dysregulation factors retrieved with both the CBCL and SDQ.

The variable-centered analyses conducted in *Chapters* 2, 3, 4, *and* 5 are helpful for general theory formation, and with the bifactor models unique and overlapping etiology and outcomes can be studied in a more refined way. Person-centered approaches acknowledge heterogeneity within the population. Resulting distinct groups from these analyses could suggest different or differentiated treatment needs, which is of high clinical value. Therefore, to supplement the variable-centered approach adopted in most studies within this dissertation, we also conducted a latent profile analysis, which is a person-centered approach, in *Chapter* 6. Many previous studies have used latent profile analyses to derive homogenous subgroups of different psychopathology profiles, with a group showing co-occurring elevated anxiety/depression, aggression and attention problems labeled as 'dysregulated' (Althoff, Verhulst, et al., 2010; Basten et al., 2013; De Caluwé et al., 2013). This approach has been validated across developmental periods and reporters (Althoff, Rettew, et al., 2010; Basten et al., 2013; De Caluwé et al., 2013). In *Chapter* 6, we identified a dysregulated subgroup using latent profile analysis as well, consisting of 14 children (8% of the sample) with clinical levels of anxiety/depression, aggression as well as attention problems, next to a normative group (53%) and a predominantly-aggressive group (39%). In line with the results of variable-centered approach, these results suggest that some children may have a general liability to develop most forms of psychopathology.

In summary, in this dissertation we demonstrated that a bifactor model of the DP, representing the DP as a broad syndrome of dysregulation, best conceptualizes the DP. In four chapters of this dissertation, the bifactor DP model was replicated across different samples (community, clinical), countries (Belgium, United States, Canada), instruments (CBCL, TRF, YSR, SDQ,) reporters (fathers, mothers, teachers, youths), and developmental periods (early and middle childhood, adolescence). We also examined measurement invariance and thereby explicitly established that the same structure of the DP held across reporters, developmental periods and child gender. The findings in this dissertation on conceptualization and operationalization of the DP therefore underscore the robustness of the profile and provide convincing support for the use of the DP as a broad measure of dysregulation, measuring a general vulnerability for psychopathology.

Aim 2: Stability and Change of the DP

The second aim of this dissertation was to examine stability and developmental change of dysregulation, as such insights into stability and change can ultimately aid in understanding of etiology of dysregulation as well as contribute to screening strategies and treatment planning (Rushton, Forcier, & Schectman, 2002).

The studies in this dissertation revealed strong relative stability (i.e., the extent to which the relative differences in the DP among children remain the same over time) of the parent-reported DP (correlations ranged from .57/.58 for eight-year stability in *Chapter* 3 (age 6.5 to 13.5 years) and 4 (age 8 to age 14 years) respectively to .88 for one-year stability in *Chapter* 5). Stability was moderate for teacher-reported DP (r= .38 for eight-year stability in *Chapter* 3), which is expected as different teachers reported on the child. When mothers reported at age 8 and youth at age 14, stability was weakest (r = .20) (*Chapter* 4), which can be expected as cross-informant agreement on child and adolescent psychopathology is generally found to be weak even concurrently (Althoff, Rettew, et al., 2010; Rescorla et al., 2014; Rescorla et al., 2013; Rubin et al., 2013).

The moderate to strong stability of the DP provides support for the viewpoint of the DP as a stable and enduring syndrome of impaired self-regulation of affect, behavior and cognition (Masi, Pisano, et al., 2015; Wang et al., 2018). Furthermore, since we extended the developmental timeframe in which stability of the DP was studied in previous studies (i.e., Boomsma et al., 2006; Halperin et al., 2011; Winsper & Wolke, 2014) by examining stability from early childhood to adolescence, we showed that early dysregulation could be a sign of persistent problems. The DP could therefore be a potential valuable stable dimensional diagnostic qualifier in clinical practice.

As we examined stability within a bifactor analytic approach, we were able to examine stability of the DP as well as stability of the specific factors of Anxiety/Depression, Aggression and Attention Problems (see *Chapter* 4). These parent-reported specific factors showed weak to moderate 8-year stability from middle childhood to adolescence, with *r*s of .42 for Anxious/Depressed, .28 for Aggressive Behavior and .41 for Attention Problems. Cross-informant stability was again weak. In other words, these specific syndromes appeared to be more transient compared to the DP.

Another gap in research that we addressed was homotypic and heterotypic continuity of dysregulation and specific forms of psychopathology. Homotypic continuity reflects stability of one form of psychopathology predicting itself at a later time point, and heterotypic continuity describes when one specific form of psychopathology predicts another form of psychopathology at a later time point (Angold et al., 1999). In accordance with several other studies (McElroy, Belsky, et al., 2018; Olino et al., 2018; Snyder et al., 2017) *Chapter* 4 shows a greater homotypic continuity than heterotypic continuity: within-domain stability of the DP (e.g., dysregulation at age 8 predicting dysregulation at age 14: r = .61 for parent-reports) was greater than across-domain stability (r range .04-.22 for parent-reports). However, there is also evidence for heterotypic continuity (between-domain associations across time) suggesting that specific manifestations of psychopathology (e.g., anxiety/depression) increase risk of comorbid psychopathology (i.e., dysregulation) and vice versa, with the broad syndrome of dysregulation being the most stable.

Next to examining relative stability, we were also interested in investigating the extent to which mean-level scores on the DP changed over time in a (general population) sample as a whole. In *Chapter* 5 we examined mean-level development of dysregulation using six time points of a population-based sample of almost 700 children, to learn about the normative developmental course of the DP from early childhood to adolescence. The results showed that the developmental course of the DP was non-linear, with a peak in early adolescence. This indicates that in the general population young adolescents show the highest levels of dysregulation.

Next to overall mean-level change we also found significant variance around the intercept and slopes, meaning that there was variation in the initial level and rate of change of the DP (*Chapter* 5). This allowed us to examine whether individual differences in the development of the DP predicted later personality pathology. Although initial levels of the DP in early childhood were most predictive for personality pathology 13 years later, the rate of change also predicted additional variance in personality pathology. Interestingly, a flatter developmental course of the DP was predictive for three dimensions of personality pathology in late adolescence: identity problems, self-harm and submissiveness. The results of *Chapter* 5 point to the significance

of stable problems of dysregulation, already present in early childhood, as a risk factor for later development. Recent studies have examined whether there are distinct developmental trajectories of the DP. These studies have described different trajectories that differed in severity: low, moderate, high, very high (Winsper & Wolke, 2014), low, moderate and high (Kunze et al., 2017) or only low and high (Wang et al., 2017). These studies thus also show that there is individual variation in how dysregulation develops, but the different trajectories itself remained stable (e.g., no increasing/decreasing trajectories). In other words, children scoring high on dysregulation at the initial assessment remained high at the last assessment (such as from age 4.5 years at time 1 to 9.5 years at time 4 in Winsper & Wolke, 2014). In all the aforementioned studies the more severe trajectory was strongest associated with more risk or maladjustment, such as earlier regulatory problems or lower quality of life, compared trajectories with less severe DP (such as low or moderate DP). This suggests that *severity* of the DP is generally related to more maladjustment or presence of risk factors, rather than that unique developmental trajectories of the DP exist with differentiated outcomes or risk factors. As such, this supports the adaptation of a dimensional approach in this dissertation.

Aim 3: Antecedents, Correlates, and Outcomes of the DP

The third aim was to examine (longitudinal) antecedents and outcomes, as well as concurrent correlates of the DP from multiple domains: biological (e.g., heart rate measures), psychological (e.g., cognitive ability), and contextual (e.g., parenting). A multi-method multi-informant approach was adopted to examine a range of constructs pertinent to the DP across all chapters of this dissertation. Examining these relations was also important for the establishment of construct and predictive validity of the DP. In this section of the general discussion, we will integrate these results and highlight several aspects.

Two notions drove the research in this dissertation related to this aim. First, we examined unique antecedents, outcomes and correlates of the DP versus more specific forms of psychopathology, by examining these relations primarily within a bifactor framework (*Chapters* 2, 3, 4, *and* 6). In our studies, the general DP factor broadly predicted a range of adverse outcomes in terms of impaired mental health and reduced psychosocial and academic functioning (*Chapter* 4). This is in line with many studies demonstrating that comorbidity especially is related to more adverse outcomes (Cuffe et al., 2015; Larson et al., 2011; Wolff & Ollendick, 2006). The specific factors were more differentially associated with outcomes, and generally predicted additional, rather than unique variance. For example, the specific Conduct Problems factor at age 6.5 predicted higher antisocial behavior and more disciplinary actions at school when adolescents were 13.5 years old (*Chapter* 3) and the specific Attention Problems factor at age 14 predicted less psychosocial maturity one year later (*Chapter* 4).

For antecedents (examined in *Chapter* 4), we also found that significant relations emerged primarily for the broad DP factor. The DP at age 8 and 14 was predicted by early childhood temperament (higher negative affectivity and lower effortful control), lower self-control, lower positive maternal parenting, higher maternal depression and lower stimulation in the home environment. Some of these antecedents, such as temperament, also predicted additional variance in the specific factors. The specific Attention Problems factor was the only specific factor that appeared to have unique antecedents, namely lower delay of gratification and planning/problem-solving abilities. These results add to the notion that it is generally difficult to identify unique risk factors for specific forms of psychopathology and suggests that many risk factors are transdiagnostic and thus involve risks for many forms of psychopathology. Therefore, prevention and intervention programs targeted at these transdiagnostic risk factors might broadly reduce overall psychopathology severity.

In *Chapter* 6, we examined psychophysiological correlates of dysregulation, specifically resting heart rate and heart rate reactivity. The broad DP factor was related to higher resting heart rate, reflecting chronic over-arousal. Interestingly, specific aggression problems were also positively related to resting heart rate, even though low resting heart rate has been described as a robust biological correlate of antisocial behavior (Ortiz & Raine, 2004). When examining the DP from a person-centered perspective, the earlier described predominantly-aggressive subgroup of children additionally showed a higher resting heart rate than the normative group, suggesting that the aggressive component of the DP reflects reactive, rather than proactive aggression. The results from *Chapter* 6 add to a scarce body of research showing links between the DP and neurobiological correlates such as blunted HPA-axis responses (Ayer et al., 2013), a distinct EEG profile (McGough et al., 2013) and upregulated GABA inhibitory function (Nagamitsu et al., 2015). Dysregulatory processes may work at different levels of functioning, with neurobiological processes inducing and responding to behavioral actions. Although at this stage the findings regarding neurobiological underpinnings of dysregulation are still preliminary, in the future identifying the neurobiological origins of dysregulation could potentially aid early diagnosis and treatment efficacy. Measures such as resting heart rate could ultimately corroborate self- or parent reported symptoms. To establish this ultimate goal, longitudinal studies are needed to examine temporal relations between neurobiological indicators and the DP.

As a second goal, we further validated the construct of dysregulation by examining links between the DP and measures of self-regulation (i.e., self-control, executive functioning), temperament and personality pathology (*Chapters* 3, 4, 5, *and* 6). The results from the studies in this dissertation clearly showed links between measures of self-regulation and the DP, with generally modest effect sizes. The DP has been described as measure of problems in self-regulation (Althoff et al., 2012; Ayer et al., 2009; Holtmann, Buchmann, et al., 2011; Uljarevic et

al., 2018), and the results from the studies in this dissertation align with this perspective. Future research is needed to determine how early self-regulation contributes to the development of dysregulation.

Results from the chapters in this dissertation showed that temperament characteristics, specifically increased negative affect and reduced effortful control, longitudinally predicted higher levels of the DP in a community sample (*Chapter* 4). Furthermore, the dysregulated subgroup that was identified in the predominantly clinically referred sample of 8-to-12-year-old children in *Chapter* 6 showed an overall (concurrent) temperamental pattern of increased Negative Affect, Reduced Effortful Control and Increased Fear. Initial levels of the DP at age 4 furthermore predicted a wide range of personality pathology traits 13 years later (*Chapter* 5). Adolescent personality pathology traits predicted by early childhood DP were from the negative affectivity, disinhibition, detachment and psychoticism DSM-5 personality pathology domains (American Psychiatric Association, 2013). The DP was also negatively associated with ego-resiliency, measuring the ability to express and modulate impulses effectively and adaptively (*Chapter* 3). These findings are in line with other studies demonstrating broad associations between dysregulation and temperament (Althoff et al., 2012) and the predictive value of dysregulation for both personality pathology (De Caluwé et al., 2013) and personality disorders (Althoff, Verhulst, et al., 2010; Halperin et al., 2011). Our findings therefore provide additional evidence for previous suggestions that the DP could reflect a trait-like temperamental vulnerability (De Caluwé et al., 2013), or a dysregulated personality profile involving high negative affect, low positive affect, and poor behavioral control (Castellanos-Ryan et al., 2016).

In this dissertation, most of the chapters included child individual antecedents and outcomes. In *Chapter* 4 however, potential antecedents based on family characteristics were included, with results showing that reduced positive maternal parenting and stimulation in the home environment, increased harsh control, and higher maternal depression predicted the DP, with maternal depression. These results are in line with previous research. For example, a previous study in young children demonstrated that maternal and paternal psychological symptoms were highest in the dysregulated-class of children, compared to other psychopathology classes (Basten et al., 2013). Links between dysregulation and maladaptive parenting have also been demonstrated in several studies (Jucksch et al., 2011; Kim et al., 2012; McQuillan et al., 2018; Winsper, Hall, Strauss, & Wolke, 2017). We examined parental factors as predictors for the DP. However, there is also evidence for child effects on parenting, with children with more difficult temperaments and/or more emotional and behavioral problems eliciting more maladaptive parenting (Kiff, Lengua, & Zalewski, 2011). This suggests a dynamic interplay between parental psychopathological problems, parenting and children's (dys)regulation. As especially young children are highly dependent upon their parents in developing self-regulatory skills, and

parents are generally the main target for instilling behavioral change in the child, parenting and parental psychopathology are likely important targets for prevention and intervention of dysregulation.

Summarizing, findings of this dissertation confirm the DP as a broad measure of vulnerability predicting a range of negative adjustment outcomes in multiple domains in functioning (i.e., academic functioning, mental health, and risk behavior). The DP was associated with measures of self-regulation, temperament and personality pathology. Early childhood antecedents from the family domain, especially maternal depression, point to parental factors as prime targets for early prevention and intervention of dysregulation.

Clinical Implications and Recommendations

The findings of this dissertation have clinical implications for screening and diagnostics, as well as for prevention and intervention. The significant interrelatedness between different forms of psychopathology, and the fact that different forms of psychopathology often co-occur within children and adolescents, stresses the importance of comprehensive diagnostic assessment in which the full spectrum of psychopathology is considered. Often externalizing symptoms are accompanied by (less visible) internalizing problems (e.g., Maughan et al., 2004). Children with anxiety problems often have difficulties in handling situations that are stressful to them and being put in anxiety-inducing situations can cause the children to lash out to escape the situation. We therefore recommend using broad screening instruments such as the CBCL and SDQ to assess both externalizing and internalizing symptoms.

The DP emerged as a stable and enduring sign of persistent difficulties in regulating affect, behavior and cognition from early childhood to adolescence. Furthermore, early childhood levels of dysregulation at age 4-7 were predictive for a wide range of (costly and impairing) personality pathology symptoms 13 years later (*Chapter* 5). This suggests that it is important to take early childhood dysregulation seriously and devote resources to identification and possible intervention of dysregulation in early childhood. Although it can be difficult to differentiate clinically relevant behavior from typical development in preschool children, a "wait-and-see" approach could result in under identification of significant difficulties. A measure such as the DP could be relevant in younger populations where stability of categorical diagnoses is modest (e.g., Bunte, Schoemaker, Hessen, van der Heijden, & Matthys, 2014; Lahey, Pelham, Loney, Lee, & Willcutt, 2005) and approaching psychopathology from a dimensional view is especially fitting. Clinicians often already describe preschool children's problem in terms of 'regulation problems' or dysregulation (Althoff, Verhulst, et al., 2010).

Various early intervention efforts have been proven to be highly cost-effective (Adi, Killoran, Schrader McMillan, & Stewart-Brown, 2007; Suhrcke, Pillas, & Selai, 2008). A recent review

and meta-analysis of universal self-regulation-based interventions in children and adolescents showed that such interventions are generally effective and can lead to improvements in educational, health and social outcomes (Pandey et al., 2018). Furthermore, as the DP is stable, and likely transfers into adulthood given the range of negative adult psychiatric and functional outcomes predicted by dysregulation, even small therapeutic successes with a child could be important and beneficial for his or her future health (Zarrella, Russolillo, Caviglia, & Perrella, 2017). As self-regulation develops rapidly in early childhood, early childhood offers a window of opportunity for treatment and prevention of negative outcomes later in life (Bridgett, Oddi, Laake, Murdock, & Bachmann, 2013; Eisenberg et al., 2010; Zelazo et al., 2003).

The dysregulation framework can inform our thinking about treatment of clinical levels of psychopathology in children and adolescence in two ways. First, as the broad syndrome of dysregulation appears to be especially predictive for adverse outcomes, dysregulation could be a potential primary target for intervention. If treatments could lower general dysregulation levels, it might impact multiple expressions of psychopathology and could thus be highly effective. Second, as the DP explains comorbidity among both externalizing and internalizing symptomatology, bifactor models can be used to examine whether and why certain psychopharmacological agents and certain psychotherapy modalities are effective for multiple forms of psychopathology. The challenge for treatment research is to clarify effective elements across treatments, i.e., to identify transdiagnostic elements (that likely focus on strengthening self- and emotion regulation).

Although there are transdiagnostic treatments available for children and adolescents, they mostly focus on comorbidity within the internalizing or externalizing spectrum. The Unified Protocols for Transdiagnostic Treatment of Emotional Disorders in Children and Adolescents is perhaps the most well-known and well-studied transdiagnostic treatment, focused on emotion and emotional disorders (Ellard, Fairholme, Boisseau, Farchione, & Barlow, 2010). Processes targeted in this treatment are transdiagnostic factors such as stress, coping, attention, and peer and family interactions. There is initial evidence for success of the protocol in children and adolescents with comorbid anxiety and depression (Bilek & Ehrenreich-May, 2012), but research is needed that includes children and adolescents with externalizing symptoms as well.

Strengths and Limitations

This dissertation is characterized by several strengths. A comprehensive, consistent and systematic approach was taken to evaluate the DP in four different samples (community and clinically referred), with different socio-economic backgrounds and from different countries (Belgium, United States, Canada), increasing generalizability of results to the wider population. A major strong point of this dissertation was the large developmental range covered. As we

examined the DP from early childhood to adolescence we covered important transitional periods (e.g., transition to adolescence) and major biological, cognitive, and social changes that occur in development. The longitudinal approach in several chapters is a clear strength of this dissertation, as these studies allowed us to examine the developmental course and stability of dysregulation and investigate longitudinal etiology and outcomes, which extended current knowledge generated by cross-sectional studies. Another strong asset was that in all the reported studies, we used multiple informants (e.g., mothers and adolescents, different teachers), and/or multiple methods (e.g., observational, physiological, questionnaires), contributing to greater understanding of the DP. Finally, we used advanced statistical techniques such as bifactor analysis, latent profile analysis and latent growth modeling to answer our research questions. In this dissertation, we were the first to apply bifactor techniques to the study of the DP (also in Geeraerts et al., 2015), and as such we uniquely contributed to the existing body of research on the DP by showing that the DP can best be conceptualized as a broad syndrome existing over and above specific syndromes. Furthermore, we stimulated the use of bifactor modeling of the DP, which has already led to replications (Haltigan et al., 2018 ; Miller et al., 2018).

The five studies in this dissertation each had limitations that were already addressed in the chapters. Here we discuss general limitations of the dissertation. First, the majority of the studies in this dissertation were conducted in longitudinal community samples, with generally low levels of psychopathology. Although we consider the DP to be dimensional in nature, and we successfully replicated the DP bifactor model in the predominantly clinically referred sample in *Chapter* 6, it is important to replicate whether associations with antecedents, correlates and outcomes generalize to clinical samples as well. Second, we did not consider interactions or additive effects of antecedents on the DP, nor did we examine interactions between the DP and risk factors in predicting outcomes. For example, it is unknown whether contextual factors as parenting amplify relations between the DP and negative outcomes. Future research should focus on examining person-environment interactions (i.e., moderation), as such studies could provide further insight into which potentially malleable contextual factors we could target to prevent or reduce dysregulation.

Future Directions

In the following section, we will elaborate on four areas of future research directions that we deem should be most prioritized in the current state of the field. First, in this dissertation, we demonstrated the relevance of the DP as a valid and dimensional measure of dysregulation. However, we used complex modeling to derive the DP. Specifically, we mainly used bifactor modeling which comes with many methodological restraints and is not directly applicable in practice. An important future direction and step in our own research therefore is to develop a Dysregulation Profile – Short Form (DP-SF): a short and practical measure that reflects the

broad syndrome of dysregulation. Such a measure would be useful for research, clinical and screening purposes. Researchers could use the DP-SF to study etiology, development and outcomes of dysregulation in smaller (but hard-to-get) samples of at-risk or clinical populations. Longitudinal analyses also become much more feasible with the DP-SF, allowing the examination of development and change of dysregulation. The DP-SF could be useful for clinicians to monitor treatment outcomes, fitting with the increasing demand for routine outcome monitoring activities in clinical practice. Given increasing interest in transdiagnostic treatments (Meier & Meier, 2017), the DP-SF might be a useful tool for determining eligibility for such treatments. Finally, as the DP has been characterized as a broad developmental risk-marker, it could be a relevant screener in the general pediatric and mental health population. Such a short and easy to use measure could be used to determine which children are most at risk for developing serious psychopathology, after which referral for more comprehensive psychiatric assessment could take place. A short and valid measure predicting general risk for psychopathology is highly fitting with the shift in delivery of mental health systems to schools and primary care, demanding easy but appropriate measures.

The second future direction we deem important concerns the recently emerged network approach which proposes an alternative view of the interrelations within and between the externalizing and internalizing symptom domains. In the network approach, comorbidity is considered an intrinsic feature of mental disorders (Borsboom, 2017). Rather than explaining these interrelations from an underlying general factor of dysregulation, network analysis argues that causal processes *between* symptoms (and disorders) are responsible for these interrelations. This suggests that intervening on central symptoms within these networks could result in a 'snowball-effect' of change. Limited research has adopted network approaches in the study of child and adolescent psychopathology. One recent study showed strong associations between internalizing and externalizing DSM-IV disorders, with generalized anxiety disorder (GAD) and ODD being the most central disorders in the networks (McElroy, Shevlin, Murphy, & McBride, 2018). This suggests that symptoms within these disorders are important in emergence and/or maintenance of comorbidity. As mood labilities are key to both GAD and ODD, network modeling on a symptom level could be used to examine central symptoms of the DP. If similar symptoms emerge as those we identified based on bifactor modeling, this would provide further support of the central role of emotional dysregulation in psychopathology.

Third, the role of emotion regulation and dynamics in the DP needs further study. Dysregulation as the underlying mechanism explaining interrelatedness between externalizing and internalizing symptomatology fits with the idea that many psychiatric disorders are thought to involve problematic patterns of emotional reactivity and emotion regulation (Gross & Jazaieri, 2014; Sheppes et al., 2015). Regardless of the child's specific diagnosis, many parents of children seek treatment because their child has difficulties in managing emotions like fear,

anger or sadness. In the extended process model of emotion regulation, it is hypothesized that difficulties in emotion regulation can lead to various forms of psychopathology (Sheppes et al., 2015), although much is uncertain regarding the causal role of emotion and emotion-regulation difficulties in the development of psychopathology (Gross & Jazaieri, 2014). Future research could focus on examining internal (e.g., temperamental) and external (e.g., situational) factors that could elicit behavioral symptoms of emotional dysregulation, as measured with the DP.

A final area that we deem highly important in future research on dysregulation is research in early childhood populations. Such research is scarce. In work not reported in this dissertation we replicated the bifactor structure of the DP in a sample of predominantly clinically referred preschoolers, suggesting that the DP is best described as a broad syndrome of dysregulation in preschoolers as well (Geeraerts et al., 2015). Another study demonstrated the presence of a 'dysregulated class' in early childhood, consisting of children with co-occurring externalizing and internalizing symptoms (Basten et al., 2013). An important future direction is to further examine early signs of dysregulation, such as crying/fussing, eating and sleeping problems, that have been shown to predict trajectories of dysregulated behavior across childhood (Winsper & Wolke, 2014). Such early problems with regulation may set a maladaptive developmental cascade in motion of negative parent-child and peer interactions, disrupted learning and potentially physiological stress related changes (Winsper & Wolke, 2014), and it is thus highly relevant to identify these early markers of dysregulation.

General Conclusion

Concluding, the findings of this dissertation show that the DP can be characterized as a stable and enduring syndrome of affective, behavioral and cognitive dysregulation, predicting a range of negative adolescent outcomes including personality pathology and reduced academic functioning. A bifactor model best described the DP across samples, developmental periods, instruments and reporters, providing robust support that the DP can best be conceptualized as a broad syndrome of dysregulation that exists next to more specific syndromes of anxiety/depression, aggressive behavior and attention problems. The DP can explain why it has been challenging, if not impossible, to find unique etiology, outcomes, biomarkers and treatments for specific forms of child and adolescent psychopathology and stresses the need to look at common underlying factors and identify transdiagnostic etiology and outcomes. We therefore encourage to move toward research using a dimensional and hierarchical structure of psychopathology with dysregulation at the highest-order factor. The DP could prove to be an efficient measure for screening children in the general population at risk for developing severe psychopathology, as well as a clinical identifier for comorbid problems in clinical practice.

Table 7.1. Summary of the Main Findings in This Dissertation

Chapter 2	• The Dysregulation Profile, or DP, is best conceptualized as a broad dysregulation syndrome, which exists over and above to specific problems of anxiety and depression, aggression, and attention problems. • DP bifactor structure was successfully replicated for father, teacher and youth reports on ASEBA questionnaires, both in middle childhood and adolescence. • Measurement invariance analyses indicated that the DP bifactor structure was similar across parents, child sex and developmental period (middle childhood and adolescence). • The general dysregulation factor was exclusively linked to adolescent self-reported self-harm and suicidal ideation.
Chapter 3	• Measured with the SDQ, the DP (again) reflects a broad syndrome of dysregulation that exists in addition to specific syndromes of emotional symptoms, conduct problems, and hyperactivity-inattention. • The bifactor model best described the data across three different developmental periods (early childhood, middle childhood, and adolescence) and across different reporters (parents, teachers, and youth). • Measurement invariance was demonstrated, showing that the DP bifactor model was constructed similarly regardless of reporter, child sex, or developmental period. • The SDQ-DP was concurrently and longitudinally associated with two indices of self-regulation: effortful control and ego-resiliency. • The SDQ-DP longitudinally predicted disciplinary measures and antisocial outcomes.
Chapter 4	• With the Child Behavior Checklist and the Youth Self Report, bifactor models of the Dysregulation Profile and the General Factor of Psychopathology result in very similar general factors in both middle childhood and adolescence. • Both the DP and GP describe a general vulnerability for developing psychopathology with (emotional) dysregulation at its core. • DP and GP were similarly related to a broad range of early-childhood antecedents (e.g., lower effortful control, higher maternal depression), and outcomes at age 15 (e.g., reduced academic functioning, poorer mental health).
Chapter 5	• The DP followed a nonlinear developmental course from ages 4 to 17 years with a peak in early adolescence. • The initial level of DP at age 4 predicted a wide range of personality pathology dimensions in late adolescence from four domains: Negative Affectivity, Disinhibition, Detachment and Psychoticism. • The DP did not predict personality pathology dimensions from the Antagonism domain (e.g., Callousness), suggesting that the aggressive component of the DP primarily concerns reactive, rather than proactive aggression. • To a lesser extent, the rate of change of DP predicted personality pathology. Specifically, slower initial decreases of the DP, combined with less pronounced declines of the DP, predicted higher levels of identity problems, self-harm, and submissiveness. • The findings suggest that the DP is a broad developmental precursor of personality pathology in late adolescence.
Chapter 6	• In a predominantly clinically referred sample, dysregulation could be measured with two approaches: (1) a variable-centered approach (bifactor model) in which dysregulation was an underlying factor of symptoms of anxiety/depression, aggression and attention problems and, (2) a person-centered approach (latent profile analysis) in which subgroups of children with similar psychopathology profiles were derived: a normative group, a predominantly-aggressive group and a dysregulated group who showed co-occurrent anxiety/depression, aggression and attention problems. • The dysregulated group showed a dysfunctional temperamental profile of increased negative affect, reduced effortful control and increased fear. • Results from the variable-centered approach demonstrated that high resting heart rate, or (trait-like) overarousal, seems to be associated with dysregulation rather than uniquely with low externalizing or high internalizing symptomatology. • Findings from the person-centered approach indicated that high heart rate reactivity, or enhanced emotional reactivity, might be characteristic for a clinically relevant subgroup of dysregulated children.

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SUMMARY

Many children and adolescents coming to clinical mental health institutions present a complex picture of co-occurring affective, behavioral and cognitive dysregulation. In order to intervene as effectively as possible, we need to know how we can measure this complex phenotype of dysregulation, and thereby improve our understanding of its nature and development. The overall aim of this dissertation was to increase knowledge of co-occurring psychopathology patterns by focusing on the Dysregulation Profile (DP), a measure of co-occurring forms of psychopathology. This dissertation was centered around three main research questions: (1) how to conceptualize and operationalize the DP? (2) how stable is the DP over time and how can the normative developmental course of the DP from age 4 to age 17 in the general population be described? and (3) what are early childhood antecedents, adolescent outcomes and psychophysiological correlates of the DP?

The DP has emerged as a reliable and valid measure of the complex phenotype of dysregulation and is generally defined by elevated scores on the Anxious/Depressed, Aggressive Behavior and Attention Problems (or AAA-) scales of the Child Behavior Checklist (CBCL). The CBCL is a well-known and widely used parent-reported instrument to chart behavioral and emotional problems of children and adolescents. More recently, the DP has also been defined on the comparable Strengths and Difficulties Questionnaires, using scores of the Emotional Symptoms, Conduct Problems and Hyperactivity-Inattention scales. In this dissertation, five empirical studies on the DP were presented, utilizing four different data sets from three countries (Belgium, Canada, United States). A multi-method and multi-informant approach were adopted.

The *first aim* was to examine the conceptualization and measurement of the DP. Results revealed that a bifactor model best described the AAA-scales that comprise the DP. The same result was found across samples, instruments (ASEBA and Strengths and Difficulties Questionnaires), developmental periods (early childhood, middle childhood and adolescence), and reporters (mothers, fathers, teachers, youth themselves). As such, this dissertation provided robust evidence that the DP can best be conceptualized as a broad syndrome of dysregulation which exists over and above specific problems related to affect (anxiety and depression or emotional problems), behavior (aggression or conduct problems), and cognition (attention problems or hyperactivity-inattention). This bifactor model bears strong resemblance to models of a 'general factor of psychopathology' (GP or 'p factor') and results in this dissertation demonstrated that integration of both fields of literature is warranted.

The *second aim* was to examine stability and change of the DP, specifically how the normative developmental course of the DP from age 4 to age 17 years in the general population could be described. Findings showed that across different samples, relative stability of the DP was strong for parent-reported DP and moderate for teacher-reported DP. The specific

factors such as anxiety/depression were weak to moderately stable. While homotypic continuity (e.g., dysregulation predicting dysregulation at another time point) was strongest, there was also evidence for heterotypic continuity which indicated that specific manifestations of psychopathology (e.g., anxiety/depression) increase risk of comorbid psychopathology (i.e., dysregulation) and vice versa. Furthermore, in this general population sample, the DP was found to follow a nonlinear developmental course, peaking in early adolescence.

The *third aim* was to investigate early childhood antecedents, adolescent outcomes and psychophysiological correlates of the DP. This dissertation further established the DP as a broad risk marker, as we found that the DP predicted a range of negative outcomes including personality pathology, mental health problems, reduced academic functioning, antisocial outcomes and increased disciplinary measures and psychosocial maladjustment. We added to a scarce body of research on antecedents by showing that the DP is predicted by early temperament and self-control, and family factors including maternal depression and parenting. Exploratory findings showed that the DP was linked to higher resting heart rate, reflecting chronic overarousal.

To conclude, the findings of this dissertation demonstrate that the DP is a useful measure of co-occurring psychopathology, that can best be described within a bifactor model, indicating that the DP can be characterized as a broad syndrome of dysregulation underlying anxiety/depression, aggression and attention problems. The DP can be characterized as a stable and enduring syndrome of affective, behavioral and cognitive dysregulation that peaks in early adolescence. The DP predicts a range of negative outcomes and could specifically be a developmental precursor of personality pathology. The results of this dissertation emphasize the need to adopt hierarchical models of psychopathology and focus on identifying transdiagnostic etiology and outcomes of interrelated externalizing and internalizing forms of psychopathology. The DP could prove to be an efficient measure for screening children in the general population at risk for developing severe psychopathology, as well as an identifier for comorbid problems in clinical practice.

SAMENVATTING

Veel kinderen en adolescenten die worden doorverwezen naar de geestelijke gezondheidszorg laten een complex beeld zien van verschillende gedrags- en emotionele problemen. Vaak is er bij deze kinderen en adolescenten sprake van comorbiditeit het samen voorkomen van internaliserende problematiek (zoals angst en depressie) en externaliserende problematiek (zoals agressie). Zij hebben daarom problemen met zelfregulatie over de gehele linie, aangezien ze problemen hebben met het reguleren van zowel emoties als aandacht en gedrag. Dit wordt ook wel affectieve, gedrags- en cognitieve dysregulatie genoemd. Deze kinderen hebben een verhoogde kans op het ontwikkelen van onder andere verslavingsproblematiek, psychosociale problemen en suïcidale neigingen. Om zo effectief mogelijk te kunnen interveniëren, is het belangrijk om te weten hoe we dit complexe fenotype van dysregulatie kunnen meten. Daarmee verbeteren we ook onze kennis van de aard en het verloop van dysregulatie.

Het overkoepelende doel van dit proefschrift is om kennis te vergroten van co-morbide gedrags- en emotionele problemen. Specifiek is in dit proefschrift het Dysregulatie Profiel (DP) onderzocht, waarbij drie onderzoeksvragen centraal stonden: (1) hoe conceptualiseren en operationaliseren we het DP? (2) hoe stabiel is het DP en hoe kunnen we het verloop van het DP van 4 tot 17 jaar beschrijven? en (3) wat zijn vroege voorspellers, uitkomsten in de adolescentie en (psychofysiologische) correlaten van het DP?

Het DP wordt gezien als een betrouwbare en valide maat voor het complexe fenotype van dysregulatie en wordt doorgaans bepaald door verhoogde scores op drie syndroomschalen van de Child Behavior Checklist (CBCL), namelijk de schalen Angstig/Depressief, Agressief Gedrag en Aandachtsproblemen, die respectievelijk slechte regulatie van emoties, gedrag en aandacht weerspiegelen. De CBCL is onderdeel van het Achenbach System of Empirically Based Assessment (ASEBA), en is een bekend en veelgebruikt instrument, waarbij ouders rapporteren over de aanwezigheid van emotionele en gedragsproblemen van hun kind. Meer recentelijk is ook de Strengths and Difficulties Questionnaire (SDQ), een instrument dat vergelijkbaar is met de CBCL, gebruikt om het DP te meten. Bij de SDQ wordt dit gedaan op basis van verhoogde scores op de schalen Emotionele Symptomen, Hyperactiviteit-Aandachttekort en Gedragsproblemen, of door een door andere auteurs bepaalde selectie van vijf items van deze schalen die samen het DP zouden meten.

In dit proefschrift werden vijf empirische studies gepresenteerd, waarbij gebruik werd gemaakt van vier verschillende datasets uit drie landen (België, Canada en de Verenigde Staten). Deze datasets waren veelal van langlopende onderzoeken in de algemene populatie, maar we hebben ook gebruik gemaakt van een klinische steekproef. Er is gekozen voor een benadering waarbij meerdere informanten (zoals ouders en leerkrachten) en meerdere methodes (zoals vragenlijsten en observaties) zijn gebruikt om de vragen uit dit proefschrift te onderzoeken.

Het *eerste doel* was om de conceptualisatie (wat betekent het DP nu eigenlijk?) en operationalisatie (hoe meten we het DP?) te onderzoeken. Dit is belangrijk, omdat er onder onderzoekers geen consensus bestaat over deze zaken. Uit de resultaten van de factoranalyses in dit proefschrift bleek dat een bifactor-model het best de profielstructuur beschrijft van het DP (bestaande uit de subschalen Angstig/Depressief, Agressief Gedrag en Aandachtsproblemen). Een bifactor-model is een hiërarchisch model, waarbij symptomen van emotionele en gedragsproblemen zowel op een algemene onderliggende factor van Dysregulatie laden, als op een van de drie specifieke subschalen. We konden dit resultaat repliceren over verschillende steekproeven, instrumenten (ASEBA en SDQ), ontwikkelingsperioden (kindertijd en adolescentie) en rapporteurs (moeders, vaders, leerkrachten en adolescenten zelf). Dit proefschrift leverde robuust bewijs op dat het DP het best kan worden geconceptualiseerd als een breed onderliggend syndroom van dysregulatie. Dit syndroom bestaat naast specifieke problemen die verband houden met problemen in de regulatie van affect (angst en depressie of emotionele problemen), gedrag (agressie of gedragsproblemen) en cognitie (aandachtsproblemen of hyperactiviteit-aandachttekort). Dit bifactor-model vertoont sterke gelijkenis met modellen die een 'algemene factor van psychopathologie' (of 'p factor' in het Engels) beschrijven, dit zijn modellen waarnaar het onderzoek exponentieel is gegroeid in de afgelopen jaren. Uit dit proefschrift blijkt dan ook aan dat integratie van beide vakgebieden gerechtvaardigd is.

Het *tweede doel* van dit proefschrift was de stabiliteit en verandering van het DP te onderzoeken. Het richtte zich daarbij voornamelijk op de vraag hoe het normatieve verloop van het DP van 4 tot 17 jaar in de algemene populatie eruitziet. Uit de bevindingen bleek dat de relatieve stabiliteit van DP (de mate waarin de relatieve verschillen tussen kinderen in DP-scores stabiel blijven over de tijd) hoog was wanneer ouders rapporteerden over hun kind, en matig wanneer (verschillende) leraren rapporteerden over het kind. De specifieke factoren zoals Angst/Depressie waren weinig tot matig stabiel, wat erop lijkt te duiden dat dysregulatie, als een soort algemene onderliggende kwetsbaarheid voor verschillende vormen van emotionele en gedragsproblemen, stabieler is dan specifieke uitingen. Hoewel het DP op één tijdsmoment een sterke voorspeller was voor het DP op een later tijdsmoment (homotypische continuiteit), voorspelde het DP ook specifieke syndromen (zoals Angst/Depressie) op een later tijdsmoment en vice versa (heterotypische continuïteit). Dat betekent dat specifieke manifestaties van psychopathologie (zoals angst/depressie) het risico op comorbide psychopathologie (dat wil zeggen dysregulatie) over tijd kunnen vergroten (en andersom). Bovendien bleek dat in een algemene populatiesample, DP een niet-lineair verloop volgde, met een piek in de vroege adolescentie. Problemen met dysregulatie namen toe van 4 tot 11 jaar om vervolgens weer af te nemen (dit ziet eruit als een omgekeerde U).

Het *derde doel* van dit proefschrift was om voorspellers in de vroege kinderjaren, uitkomsten in de adolescentie en psychofysiologische correlaten van het DP te onderzoeken. Dit is belangrijk om beter te begrijpen wat de aard van het DP is, maar ook om te weten op welke kind- en omgevingskenmerken we zouden kunnen interveniëren om de negatieve gevolgen van dysregulatie te beperken. Er was nog zeer weinig onderzoek gedaan naar voorspellers van DP; wij hebben hieraan bijgedragen door te laten zien dat DP wordt voorspeld door temperamentskenmerken en zelfbeheersing in de vroege kindertijd, en door gezinsfactoren, waaronder depressiviteit en opvoedgedrag van moeders.

De bevindingen uit dit proefschrift laten zien dat het DP gezien kan worden als een brede risicomarker, omdat we ontdekten dat het DP een reeks negatieve uitkomsten voorspelde, waaronder persoonlijkheidspathologie, psychische problemen, verminderd academisch functioneren, antisociaal gedrag en problemen in psychosociaal functioneren. Omdat we in de analyses gebruik maakten van het hiërarchische bifactor-model, konden we laten zien dat vooral dysregulatie voorspellend was voor negatieve uitkomsten en niet de specifieke subschalen. Het DP lijkt daarom op een algemene kwetsbaarheid te duiden. Daarnaast hebben we ook gekeken naar psychofysiologische correlaten van DP. Eerste bevindingen toonden aan dat DP was gerelateerd aan een hogere hartslag in rust, hetgeen op chronische overarousal duidt.

Concluderend toont dit proefschrift dat het Dysregulatie Profiel een bruikbaar instrument is voor het meten van comorbide gedrags- en emotionele problemen. Een bifactor-model bleek het DP het best te omschrijven. Dit geeft aan dat het DP het best kan worden gekarakteriseerd als een breed syndroom van dysregulatie, dat bestaat naast specifieke problemen met het reguleren van emoties (angst/depressie), gedrag (agressie) en aandacht (aandachtsproblemen). DP kan worden gekarakteriseerd als een stabiel en chronisch syndroom van dysregulatie dat, in de normale populatie, piekt in de vroege adolescentie. Het DP voorspelt een reeks negatieve uitkomsten en kan specifiek een ontwikkelingsvoorloper zijn van persoonlijkheidspathologie. De resultaten van dit proefschrift benadrukken de noodzaak om hiërarchische modellen van psychopathologie te gebruiken. Tevens lijkt het belangrijk om te kijken naar gezamenlijke (oftewel transdiagnostische) risicofactoren en uitkomsten van (sterk) aan elkaar gerelateerde gedrags- en emotionele problemen, ook omdat het tot nu toe moeilijk is gebleken om unieke risicofactoren, uitkomsten of behandelingen te vinden voor specifieke vormen van gedrags- en emotionele problemen van kinderen en jongeren. Het DP zou een efficiënte maat kunnen zijn voor het screenen van kinderen in de algemene populatie die een risico lopen op het ontwikkelen van ernstige psychopathologie. Daarnaast zou het DP een middel kunnen zijn om comorbide problematiek te identificeren in de klinische praktijk.

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ABOUT THE AUTHOR

Marike Deutz was born on September 5th, 1987, in Amersfoort. After completing pre-university education at Montessori College Maastricht (2005), she studied Psychology at Radboud University Nijmegen for one year, after which she switched to Pedagogical Sciences. For her final year of the Bachelor, she was selected to participate in the International Student Exchange Program (ISEP) and studied at the University of Idaho in the United States for one semester. In 2010, she obtained a master's degree in Pedagogical Sciences (*cum laude*) after which she also completed a Research Master's degree in Behavioural Sciences (2012, *bene meritum* and 1st prize for Best Research Master Thesis), both at Radboud University Nijmegen.

In 2012, Marike started her PhD project at Utrecht University at the Clinical Child and Family Studies research group. She was given the opportunity to design her own PhD project, which she centered around dysregulation in childhood and adolescence. Alongside her PhD, Marike gained teaching experience by supervising theses of bachelor, master and research master students and teaching work groups to first year students. In the academic year 2016-2017 she was a visiting scholar at the Neurobiological Lab for Learning and Development at Texas A&M University, sponsored by a Fulbright scholarship and a Young Talent Award from the Prince Bernhard Culture fund. During her PhD, Marike served as Research Officer for the Junior Researcher Programme in 2013-2014, (co-)organized a symposium titled 'New Insights into the Structure of Psychopathology" in 2016, was selected to be one of twenty participants in 2-day Research Academy Workshop from the European Society for Child and Adolescent Psychiatry in Geneva, Switzerland in 2016, and presented her work at several international conferences. In December 2017, she started working as a pedagogist/child psychologist (or 'orthopedagoog' in Dutch) at GGz Centraal, a specialized center for child and adolescent psychiatry.

Since August 2018, Marike works as an assistant professor at the Department of Pedagogical Sciences of the Erasmus University Rotterdam. She continues to work at GGz Centraal, where she is also involved in research. She sees great value in being a scientist-practitioner and aspires to continue to combine research, clinical work and teaching in her career.

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