Taxonomy of Disruptive Behavior in Children and Adolescents

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Taxonomy of Disruptive Behavior in Children and Adolescents

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Contents

Chapter 1

Introduction

TAXONOMY

Taxonomic systems try to describe physical as well as behavioral and social phenomena in a meaningful way. Taxonomy can be defined as the grouping of cases, e.g. individuals, according to their distinguishing features. This grouping can be done on different, hierarchical levels of defining characteristics, such as, in medicine: individual problems or symptoms; symptom aggregates or syndromes; functional disorders; or etiological factors (Verhulst & Koot, 1992). Taxonomy is the process of the identification of groups of individuals according to their properties, hence according to intrinsic criteria.

Classification is related to taxonomy, but is somewhat broader and includes the grouping of cases according to extrinsic criteria (e.g., source of referral) as well as intrinsic criteria, which are based on the features of the cases themselves. Diagnosis can be defined as the medical term for classification (Achenbach, 1991c; Verhulst & Koot, 1992).

Taxonomy should also be distinguished from assessment, although they are closely related. Assessment identifies the distinguishing features of each individual case, which, in child and adolescent psychiatry e.g., can be expressed in behavioral, emotional, or physical measures (Achenbach, 1991c; Verhulst & Koot, 1992). While in taxonomy the central goal is identifying groups of individuals with similar intrinsic features, assessment aims to identify characteristics that distinguish one individual from others. Assessment can be used to classify an individual in the proper taxonomic category. Examples of assessment procedures are questionnaires, e.g. the Child Behavior Checklist (CBCL) and the Teacher's Report Form (TRF) (Achenbach and Rescorla, 2001), as well as interviews, e.g. the Diagnostic Interview Schedule for Children – Parent Version (DISC-IV-P; Shaffer et al., 1998).

In child and adolescent psychiatry, as a branch of medicine, taxonomic and classification systems are needed for clinical practice as well as for research purposes. They are catalysts of the ongoing research regarding the etiology, prognosis, and treatment of psychiatric disorders in children and adolescents. In child and adolescent psychiatry, the present state of the art only permits to identify groups of children who share patterns of symptoms, e.g. disruptive, externalizing behaviors, or attention problems, hyperactivity and impulsivity. Patients with similar symptom patterns might share a common etiology or need similar treatments.

Different approaches to taxonomy in child and adolescent psychiatry are possible (Figure 1.1). They can be divided into two kinds of approaches: top-down and bottom-up. The top-down or a priori approaches are exemplified by the *DSM* (American Psychiatric Association, 1994) and *ICD* (World Health Organization, 2005) taxonomic systems , which involve expert consensus, and therefore the combined clinical experience of leading clinicians. The bottom-up or empirical approaches can be subdivided into: factor analysis, which is a variable-oriented approach; cluster analysis, which is a person-oriented approach and which makes use of continuous latent variables; and latent class analysis (LCA; McCutcheon, 1987), which is also a person-oriented approach but which makes use of categorical latent variables.

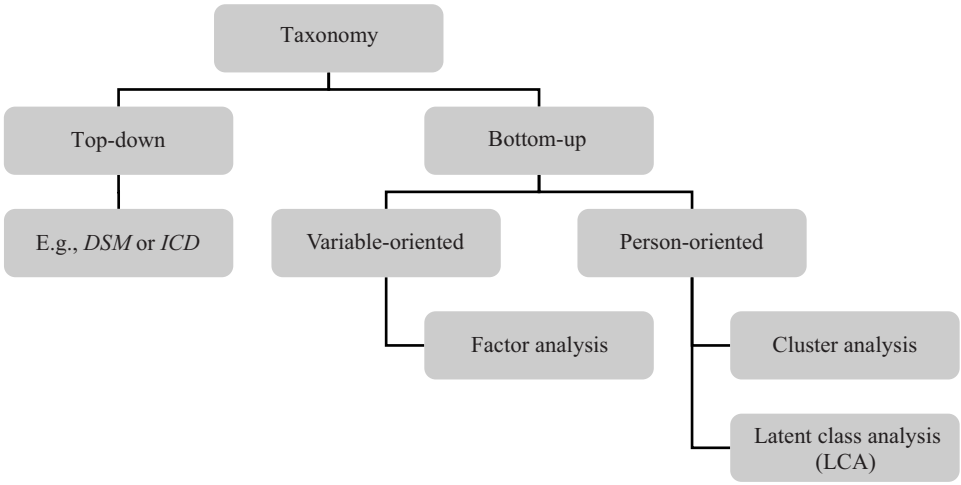

Figure 1.1. Approaches to taxonomy.

Factor analysis, or principal components analysis, aims to find out which variables, e.g. symptoms or behavior items, occur together to form syndromes, by analyzing their relationships (factor loadings) to a number of continuous latent variables, which are called factors. In cluster analysis, on the other hand, individuals in a sample who have the most similar profiles of several continuous behavioral measures, are clustered together (Achenbach & Edelbrock, 1983).

LCA differs from factor analysis in its use of categorical latent variables, which indicate classes, instead of continuous latent variables, and because it is a person-oriented instead of a variable-oriented approach. LCA uses categorical data, e.g. the presence or absence of symptoms, for identifying homogeneous groups of children or adolescents that are as different as possible from other groups. These groups are called latent classes. LCA describes the probabilities of a set of observed categorical variables across groups of individuals when group membership of the individuals is unknown. The objective of LCA is to find the smallest number of classes of individuals with similar patterns of symptoms that can explain the relationships among a set of observed variables.

In the present thesis, ADHD (Attention-Deficit/Hyperactivity Disorder) and externalizing or disruptive disorders are studied. For the sake of brevity, in this thesis, ADHD and externalizing disorders will together be denoted as disruptive behavior (disorders). Many children and adolescents referred to mental health institutions are suffering from these disorders, which also tend to persist and make life difficult for the children and adolescents themselves, their parents, and their teachers. These disorders do not only lay a burden on the lives of the families of the patients, but on society as well.

The present study reports on the taxonomy of these disorders. Comorbidity, informant differences, and outcome of disruptive behaviors and ADHD symptoms will also be studied, in order to improve taxonomy. These aspects will be explained further in the following sections.

ADHD

Attention-Deficit/Hyperactivity Disorder (ADHD) is a psychiatric condition with a fairly high prevalence, ranging from 5 to 10% in school-aged children (Faraone et al., 2003; Scahill & Schwab-Stone, 2000). Adewuya and Famuyiwa (2007) found a prevalence of 9% in a sample of Nigerian primary school children, while Polanczyk et al. (2007) reported a worldwide-pooled prevalence of 5%. Polanczyk and Rohde (2007) reported prevalence estimates of 5% for children and adolescents and 4% for adults. ADHD appears to be a condition with limited temporal stability, since an age-dependent decline was observed, with rates of persistence of ADHD into adulthood ranging between 15% and 65% (Faraone et al., 2006). Hill and Schoener (1996) found an exponential decline, by 50% approximately every five years, with an estimated adult ADHD prevalence of only .8% at age 20 and .05% at age 40. The commonly used *DSM-IV* classification system (American Psychiatric Association, 1994) describes three subtypes of ADHD: the predominantly inattentive type, the predominantly hyperactive-impulsive type, and the combined type, with prevalences in the general population of 5%, 1%, and 3%, respectively. A male to female prevalence ratio of 2 : 1 was found across the subtypes of ADHD except the hyperactive-impulsive type, which had a ratio of 3.2 : 1 (Adewuya and Famuyiwa, 2007). Five-year *DSM-IV* ADHD subtype stability was poor to modest, ranging from 11% to 24% (Todd et al., 2008).

The history of ADHD taxonomy starts with early descriptions of children with hyperactive and impulsive behavior by Still (1902) and Tredgold (1908). The concept of minimal brain damage or dysfunction (MBD) was used in the 1950s and 1960s. *DSM-II* (American Psychiatric Association, 1968) described the Hyperkinetic Reaction of Childhood, while *DSM-III* (American Psychiatric Association, 1980) proposed the concept of Attention-Deficit Disorder (ADD), linking hyperactivity to deficits in attention, with subtypes based on the presence or absence of hyperactivity (+H/-H). *DSM-III-R* (American Psychiatric Association, 1987) only described ADD+H, which it called Attention-Deficit/Hyperactivity Disorder (ADHD).

Despite the fact that the development of the concept of ADHD has received a great deal of scientific attention across time, data supporting the validity of the inattentive and the hyperactive-impulsive subtypes are still scarce. In a study of the stability of the *DSM-IV* subtypes during preschool and primary school, children who met criteria for the

combined subtype met criteria for ADHD in more subsequent assessments than children in the predominantly hyperactive-impulsive subtype. Thirty-seven percent of children with combined subtype, and 50% of children with inattentive subtype met criteria for a different subtype at least twice in the six reassessments. Children with hyperactive-impulsive type ADHD rarely remained in this subtype classification over time, but shifted to combined type in later years instead (Lahey et al., 2005). Todd et al. (2008) found a poor to modest five-year ADHD subtype stability, of which the most stable was the combined type, with a subtype stability of 24%, while the inattentive and hyperactive-impulsive subtypes had stabilities of, respectively, 18% and 11%. Hence, it can be concluded that the stability of a diagnosis of the combined subtype of ADHD is modest, while the stability is poor for the other two subtypes. Besides, the validity of the inattentive and hyperactive-impulsive type is not sufficiently supported by empirical data. The hyperactive-impulsive subtype differs from the inattentive and combined subtypes in age distribution and in association with neuropsychological parameters.

Since inattention is the hypothesized core symptom of ADHD, and since sufficient inattentive symptoms are lacking in the hyperactive-impulsive subtype, it is not clear whether children with this subtype have the same disorder as children with the inattentive and combined subtypes (Woo and Rey, 2005). In light of the development of *DSM-V*, it is important to test the current *DSM* taxonomy of ADHD.In studies of taxonomy, as well as in assessment procedures, different informants have to be dealt with. Previous studies have investigated the taxonomy of ADHD in several general population samples, by using parent report as well as self-report data.

Parent-report data regarding ADHD symptoms were analyzed with LCA in general population samples of child and adolescent twins (Hudziak et al., 1998; Neuman et al., 1999; Rasmussen et al., 2002a, 2004; Todd et al., 2001) and in a sample of child and adolescent offspring of families ascertained through an alcoholic proband (Neuman et al., 1999). Neuman et al. (1999) used the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA; Bucholz et al., 1994) for the assessment of ADHD symptoms and only found support for an inattentive subtype and a combined subtype, but not for a hyperactive-impulsive subtype. The other studies that used parent-report data found separate inattention and hyperactivity-impulsivity classes, next to combined inattention/hyperactivity-impulsivity classes. For instance, Todd et al. (2001) applied LCA to ADHD symptoms, reported by the parent on the Diagnostic Interview for Children and Adolescents-Revised-Parent version (DICA-R; Reich, 1996) and on the SSAGA, in a general population sample of 4,036 female twins aged 13 to 23 years. They found a mild and a severe inattentive, a mild and a severe hyperactive-impulsive, and a mild and a severe combined class.

Self-report data were used by Rohde et al. (2001) and by Rasmussen et al. (2002b). Rohde et al. (2001) investigated male and female adolescents from the general population,

aged 12 to 24 years, and applied LCA to the self-reported ADHD symptoms on an instrument including all 18 *DSM-IV* ADHD symptoms. They found that an LCA model with eight classes fitted best, and they found that class solutions were different from previous analyses of parent report data. In contrast to the previous studies, a smaller proportion of adolescents was in the class with few problems, and no class with inattention problems only was identified. Rasmussen et al. (2002b) analyzed self-reported ADHD symptoms of 980 males, aged 12 to 19 years, from the general population as well, using the Australian Twin Behaviour Rating Scale (ATBRS; Hay et al., 2001). LCA yielded several combined symptom classes but few strictly inattentive or strictly hyperactive-impulsive classes.

The different findings of these studies could possibly be explained by difference in informants. Informant differences will be discussed below.

It is also important to study clinical correlates of ADHD. This can be done by investigating comorbidity patterns. Patterns of comorbidity may have implications for diagnosis, prognosis, and intervention (Gillberg et al., 2004). These comorbidity patterns yield information for the taxonomy of ADHD. E.g., if one ADHD subtype has a higher rate of comorbidity with ODD than a different ADHD subtype, this may imply a difference in prognosis and in treatment between these ADHD subtypes. Comorbidity patterns support the external validation of a taxonomic system. ADHD frequently co-occurs with disruptive or externalizing disorders (Dick et al., 2005; Gadow & Nolan, 2002).

EXTERNALIZING DISORDERS

The group of externalizing or disruptive behavior disorders includes Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD). Disruptive behaviors in the broader sense, as will be used in the present thesis, in children and adolescents generally contain three problem domains: attention/hyperactivity problems, aggressive/oppositional problems, and rule-breaking/conduct problems (Achenbach & Rescorla, 2001; American Psychiatric Association, 1994). These behaviors form a major health care problem and make life difficult for the children and adolescents themselves, their parents, and their teachers.

The lifetime prevalence of ODD is estimated to be 10% (Nock et al., 2007), while point prevalence estimates are much lower, 2% in Norwegian 8- to 10-year-olds (Heiervang et al., 2007). In this same age group, a prevalence of .5 for CD was found (Heiervang et al., 2007). In British children and adolescents, aged 5-15, a prevalence of 2% (3% in boys, 1% in girls) was found for ODD, and a prevalence of 1% (2% in boys, 1% in girls) for CD (Ford et al., 2003). In higher age groups, lower prevalences of ODD and higher prevalences of CD were seen (Ford et al., 2003).

The *DSM-IV* taxonomic system uses a priority rule: CD precludes ODD. Nevertheless, in taxonomy research, the different domains of disruptive behavior, aggressive/oppositional problems and delinquent/conduct problems, as well as attention/hyperactivity problems, can be studied in order to investigate the extent of their co-occurrence. Further, although ADHD is not unequivocally considered a disruptive or externalizing disorder, attention/hyperactivity problems are considered a domain of disruptive behavior. Many studies found high co-occurrence rates between the three areas of disruptive behavior (Burt et al., 2005; Dick et al., 2005; Gadow and Nolan, 2002; Loeber and Keenan, 1994; Loeber et al., 1995; Maughan et al., 2004; Pfiffner et al., 2005). Further, individuals with different types of disruptive behavior appeared to be very similar with regard to deficiencies in problem-solving skills, pervasiveness of problems across different settings, intelligence and achievement measures, family context measures, and behavioral symptoms (Matthys et al., 1999; Paternite et al., 1995). However, when considering disorders instead of behaviors, patients with both ADHD and ODD displayed more problems in the relationship with teachers, friends, and with their mothers, than patients with 'pure' ADHD (Harada et al., 2002).

Previous studies (Sondeijker et al., 2005; Van Lier et al., 2003) with children from the general population failed to find latent classes of children with attention-deficit/hyperactivity, oppositional defiant, or conduct problems only. Instead, different types of disruptive behaviors tended to co-occur, thus forming only classes with different severity levels of disruptive behaviors, instead of different disruptive symptom patterns. Other studies, though, found that different disruptive behavior domains occurred separately. For instance, a study in a sample of adolescent female twins from the general population, which concerned LCA on *DSM-IV* attention/hyperactivity and oppositional symptoms derived from adolescent and parent ratings on the SSAGA (Semi-Structured Assessment for the Genetics of Alcoholism; COGA, 1996) revealed two ODD symptoms classes with different levels of ODD symptoms, but with low levels of ADHD symptoms, a mild hyperactive-impulsive class, an inattentive class, an inattentive class combined with ODD symptoms, as well as a combined type ADHD symptoms class with ODD symptoms (Neuman et al., 2001).

From these studies it can be concluded that the validity of the distinction between ODD and CD, as well as the distinction between the three domains of disruptive behaviors, can be questioned. The taxonomy of disruptive behaviors, and of disruptive behavior disorders in particular, should be investigated further.

Disruptive disorders have a poor prognosis. Investigating prognosis of disruptive behaviors may elucidate their taxonomy. Biederman et al. (1996) identified two subtypes of ODD associated with ADHD, of which one is prodromal to CD and another that is subsyndromal to CD but unlikely to progress into CD in later years. When studied in clinically referred samples, childhood ODD can be a precursor of adolescent CD, while childhood ADHD can be a precursor of later CD symptoms or antisocial disorder, even in the absence of comorbid

ODD or CD in childhood (Mannuzza et al., 2004; Whittinger et al., 2007). On the other hand, in a general population sample, Hofstra et al. (2002) found that CBCL Attention Problems did not predict any *DSM-IV* disorder 14 years later when adjusted for the associations with other CBCL scales. Comorbidity is not only observed within the area of disruptive behavior, but also with different behaviors and disorders, e.g. depression and anxiety. Since these comorbidity patterns may influence diagnosis, prognosis, and treatment as well, they may also influence taxonomy.

COMORBIDITY

ADHD not only frequently co-occurs with ODD or CD, as was mentioned above, but also with anxiety symptoms (Jensen et al., 1994), while patients with both ADHD and ODD had more depression and anxiety symptoms than ADHD-only patients (Harada et al., 2002). When a certain group of patients needs a different treatment than another group, this may justify delineating these two groups in taxonomy. Symptom and comorbidity patterns are always observed through the eyes of one or more informants. Hence, which informants are reporting and which differences show up between their reports, is important information that influences taxonomy as well as clinical assessment.

INFORMANT DIFFERENCES

Assessment and taxonomy of child and adolescent psychopathology rely on information from multiple sources, multiple informants, such as the child or adolescent, the parents, and the teacher. According to Achenbach (1991c), these multiple informants are used because of the following.

Observable behavior of children and adolescents, their competencies, as well as their problems are likely to differ from one context to another, e.g. home or school. Different informants about children and adolescents are likely to observe different samples of their behavior.

Informants differ with respect to their sensitivity to various aspects of functioning of children and adolescents: different informants have different views, different perspectives on the behavior of the child or adolescent. They also differ with respect to their basis for judging and reporting what they observe: informants have different thresholds for reporting. Also, informants differ in their effects on the behavior of a child or adolescent in their presence: informants do not have the same relationship with the child.

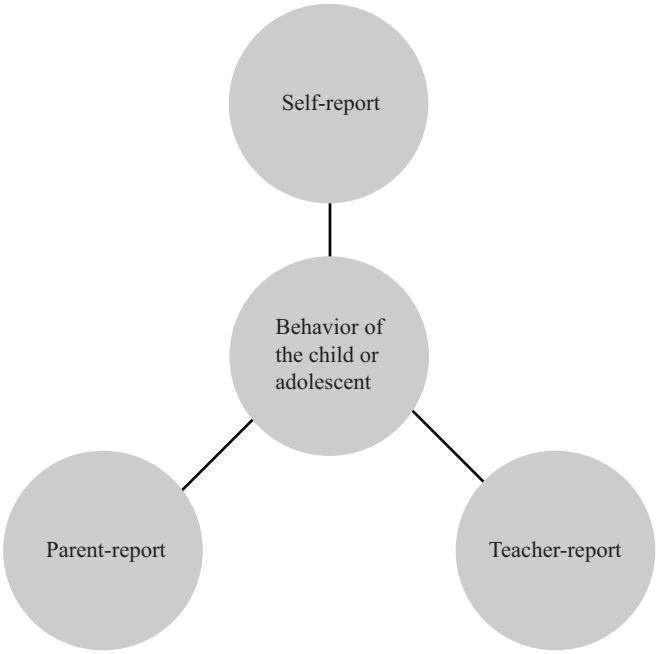

Figure 1.2. Psychopathology influences parent, teacher, and self-report.

The behavior of the child or adolescent, and hence, psychopathology, influences how an informant will report (Figure 1.2). Therefore, informants will often report different behavior and behavior patterns about the same child. Correlations between reports by different informants are generally modest, averaging .60 between informants reporting from similar contexts (e.g., mother versus father or two different teachers); .28 between informants reporting from different contexts (e.g., parents versus teachers); and .22 between self-reports by children or adolescents on the one hand and reports by parents, teachers, and mental health workers on the other (Achenbach et al., 1987; Klein, 1991; Van der Valk et al., 2001).

Hence, informant-specific assessment yields informant-specific taxonomies. Informant-specific taxonomies can be combined to a cross-informant taxonomy (Figure 1.3). Achenbach derived informant-specific as well as cross-informant syndromes (Achenbach, 1991c; Achenbach et al., 1995). In the cross-informant profiles, the data from multiple informant-specific assessments are combined. As an example of a cross-informant taxonomy difference, in the study of ADHD symptoms by Rohde et al. (2001), based on self-report data, an inattentive class was lacking, while in the Neuman et al. (1999) study, which was based on parent reports, a hyperactive-impulsive class was not found.

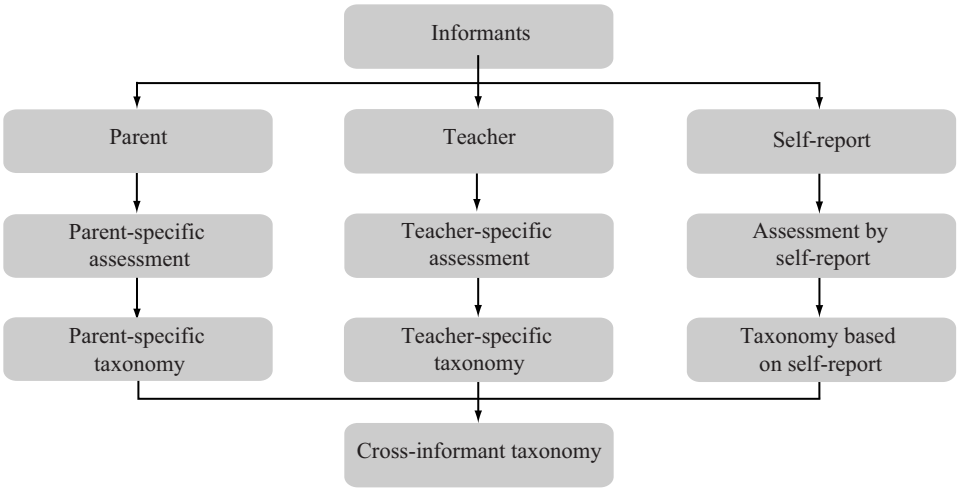

Figure 1.3. Informant-specific assessment and informant-specific taxonomies.

When teachers report about home, or when a parent reports about school, the informant is giving information about a different setting. Although this type of assessment is frequently used in clinical practice, very little is known from scientific literature about how informants report about a different setting. An informant reporting about a different setting could be indicated as 'cross-setting assessment'. It is important to investigate the correlation between cross-setting and intra-setting assessments, such as when the parent reports about home, or when the teacher reports about school.

In clinical assessment of ADHD, *DSM-IV* requires symptoms to be present in two or more settings, e.g. at home and in school. Therefore, in clinical practice information about the behavior of the child or adolescent in each of these settings should be collected. However, *DSM-IV* does not give guidelines about which informant should report symptoms for each setting. Previous studies (Loeber et al., 1990; Phares, 1997) found that both mental health professionals and mothers thought that the teacher was the most useful informant for hyperactivity and inattentiveness, but it is not known what is the best way to combine the information obtained from different informants within the clinical assessment of ADHD.

Cross-setting assessment of ADHD symptoms is frequently used in clinical practice, but whether this is a valid procedure to derive a diagnosis, is unknown. The study by Mitsis et al. (2000), which was replicated in the present thesis, found that DISC (Shaffer et al., 1998) parent reports of in-school ADHD behavior in referred 7- to 11-year-olds correlated higher with their own reports of their child's behavior at home than with teacher reports of their child's behavior in school. These findings indicate that taxonomy of ADHD might be informant-specific as well as setting-specific.

Different patterns of symptoms, as reported by different informants, may determine taxonomy. But the predictive validity of a taxonomic system is determined by studying the outcome of individuals within the taxonomic categories. If all categories yield a similar outcome, the validity of differentiating between these categories should be questioned.

OUTCOME

A taxonomic system can be validated and corroborated in different ways, e.g. by demonstrating different etiologies or different treatment responses for each grouping of individuals within the taxonomy, but also by demonstrating specific outcomes for each grouping of individuals within the taxonomy. This is exemplified by Biederman et al. (2008), who found that only CD, and not ADHD or ODD, was associated with significantly increased risk for substance use disorders.

Finding differential outcome, which means specificity of outcome, can corroborate a taxonomic system. Besides, when differential stability of syndromes is found, e.g. when one grouping of subjects has a greater tendency towards maintaining the same behavior through time than another grouping, which means a higher within-syndrome than cross-syndrome stability, this can also yield external validation to the taxonomic system studied.

Therefore, for the development of taxonomic systems of ADHD and disruptive behavior disorders, it is important to know the outcome of patients with these disorders and to know whether the outcome differs according to taxonomic grouping. For instance, if one subtype of ADHD has a different outcome than another ADHD subtype, this yields information about the predictive validity of these subtypes. Information about outcome supports the external validation of a taxonomic system.

Fergusson and Horwood (1995) compared the efficacy of the *DSM* system and of dimensionally scored measures as predictors of outcomes of disruptive behaviors. They found evidence of continuous and generally linear dose-response functions between symptom severity and outcome risks and that dimensionally scored variables were considerably better predictors of outcome than measures based on the *DSM* system. From this it could be inferred that a taxonomic system that allows for different levels of severity of disruptive behaviors might receive more external support demonstrated by finding differential outcome than a taxonomic system that uses cut-off levels of symptoms.

The above mentioned LCA system identifies homogeneous groups of children, classes, based on categorical data, e.g. the presence or absence of symptoms. In contrast to the *DSM* taxonomic system, in which predetermined cut-off levels of symptoms are used, resulting in the identification of disorders which are present or absent, LCA can identify classes that have different probabilities of displaying the same symptoms and allows for different symptom

levels. Possibly, when different levels of severity of disruptive behaviors are being taken into account, as can be done with LCA, more support can be found in differential outcome patterns than when the *DSM* approach is being used. Probably, homogeneous groups of children also yield a more stable predictive model than just dividing the individuals in groups on the basis of cut-off points of disruptive behavior.

AIMS OF THE PRESENT THESIS

This thesis aims to investigate taxonomy of disruptive behavior. Despite the fact that the development of the taxonomy of child and adolescent disruptive behavior has received a great deal of scientific attention across time, questions remain and there is room for improvement of current taxonomic systems.

Most of the previous studies used general population samples instead of referred samples. Although general population samples are important for testing the validity and natural occurrence of clinic-based definitions of illness, in a general population sample only a relatively small number of children and adolescents with elevated problem levels will be found. Referred samples can be used to find subtypes of disorders. For instance, a relatively rare strictly hyperactive-impulsive class, or classes of individuals with 'pure' attention/ hyperactivity, oppositional, or conduct problems might not be detectable in general population samples, but could be found by latent class analysis of a referred sample.

In most previous studies parent reports or self-reports were used. Teacher information was not used. The school setting is very different from the generally less structured setting at home. Maintaining attention and controlling hyperactivity and impulsivity are more important in school than at home, which makes information about behavior in school very important for assessment of ADHD.

Besides investigating general population and referred samples with LCA, and using teacher information as well, taxonomy can be studied further by looking at comorbidity and outcome patterns. Different comorbidity patterns or a different outcome of a certain group of individuals might justify the taxonomic delineation of this group from other groups.

The following specific research questions are addressed in the subsequent chapters of the present manuscript:

Taxonomy of ADHD

1. Do different approaches to taxonomy of ADHD symptoms (the top-down *DSM* approach and the bottom-up LCA approach) yield different or comparable results; is this comparison different in referred vs. non-referred children; are the three subtypes of ADHD valid; what patterns of disruptive behavior comorbidity are associated with the classes found using the bottom-up, empirical approach?

2. Which taxonomy arises when a bottom-up approach is applied to teacher-reported inattention and hyperactivity/impulsivity symptoms in referred children and adolescents; which comorbidity patterns are associated with this empirically derived taxonomy?

Assessment of ADHD

3. To which extent can parents provide information about ADHD symptoms in school, independently of their vision on the child's functioning at home; to which extent can teachers provide information about ADHD symptoms at home, independently of their vision on the child's functioning in school?

Taxonomy of disruptive behavior

4. Which taxonomy arises when a bottom-up approach is applied to mother-reported disruptive behavior in referred adolescents; is the current disruptive behavior taxonomy, with its three problem domains (inattention/hyperactivity, aggressive/oppositional, and rule-breaking/conduct problems) valid or do these three domains tend to co-occur not only in general population samples, but also in referred samples?
5. Can an empirical taxonomy of disruptive behaviors in referred children and adolescents be validated by studying the outcome of the individuals within this taxonomy?

METHODS

These research questions are addressed using several different referred and non-referred samples of children and adolescents. These samples are investigated with different instruments, both questionnaires and interviews, involving different informants as well. Samples, instruments, and informants are further described in the subsequent chapters of this thesis.

In most chapters, LCA is used. As mentioned before, this is a statistical technique that fits models of increasing numbers of homogeneous classes of persons upon empirical data, in order to obtain the optimal model of homogeneous classes describing the given data. Subsequently, the symptom profiles of these classes can be studied.

LCA starts with a one-class model, followed by a two-class model. The same analyses are run with different starting values to avoid a local maximum. Fit indices, like the Bayesian Information Criterion (BIC; Kass & Wasserman, 1995), are calculated to check whether the two-class model fits better than the one-class model. In the same way, models with three and more classes are analyzed stepwise, until the model does not improve further. The estimated parameters of the latent class model are the probabilities for an individual to belong to each of the classes and the probabilities for individuals in a class to endorse a specific item (Van Lier et al., 2003).

STRUCTURE OF THIS THESIS

In chapter 2, the relationship between latent class and *DSM-IV* taxonomies of ADHD symptoms is investigated in both referred and non-referred children. In chapter 3, latent class analysis is performed on teacher-rated attention deficit/hyperactivity problems in referred children and adolescents. Associated comorbidity patterns are studied as well. In chapter 4, cross-informant and cross-setting differences in ADHD symptoms are investigated in referred children and adolescents. In chapter 5, latent classes of mother-reported disruptive behavior in referred adolescents are studied. In chapter 6, the outcome of disruptive behavior in latent classes of referred children and adolescents is investigated. Finally, in chapter 7, main findings and conclusions of this thesis are discussed. Moreover, implications and recommendations for further research are given.

Chapter 2

Latent class analysis supports *DSM-IV* taxonomy of ADHD

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ABSTRACT

Objective: To compare latent class and *DSM-IV* taxonomies of Attention-Deficit/ Hyperactivity Disorder (ADHD) in referred and non-referred children and to investigate patterns of disruptive behavior disorders in relation to both taxonomic approaches.

Methods: Mothers of 8- to 12-year-olds, 161 from a clinical and 211 from a general population sample, were interviewed with the Diagnostic Interview Schedule for Children-Parent Version. Latent class analysis (LCA) of ADHD symptom scores within each sample was compared with *DSM-IV* diagnoses of ADHD, Oppositional Defiant Disorder (ODD), and Conduct Disorder (CD).

Results: LCA yielded four ADHD classes: a combined class, an inattentive-impulsive class, a predominantly hyperactive-impulsive class, and a low class. The hyperactive-impulsive class as well as the hyperactive-impulsive type of ADHD according to *DSM-IV* were only found in the referred sample. The LCA and *DSM-IV* taxonomies of ADHD tended to converge. Disruptive comorbidity (ODD or CD) was present within each latent class, with a tendency towards the combined class.

Conclusions: The LCA and the *DSM-IV* taxonomies yielded comparable classifications in eight- to twelve-year-olds. Disruptive comorbidity was most frequently found in the combined class.

INTRODUCTION

To facilitate and enhance research regarding the etiology, prognosis, and treatment of psychiatric disorders, development and improvement of diagnostic systems are needed. Child psychiatric diagnostic systems try to identify groups of children that share patterns of symptoms. Children within such homogeneous groups might need similar treatments or share common etiologies.

The current taxonomy of Attention-Deficit/Hyperactivity Disorder (ADHD) as described by *DSM-IV* (American Psychiatric Association, 1994; Task Force on *DSM-IV*, 1991, 1993), lists three subtypes: the predominantly inattentive type, the predominantly hyperactive-impulsive type, and the combined type.

Despite the fact that the development of the concept of ADHD has received a great deal of scientific attention across time, data supporting the validity of the inattentive and the hyperactive-impulsive subtypes are still scarce. In a study of the stability of the *DSM-IV* subtypes from preschool through primary school, children who met criteria for the combined subtype met criteria for ADHD in more subsequent assessments than children in the predominantly hyperactive-impulsive subtype. Thirty-seven percent of children with combined subtype, and 50% of children with inattentive subtype met criteria for a different subtype at least twice in the six reassessments. Children with hyperactive-impulsive type ADHD rarely remained in this subtype classification over time, but shifted to combined type in later years instead (Lahey et al., 2005). Todd et al. (2008) found a poor to modest five-year ADHD subtype stability, of which the most stable was the combined type, with a subtype stability of 24%, while the inattentive and hyperactive-impulsive subtypes had stabilities of, respectively, 18% and 11%. Hence, it can be concluded that the stability of a diagnosis of the combined subtype of ADHD is modest, while the stability is poor for the other two subtypes. Besides, the validity of the inattentive and hyperactive-impulsive type is not sufficiently supported by empirical data. The hyperactive-impulsive subtype differs from the inattentive and combined subtypes in age distribution and in association with neuropsychological parameters (Weber et al., 2007). Since inattention is the hypothesized core symptom of ADHD, and since sufficient inattentive symptoms are lacking in the hyperactive-impulsive subtype, it is not clear whether children with this subtype have the same disorder as children with the inattentive and combined subtypes (Woo and Rey, 2005). In light of the development of *DSM-V*, it is important to test the current *DSM* taxonomy of ADHD.

Taxonomy, the identification of groups of children sharing patterns of symptoms, can be approached in different ways. One approach is exemplified by the *DSM* taxonomy, which is based on expert consensus, and therefore on combined experience of leading clinicians. Another approach is latent class analysis (LCA; McCutcheon, 1987), which is a bottom-up, empirical approach for identifying homogeneous groups of children, classes, based on empirical data.

Parent-report data regarding ADHD symptoms were analyzed with LCA in general population samples of child and adolescent twins (Hudziak et al., 1998; Neuman et al., 1999; Rasmussen et al., 2002a, 2004; Todd et al., 2001) and in a sample of child and adolescent offspring of families ascertained through an alcoholic proband (Neuman et al., 1999). Neuman et al. (1999) used the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA; Bucholz et al., 1994) for the assessment of ADHD symptoms and only found support for an inattentive subtype and a combined subtype, but not for a hyperactive-impulsive subtype. The other studies that used parent-report data found separate inattention and hyperactivity-impulsivity classes, next to combined inattention/hyperactivity-impulsivity classes. For instance, Todd et al. (2001) applied LCA to ADHD symptoms, reported by the parent on the Diagnostic Interview for Children and Adolescents-Revised-Parent version (DICA-R; Reich, 1996) and on the SSAGA, in a general population sample of 4,036 female twins aged 13 to 23 years. They found a mild and a severe inattentive, a mild and a severe hyperactive-impulsive, and a mild and a severe combined class.

Self-report data were used by Rohde et al. (2001) and by Rasmussen et al. (2002b). Rohde et al. (2001) investigated male and female adolescents from the general population, aged 12 to 24 years, and applied LCA to the self-reported ADHD symptoms on an instrument including all 18 *DSM-IV* ADHD symptoms. They found that an LCA model with eight classes fitted best, and they found that class solutions were different from previous analyses of parent report data. In contrast to the previous studies, a smaller proportion of adolescents was in the class with few problems, and no class with inattention problems only was identified. Rasmussen et al. (2002b) analyzed self-reported ADHD symptoms of 980 males, aged 12 to 19 years, from the general population as well, using the Australian Twin Behaviour Rating Scale (ATBRS; Hay et al., 2001). LCA yielded several combined symptom classes but few strictly inattentive or strictly hyperactive-impulsive classes.

Teacher-report data were used by De Nijs et al. (2007a). In a referred sample of 4,422 children and adolescents, rated by the teacher on the Teacher's Report Form (TRF; Achenbach, 1991b; Achenbach and Edelbrock, 1986; Achenbach and Rescorla, 2001; Verhulst et al., 1997), LCA yielded 3 different groups with both inattention and hyperactivity-impulsivity, and one group with high scores on inattention but low scores on hyperactivity-impulsivity. A group of patients with predominantly hyperactivity and impulsivity was not found.

From these studies, no definitive conclusions about ADHD taxonomy can be drawn. The latent class structures that were found, tended to differ by informant. Several studies failed to find a hyperactive-impulsive class.

Most of the previous studies that performed LCA were based on parent or teacher reports of children from the general population. According to our present knowledge, studies that performed LCA on all *DSM* ADHD symptoms in clinically referred children are lacking. In order to improve ADHD taxonomy, it is important to compare latent classes of ADHD

symptoms, measured with a *DSM*-based instrument, in both samples from the general population and clinically referred samples. Since groups of children who share patterns of symptoms, may have different prevalences in a clinical and in a general population setting, due to referral patterns, classes found in referred samples should be compared with classes in general population samples, in order to find out which classes from both samples are the same and which are sample-specific.

It is also important to study comorbidity patterns of the ADHD classes. Patterns of comorbidity may have implications for diagnosis and intervention (Gillberg et al., 2004). ADHD frequently co-occurs with Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD) (Dick et al., 2005; Gadow & Nolan, 2002). Patients with both ADHD and ODD displayed more problems in the relationship with teachers, friends, and with their mothers, than patients with 'pure' ADHD (Harada et al., 2002). Previous studies found significant comorbidity associated with the high symptom level ADHD latent classes (Neuman et al., 2001; Volk et al., 2005, 2006). In previous work using LCA, substantial overlap between ADHD, Oppositional Defiant Disorder (ODD), and Conduct Disorder (CD) symptoms was found in children and adolescents, both in the general population (Sondeijker et al., 2005; Van Lier et al., 2003) and in a referred sample (De Nijs et al., 2007b). In a teacher-rated referred sample, significantly higher levels of ODD and CD problems were found in a class with higher levels of ADHD problems (De Nijs et al., 2007a).

The aim of the present study was to compare latent class and *DSM-IV* taxonomies of ADHD in referred and non-referred children and to investigate the patterns of disruptive behavior disorders in relation to both taxonomic approaches.

METHODS

Participants/Subjects

Referred sample. The mothers of 161 8- to 12-year-olds (mean age = 9.7 years; 126 boys, 35 girls), who had been referred consecutively to the outpatients' department of child and adolescent psychiatry of the University Hospital Rotterdam/Sophia Children's Hospital, between October 2003 and February 2005, were interviewed.

General population sample. This sample was drawn from a general population sample of 2,567 6- to 18-year-olds from the Dutch province of Zuid-Holland, who had been randomly selected from the municipal registers. The parents of 2,536 children could be reached. Two hundred fifty children were excluded: 191 whose parents did not speak Dutch, 31 who had physical or mental disability, 22 who departed from the study area, and 6 for whom no person could complete the questionnaire. Of the 2,286 eligible respondents, 1,710 participated. A valid Child Behavior Checklist (CBCL; Achenbach and Rescorla, 2001) was obtained from

the parents of 1,417 6- to 16-year-olds. From this sample, 8- to 12-year-olds living close to Rotterdam were randomly selected: 50 children with borderline- or clinical-range scores on the CBCL Internalizing broadband scale, 50 children with borderline- or clinical-range scores on the CBCL Externalizing broadband scale, and 111 children from the remaining sample. The mothers of these 211 children (mean age = 10.0 years; 102 boys, 109 girls) were interviewed between January 2004 and July 2006. This sample is actually an enriched sample, but in the remainder of this article, it will be indicated as the general population sample.

Measures

Diagnostic Interview Schedule for Children-Parent Version. The DISC-IV-P (Shaffer et al., 1998) is a highly structured respondent-based psychiatric interview to assess *DSM-IV* disorders found in children and adolescents. The time frame of the DISC-IV-P is the past year. Ferdinand and Van der Ende (1998) made an official Dutch translation of the DISC-IV-P. The comparison of its back-translation into English by an independent translator, with the original DISC-IV-P supported the accuracy of the Dutch translation. The DISC-IV-P and its earlier versions showed good inter-rater and test-retest reliability (Schwab-Stone et al., 1993; Shaffer et al., 1993, 1996, 2000).

For the present study, psychologists and psychology master students who were trained by the authors of the Dutch DISC-IV-P administered DISC-IV-Ps. The training schedule used was similar to the schedule used by the authors of the original version, at Columbia University, New York. *DSM-IV* disruptive behavior disorders (ADHD, ODD, CD) diagnoses during the last year were calculated according to the DISC-IV-P diagnostic algorithm.

Data analysis

LCA was performed on the ADHD symptoms of the DISC-IV-P with Mplus version 4.21 (Muthén and Muthén, 2007). In a first set of LCAs, the two data sets were analyzed separately. The objective of the LCAs was to find the smallest number of classes of individuals with distinct endorsement profiles of ADHD symptoms for each sample. For each sample, classes were added until the model did not improve further. To identify the lowest number of classes that fitted the data of the sample well, the Bayesian Information Criterium (BIC; Kass and Wasserman, 1995) was used. Sex was included in each model as a covariate to control for sex effects (Dayton and Macready, 1988).

A second set of – multiple group – LCAs (Hagenaars and McCutcheon, 2002) was conducted to test whether the classes that were found in the two subsamples were similar or different. Differences between the following two models were tested: (model 1) a latent class model with no constraints on item probabilities, and (model 2) a latent class model with equality constraints on item probabilities between the subpopulations.

RESULTS

A two-class model LCA on ADHD symptoms in the referred sample yielded a BIC value of 3,618. Going from a two-class to a three-class solution resulted in a BIC drop of 81 points, which means that adding a third class improved the model. Going from three to four classes resulted in a BIC drop of 3 points. A five-class model was unstable, i.e. it yielded different solutions when different starting values were applied. Hence, a four-class solution fitted the data of the referred sample best.

In the general population sample, a two-class model LCA on ADHD symptoms yielded a BIC value of 3,328. Going from a two-class to a three-class solution resulted in a BIC drop of 2 points. A four-class model did not yield a stable solution. Hence, a three-class solution fitted the data of the general population sample best.

In order to compare the latent class solutions in both samples in a multiple group approach, equal numbers of latent classes in both samples are necessary. Therefore, for both samples a four-class model was used, in which two classes in the general population sample were set to be equal. This multiple group model yielded a BIC value of 7,448 (model 1). When the classes that were similar in the general population sample and in the referred sample, i.e. all three classes of the general population sample, were constrained to be equal, but the remaining class of the referred sample, with medium probabilities for the Inattention and Hyperactivity items but high probabilities for Impulsivity, was allowed to vary, the BIC dropped to 7,214 (model 2), indicating an improvement of the model.

The numbers of children in each of the four classes of this optimal model (model 2), as well as their sex distribution and sample of origin, are shown in Table 2.1. In the general population sample, class 1 contained 10 boys (91%) and 1 girl (9%), while 24 boys (56%) and 19 girls (44%) were in class 2, and 68 boys (43%) and 89 girls (57%) were in class 4. In the referred sample, class 1 contained 44 boys (83%) and 9 girls (17%), class 2 contained 36 boys (78%) and 10 girls (22%), class 3 contained 19 boys (91%) and 2 girls (9%), while 27 boys (66%) and 14 girls (34%) were in class 4.

Class-specific probabilities for ADHD symptoms are presented in Figure 2.1. For instance, it can be seen in Figure 2.1 that the probability of having a positive score on the item “difficulty sustaining attention” for members of class 2 is about .6, while this probability is about .05 for members of class 4. The profiles of the latent classes are described in Table 2.1.

The numbers of children fulfilling criteria for the three *DSM-IV* subtypes of ADHD, for ODD, and for CD, as well as their sex distribution and sample of origin, are shown in Table 2.2. In the general population sample, 17 children (8%) fulfilled criteria for ADHD, of whom 14 (7%) had inattentive type and 3 (1%) had combined type ADHD, 17 (8%) fulfilled criteria for ODD, and 1 (1%) for CD. Eighty children (50%) from the referred sample fulfilled criteria for ADHD, of whom 36 (22%) with inattentive type, 10 (6%) with hyperactive-impulsive type, and 34 (21%) with combined type ADHD, while 49 (30%) fulfilled criteria

for ODD and 10 (6%) for CD. The relationship between disruptive behavior *DSM* (DISC-IV-P) diagnoses and LCA classes is also shown in Table 2.2.

Table 2.1. Latent classes membership: sex distribution and sample of origin.

Class	Profile			Members	Sex (%)		Sample (%)	
	Inattention	Hyperactivity	Impulsivity	Number (%[1])	Boys[2]	Girls[3]	General population[4]	Referred[5]
1	high	high	high	64 (17%)	84	16	17	83
2	medium	low	medium	89 (24%)	67	33	48	52
3	medium	medium	high	21 (6%)	91	9	0	100
4	low	low	low	198 (53%)	48	52	79	21

Note: 1 Percentages in parentheses represent the class members as part of the total sample
2 Percentages in this column represent the boys in the class as part of the total number of members of the class
3 Percentages in this column represent the girls in the class as part of the total number of members of the class
4 Percentages in this column represent the children from the general population as part of the total number of members of the class
5 Percentages in this column represent the referred children as part of the total number of members of the class

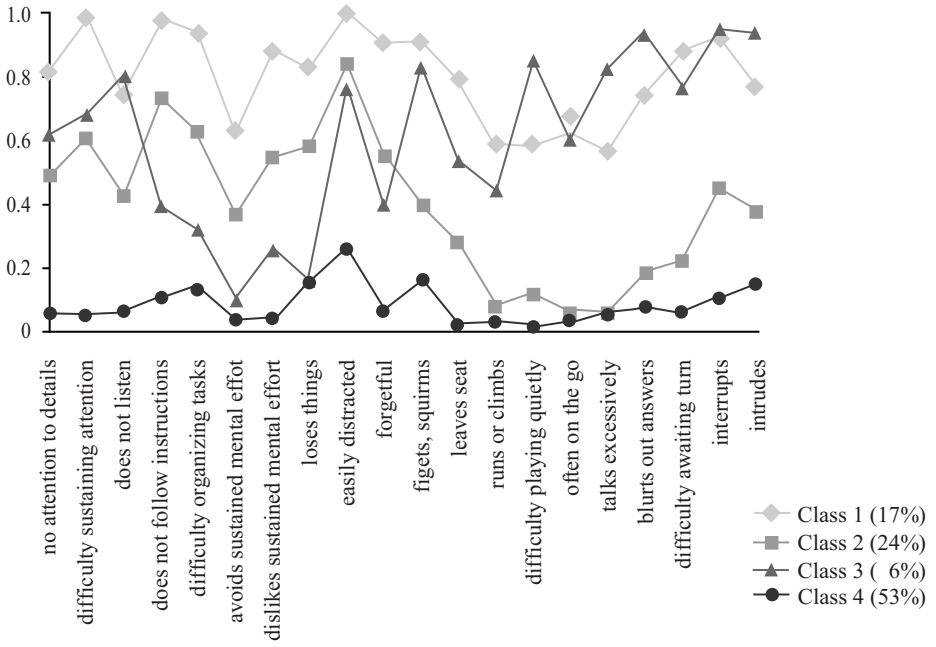

Figure 2.1. Probabilities of ADHD symptoms.

Table 2.2. Disruptive behavior *DSM* (DISC-IV-P) diagnoses: sex distribution, sample of origin, and relation to ADHD symptoms latent classes.

DISC-IV-P diagnosis	Frequency	Sex (%[2])		Sample (%[3])		Class (%[4])			
	Number (%[1])	Boys	Girls	General population	Referred	1	2	3	4
Attention-Deficit/Hyperactivity Disorder (ADHD)	97 (26%)	84	16	18	82	57 (59%)	28 (29%)	12 (12%)	0 (0%)
inattentive type	50 (13%)	78	22	28	72	22 (44%)	28 (56%)	0 (0%)	0 (0%)
hyperactive-impulsive type	10 (3%)	80	20	0	100	1 (10%)	0 (0%)	9 (90%)	0 (0%)
combined type	37 (10%)	92	8	8	92	34 (92%)	0 (0%)	3 (8%)	0 (0%)
Oppositional Defiant Disorder (ODD)	66 (18%)	77	23	26	74	31 (47%)	14 (21%)	8 (12%)	13 (20%)
Conduct Disorder (CD)	11 (3%)	73	27	9	91	4 (36%)	3 (27%)	3 (27%)	1 (9%)

Note: 1 Percentages in parentheses represent the children fulfilling criteria for a specific DISC-IV-P diagnosis as part of the total sample
2 Percentages in these columns represent the sex distribution of the children with a specific DISC-IV-P diagnosis
3 Percentages in these columns represent the sample of origin distribution of the children with a specific DISC-IV-P diagnosis
4 Percentages in parentheses represent the class members as part of the number of children with a specific DISC-IV-P diagnosis

DISCUSSION

This study investigated patterns of interview-based ADHD symptoms in a combined clinical and general population sample. Four homogeneous groups were identified using LCA: a combined class, class 1, with high scores on both Inattention and Hyperactivity-Impulsivity; an inattentive-impulsive class, class 2, with medium scores on Inattention and on Impulsivity, but low scores on Hyperactivity; a predominantly hyperactive-impulsive class, class 3, with medium/high scores on Hyperactivity-Impulsivity and medium scores on Inattention; and a low class, class 4, with low scores on all ADHD symptom domains. All four classes were present in both the general population and the referred sample, except class 3, the hyperactive-impulsive class, which was only found in the referred sample.

The combined class showed a profile that resembled the combined type of ADHD, while the inattentive-impulsive class resembled, to a certain extent, the predominantly inattentive type of ADHD. The predominantly hyperactive-impulsive class showed resemblance to the hyperactive-impulsive type of ADHD.

The hyperactive-impulsive class was not found in the general population sample. This was in accordance with Neuman et al. (1999), who did not find support for a hyperactive-impulsive subtype of ADHD in a parent-rated sample from the general population. Our finding was not in accordance, though, with Todd et al. (2001), who found a mild and a severe inattentive, a mild and a severe hyperactive-impulsive, and a mild and a severe combined class of ADHD in a parent-rated sample of female twins from the general population, although none of the subjects in the mild hyperactive-impulsive latent class and only 28% of the subjects in the severe hyperactive-impulsive latent class fulfilled *DSM-IV* criteria for an ADHD diagnosis.

Fifty percent of the children in the referred sample of the present study fulfilled *DSM-IV* criteria for ADHD. Not all referred children would be expected to fulfill criteria for ADHD, since not all children had been referred for assessment of ADHD. The *DSM* inattentive and combined subtypes were the most prevalent in the referred sample. In the general population sample, a prevalence of ADHD of 8% was found. Seven percent of the general population sample fulfilled criteria for inattentive type ADHD, whereas combined type ADHD was present in 1%. This was comparable to the study by Adewuya and Famuyiwa (2007), who found, in a general population sample of Nigerian primary school children, a prevalence of ADHD of 9%, with subtype prevalences of 5% for the inattentive type, 3% for the combined type, and 1% for the hyperactive-impulsive type. Polanczyk et al. (2007) found a worldwide-pooled prevalence for ADHD of 5%, but they did not determine ADHD subtypes in their meta-analysis. In the present study, children with hyperactive-impulsive type of ADHD were only found in the referred sample.

It is unclear whether the presence of hyperactive-impulsive symptoms determines referral, since, e.g., symptoms of autism and other pervasive developmental disorders (PDDs) were not investigated in the present study. The high prevalence of the combined class within the referred sample could be influenced by the occurrence of Berkson's bias. According to Berkson (1950), high rates of comorbidity between two symptom clusters seen in clinical practice may be in part an artifact if both symptom clusters independently influence help-seeking behavior and need for care. This phenomenon will, therefore, result in a higher estimate of the comorbidity between those symptom clusters in clinical samples than in general population samples. This hypothesis is, however, refuted by the findings by Todd et al. (2001), who found several combined classes in a general population sample.

When the *DSM-IV* and the LCA taxonomies were compared, we found high degrees of overlap between the combined class and combined type ADHD; between the inattentive-impulsive class and inattentive type ADHD; and between the predominantly hyperactive-

impulsive class and hyperactive-impulsive type ADHD. This convergence of *DSM-IV* and the LCA approach is in accordance with findings by Rasmussen et al. (2002a), who found substantial overlap between the inattentive *DSM-IV* subtype and the severe inattentive latent class, and between the combined *DSM-IV* subtype and the severe combined latent class.

Sex differences in prevalence

In the combined and inattentive-impulsive classes, both in the referred sample and the general population sample, a predominance of boys was found. In the hyperactive-impulsive class, which was only found in the referred sample, boys outnumbered girls as well. This was in accordance with Nolan et al. (2001), who found, in a US general population sample of 3- to 18-year-olds, that boys outnumbered girls for all ADHD subtypes, except for the predominantly inattentive type in young children. Gomez et al. (1999) found, in a sample of Australian primary school children, a male to female ratio in ADHD of 5 : 1, while Bauermeister et al. (2007) found, in a community sample of four- to seventeen-year-olds in Puerto Rico, that ADHD was 2.3 times more common in boys than in girls. Adewuya and Famuyiwa (2007) found, among Nigerian primary school children, a male to female ratio of 2 : 1 for all the subtypes of ADHD, except for the hyperactive-impulsive subtype, which was 3.2 : 1. With regard to *DSM-IV* diagnoses it was found in the present study that for all subtypes of ADHD, as well as for ODD and CD, boys outnumbered girls. It can be concluded that the relative gender specificity of ADHD has consistently been found across different cultures.

Comorbidity

Thirty percent of the referred sample fulfilled ODD criteria, while 6% of the referred sample fulfilled CD criteria. Within the general population sample, these percentages were much lower, as expected. The relatively low frequency of CD within the referred sample can be explained by the young age of the studied group.

Disruptive comorbidity (ODD or CD) was present within each ADHD latent class, with a tendency towards the combined class. This is in line with previous findings by Volk et al. (2005), who found *DSM-IV* diagnosis of ODD to be greatest in the severe combined ADHD latent class (57%), whereas the prevalence of *DSM-IV* CD was nearly equal in the severe combined and mild combined ADHD latent classes (13% and 14%, respectively), while they found that 10% of subjects in the severe inattentive ADHD latent class met criteria for *DSM-IV* CD. This is also in accordance with findings by Nadder et al. (2002), which indicated that the comorbidity between ADHD and ODD/CD is likely to be due to a shared genetic liability, but that additional genetic factors were specific for ODD/CD symptoms. This is in line with our finding that also in the low ADHD classes, substantial proportions of the children fulfilled ODD criteria.

In the present study, internalizing comorbidity was not investigated. Possibly, the children in the inattentive-impulsive class had a combination of inattentive and affective symptoms, displaying higher levels of internalizing comorbidity than the other classes, as was found in previous work that investigated teacher-rated ADHD symptoms subtypes and comorbidity patterns (De Nijs et al., 2007a). A combination of affective and inattentive symptoms is also seen in depressive disorder.

In the present study, symptoms of autism and other PDDs were not investigated, although referral for PDD diagnostic evaluation was very common in the referred sample. It can be hypothesized that in a substantial number of referred subjects in the present study were suffering from PDD, since high rates of psychiatric comorbidity, especially ADHD and ODD, but also CD, have been found in PDD-NOS (De Bruin et al., 2007).

Clinical implications

The results of this study indicated that the LCA and *DSM-IV* taxonomies of ADHD tended to converge. A predominantly hyperactive-impulsive latent class was only found within the referred sample. Patients fulfilling criteria for hyperactive-impulsive type ADHD according to *DSM* criteria were also found only in the referred sample. In clinical practice, the hyperactive-impulsive type can be expected to be more prevalent than in the general population, due to a higher chance of referral of these children.

Instead of a 'pure' inattentive class, inattentive-impulsive classes were found in both samples. This highlights the need for the clinician to expect a certain degree of impulsive behavior even in the ADHD child with predominantly inattention symptoms. Inattentive type ADHD, ADD (Attention-Deficit Disorder), was rather prevalent in the general population and might not be detected by parents and teachers as a problem requiring clinical attention. ADD may have a different etiology and may require a different treatment than combined type ADHD. For instance, Houghton et al. (1999) found a more severe level of perseveration and response inhibition deficit in children with combined type ADHD than in children with inattentive type ADHD, and Lockwood et al. (2001) found differences between these ADHD subtypes on tasks associated with executive control and on selective attention tasks as well.

Disruptive comorbidity (ODD/CD) was predominantly associated with the combined and predominantly hyperactive-impulsive ADHD classes. For the clinician, this indicates the awareness of disruptive behavior problems as frequent comorbidity especially in children with combined type ADHD.

Limitations

The value of the present study was limited by the use of a parent interview only. It is known that parents often disagree with other informants, teachers for instance, about the presence or absence of disruptive behaviors (Achenbach et al., 1987; De Nijs et al., 2004). Future

studies that make use of information from other informants as well, may provide valuable additional information regarding latent classes of disruptive behaviors in children. Second, only children aged 8-12 were investigated. Third, both latent class and *DSM-IV* taxonomy were based on the same measure, DISC-IV-P.

Conclusion

In this study, patterns of parent-reported ADHD symptoms through a standardized psychiatric interview (DISC-IV-P) in both a general population sample and a clinically referred sample revealed several homogeneous classes, in which a predominantly hyperactive-impulsive latent class as well as children fulfilling criteria of the hyperactive-impulsive subtype of ADHD were only found in the referred sample. The latent class and *DSM-IV* taxonomies of ADHD tended to converge. Disruptive comorbidity (ODD/CD) was predominantly, but not exclusively, associated with the combined ADHD latent class.

Chapter 3

No hyperactive-impulsive subtype in teacher-rated Attention-Deficit/ Hyperactivity Problems

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Frank Verhulst

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ABSTRACT

Objective: The aim of this study was to investigate which homogeneous groups, according to teacher reports of Attention-Deficit/Hyperactivity (ADH) Problems on the Teacher's Report Form (TRF), can be identified.

Methods: In a referred sample (n = 4,422; age = 6 – 18 years; mean age = 9.9 years; 66% boys, 34% girls), latent class analysis (LCA) was conducted on ADH Problems. In addition, comorbidity levels in the different ADH Problems groups were compared.

Results: LCA yielded three different groups of children and adolescents with both Inattention and Hyperactivity-Impulsivity, and one group with high scores on Inattention but low scores on Hyperactivity-Impulsivity. A group of patients with predominantly hyperactivity and impulsivity was not found. Individuals in groups with higher levels of ADH Problems had significantly higher levels of Oppositional Defiant (OD) and Conduct Problems, and, although to a lesser extent, significantly higher levels of Affective and Anxiety Problems than individuals in groups with lower levels of ADH Problems.

Conclusions: It may not be useful to discern the hyperactive-impulsive type of ADHD.

INTRODUCTION

Development and improvement of taxonomic systems that describe psychopathology in children and adolescents facilitate and enhance research regarding the aetiology, prognosis, and treatment of psychiatric disorders. This can be illustrated by the history of the taxonomy of Attention-Deficit/Hyperactivity Disorder (ADHD). After early descriptions by Still (1902) and Tredgold (1908), children with hyperactive and impulsive behavior were thought to be suffering from minimal brain damage or dysfunction (MBD) by the 1950s and 1960s. *DSM-II* (American Psychiatric Association, 1968) described the Hyperkinetic Reaction of Childhood. During the 1970s, hyperactivity was linked to deficits in attention, which gave rise to the concept of Attention-Deficit Disorder (ADD) in *DSM-III* (American Psychiatric Association, 1980). *DSM-III* introduced specific symptom lists and numerical cut-off scores. Subtypes of ADD were defined, based on the presence or absence of hyperactivity (+H/-H). *DSM-III-R* (American Psychiatric Association, 1987) only provided criteria for ADD+H, now called Attention-Deficit/Hyperactivity Disorder (ADHD). ADD-H was not considered to be a subtype of ADD anymore but was moved to the category of Undifferentiated ADD, because, at that time, insufficient evidence supported its definition (Spitzer et al., 1990). *DSM-IV* (American Psychiatric Association, 1994; Task Force on *DSM-IV*, 1991, 1993) describes three subtypes of ADHD: the predominantly inattentive type, the predominantly hyperactive-impulsive type, and the combined type. Despite the fact that the development of the concept of ADHD has had a great deal of scientific attention across time, it is still unclear whether these subtypes represent the most useful way of characterizing individuals with different types of problems of attention, hyperactivity, and impulsivity.

One way to investigate the taxonomy of ADHD is to perform factor analysis on ADHD symptom ratings regarding large samples of children and adolescents. Several studies applied a factor analytic approach (e.g. Gomez et al., 1999; Hudziak et al., 1998). However, factor analysis strictly does not yield information about the way the most homogeneous groups of children, based on the presence or absence of symptoms, can be identified. For that purpose, latent class analysis seems to be more useful (LCA; McCutcheon, 1987).

Parent-report data regarding ADHD symptoms were analyzed with LCA by Neuman et al. (1999), Hudziak et al. (1998), Todd et al. (2001), and Rasmussen et al. (2002a, 2004). Neuman et al. (1999) only found support for an inattentive subtype and a combined subtype, but not for a hyperactive-impulsive subtype. The other studies that used parent-report data found separate inattention and hyperactivity-impulsivity classes, next to combined inattention/hyperactivity-impulsivity classes. For instance, Todd et al. (2001) applied LCA to ADHD symptoms, reported by the parent on the Diagnostic Interview for Children and Adolescents-Revised-Parent version (DICA-R; Reich, 1996) and the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA; Bucholz et al., 1994), in a general population sample of

4,036 female twins aged 13 to 23 years. They found a mild and a severe inattentive, a mild and a severe hyperactive/impulsive, and a mild and a severe combined class.

Self-report data were used by Rohde et al. (2001) and by Rasmussen et al. (2002b). Rohde et al. (2001) investigated male and female adolescents from the general population, aged 12 to 24 years, and applied LCA to their self-reported ADHD symptoms. They found that an LCA model with eight classes fitted best, and they found that class solutions were different from previous analyses of parent report data. Rasmussen et al. (2002b) analyzed self-reported ADHD symptoms of 980 males, aged 12 to 19 years, from the general population as well, using the Australian Twin Behaviour Rating Scale (ATBRS; Hay et al., 2001). LCA yielded several combined symptom classes but few strictly inattentive or strictly hyperactive-impulsive classes.

In all studies performed thus far, general population samples were investigated. Although general population samples are important for testing the validity and natural occurrence of clinic-based definitions of illness, in a general population sample only a relatively small number of children and adolescents with elevated problem levels will be found. Referred samples can be used to find subtypes of disorders. For instance, in a referred sample a strictly hyperactive-impulsive class might still be present, and might be detected with LCA. Furthermore, all previous LCA studies used parent or self-report information. Teacher information was not used. The school situation is very different from the generally less structured situation at home. Maintaining attention and controlling hyperactivity and impulsivity are more important in school than at home, which makes information about behavior at school very important for assessment of ADHD. Taxonomy might be situation-sensitive or even situation-specific. Information from the teacher is necessary to assess ADHD problems in school; teacher information is very different from parent or self-report data (Achenbach et al., 1987a, 1987b; De Nijs et al., 2004; Gadow et al., 2004). Therefore, studies of ADHD taxonomy using teacher information are needed.

It is important to study clinical correlates of the ADHD classes that were found. This can be done by investigating comorbidity patterns of each class. Patterns of comorbidity may have implications for diagnosis and intervention (Gillberg et al., 2004). ADHD frequently co-occurs with Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD) (Dick et al., 2005; Gadow & Nolan, 2002), but also with anxiety symptoms (Jensen et al., 1994). Patients with both ADHD and ODD displayed more problems in the relationship with teachers, friends, and with their mothers, than patients with ‘pure’ ADHD; they also had more depression and anxiety symptoms than ADHD-only patients (Harada et al., 2002). Previous studies found significant comorbidity associated with the severe ADHD latent classes (Neuman et al., 2001; Volk et al., 2005, 2006).

The first aim of the present study was to investigate which homogeneous groups of children and adolescents, according to teacher reports of inattention and hyperactivity/

impulsivity symptoms, can be identified in a large referred sample. The second aim was to investigate the comorbidity patterns of these groups.

METHODS

Sample

The sample consisted of 4,422 6- to 18-year-olds (mean age = 9.9 years; 2,927 boys, 1,495 girls). All participants were referred consecutively to the outpatients' department of child and adolescent psychiatry of the University Hospital Rotterdam/Sophia Children's Hospital (n = 3,340) or to a community mental health centre in Rotterdam (n = 1,082), between April 1983 and August 2003. The use of data from a university clinic and a community mental health clinic has possibly reduced effects of referral bias, by yielding a sample of children and adolescents with a broad range of problems and a wide variety of problem levels. This was important for the detection of groups with higher levels as well as groups with moderate or low levels of Attention-Deficit/Hyperactivity (ADH) Problems. Data obtained from teachers were used.

Procedure and measures

Teacher's Report Form. The Teacher's Report Form (TRF) is a teacher questionnaire for assessing problems in children and adolescents. The first version (Achenbach and Edelbrock, 1986) was developed for 4- to 16-year-olds. It contains 120 items on behavioral or emotional problems in the past six months. The response format is 0 = not true, 1 = somewhat or sometimes true, and 2 = very true or often true. A second version of the TRF for age 4 to 18 years was developed in 1991 (Achenbach, 1991b), and a third version for age 6 to 18 years in 2001 (Achenbach and Rescorla, 2001).

The original empirical syndrome scales for the TRF were based on multivariate statistical analyses on data from large samples. To fit more closely to the clinical-diagnostic approach, represented by the *DSM* (American Psychiatric Association, 1994), the following *DSM-IV* scales were constructed for the TRF: Affective Problems, Anxiety Problems, Somatic Problems, Attention-Deficit/Hyperactivity (ADH) Problems, Oppositional Defiant (OD) Problems, and Conduct Problems (Achenbach and Dumenci, 2001; Achenbach et al., 2003).

In the present study, all scales except the Somatic Problems scale were used. Table 3.1 shows the ADH Problem items of the TRF, as well as the percentages of positive item scores. Item 5, "There is very little that he/she enjoys", part of the Affective Problems scale, and item 28, "Breaks school rules", part of the Conduct Problems scale, had been added to later versions of the TRF and were not included in the analyses. The good reliability and validity

of the American version of the TRF (Achenbach, 1991b; Achenbach and Edelbrock, 1986; Achenbach and Rescorla, 2001) were confirmed for the Dutch translation (De Groot et al., 1996; Verhulst et al., 1997).

Table 3.1. ADH Problems: percentages of positive scores.

	Scores (%)	
	1	2
Inattention:		
4. Fails to finish things he/she starts	29	18
8. Can't concentrate, can't pay attention for long	34	39
22. Difficulty following directions	35	25
78. Inattentive or easily distracted	27	33
100. Fails to carry out assigned tasks	30	11
Hyperactivity-Impulsivity:		
10. Can't sit still, restless, or hyperactive	27	28
15. Fidgets	27	24
24. Disturbs other pupils	29	26
41. Impulsive or acts without thinking	28	28
53. Talks out of turn	24	26
67. Disrupts class discipline	23	17
93. Talks too much	24	18
104. Unusually loud	22	18

Note: ADH = Attention-Deficit/Hyperactivity.

Analyses

Mplus version 3.0 was used (Muthén and Muthén, 2004) for performing LCA. The TRF items were not dichotomized, but instead, multiple levels of endorsement probability were used. First, we searched for a one-class model for the items of the ADH Problems scale. Next, a two-class model was searched for. The same analyses were run with different starting values to avoid a local maximum. A Bayesian Information Criterium (BIC; Kass and Wasserman, 1995) was applied to check whether the two-class model fitted better than the one-class model. In the same way, models with three and more classes were analyzed stepwise, until the model did not improve further. Age and gender were included as covariates (Dayton and Macready, 1988; Leadbeater et al., 1999).

To compare comorbidity levels in the different ADH Problems classes, an ANOVA was performed for each of the four scales assessing comorbidity – Affective Problems, Anxiety

Problems, OD Problems, and Conduct Problems. After each ANOVA, post hoc tests were performed, using Gabriel's procedure (Gabriel, 1978).

RESULTS

ADH Problems

A two-class model LCA on ADH Problems items yielded a BIC value of 93,819. Going from a two-class to a three-class solution resulted in a BIC drop of 4,211 points, which means that adding a third class improved the model. BIC values indicated that a five-class solution fitted the data best; going from three to four classes resulted in a BIC drop of 1,693 points; from four to five classes, BIC dropped by 1,119 points. A six-class model did not converge.

Six hundred ninety-four (16%) adolescents were in class 1, 737 (17%) in class 2, 1,046 (24%) in class 3, 774 (18%) in class 4, and 1,171 (27%) in class 5. Class 1 contained 594 (86%) boys and 100 (14%) girls, class 2 589 (80%) boys and 148 (20%) girls, class 3 728 (70%) boys and 318 (30%) girls, class 4 457 (59%) boys and 317 (41%) girls, and class 5 559 (48%) boys and 612 (52%) girls (Table 3.2).

Class-specific probabilities for ADH Problems items are presented in Figure 3.1. The upper part of Figure 3.1 shows the probability of having a '1' or a '2' score, by adding the item endorsement probabilities for '1' and '2' scores. For instance, it can be seen in the upper part of Figure 3.1 that the probability of having a '1' or a '2' score on the item "fails to do tasks" for members of class 1 is about .8, while this probability is about .3 for members of class 3. The lower part of Figure 3.1 shows the probability of having a '2' score on the ADH Problems items for the five ADH Problems classes.

Class 1 was characterized by high scores on both Inattention and Hyperactivity-Impulsivity. Class 2 represented individuals with high scores on Inattention and somewhat lower scores on Hyperactivity-Impulsivity. Individuals in class 3 had medium scores on Inattention and Hyperactivity-Impulsivity. Class 4 patients had high Inattention scores and low Hyperactivity-Impulsivity scores. Class 5 represented individuals with low scores on Inattention and on Hyperactivity-Impulsivity.

Sex and age were used as covariates. The effect of sex on class membership is shown in Table 3.2. Classes 1-3 contained more boys than girls. Class 4 contained 41% girls, while class 5 contained more girls than boys. The effect of age on the probability of class membership is shown in Figure 3.2. The probability of belonging to classes 1-3 was higher in younger children, as compared to older children, while the probability of belonging to classes 4 and 5 was higher in older children.

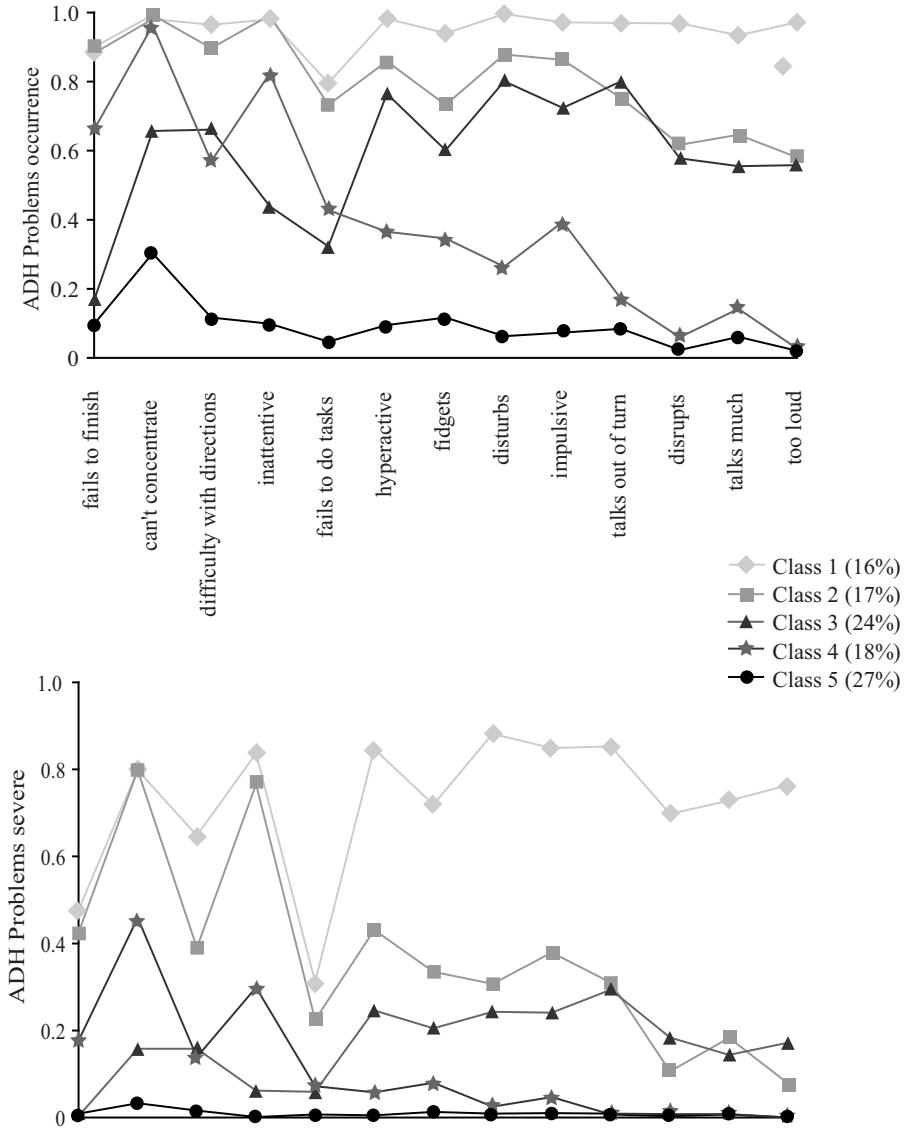

Figure 3.1. Probability of ADH Problems items.

Note: Occurrence indicates the probability of a '1' or a '2' score = the probability of a '1' score + the probability of a '2' score; Severe indicates the probability of a '2' score.

Table 3.2. Sex effect on class membership.

Profile			Members	Sex distribution (%)	
Class	Inattention	Hyperactivity-Impulsivity	Number (%)	Boys	Girls
1	high	high	694 (16%)	86	14
2	high	medium	737 (17%)	80	20
3	medium	medium	1,046 (24%)	70	30
4	high	low	774 (18%)	59	41
5	low	low	1,171 (27%)	48	52

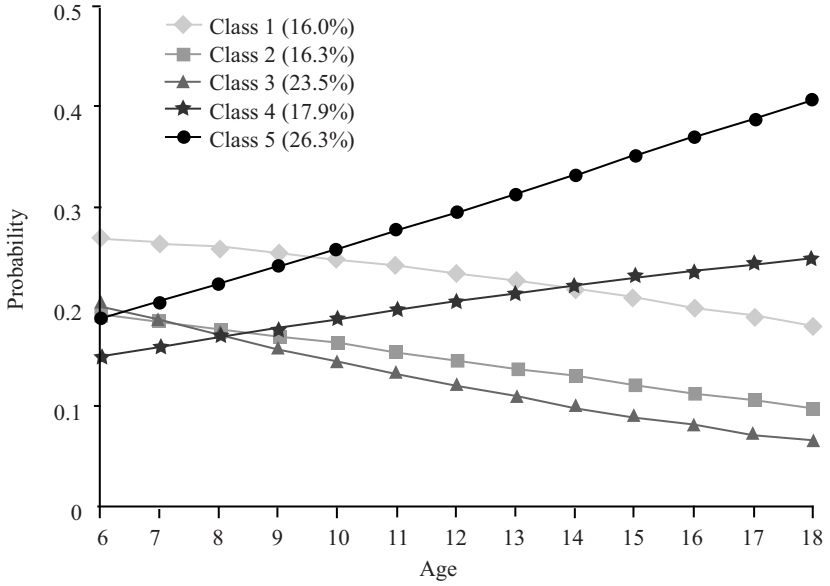

Figure 3.2. Age effect on probability of class membership.

Comorbidity

ANOVAs showed differences between the classes on the following TRF scales: Affective Problems, $F(4, 250) = 49.89$, $p < .001$, $\eta^2 = .23$; Anxiety Problems, $F(4, 247) = 9.68$, $p < .001$, $\eta^2 = .09$; OD Problems, $F(4, 257) = 239.90$, $p < .001$, $\eta^2 = .51$; and Conduct Problems, $F(4, 247) = 133.39$, $p < .001$, $\eta^2 = .44$. The results of post hoc tests, performed using Gabriel's procedure ($\alpha = .05$), are shown in Figure 3.3. For instance, individuals in class 1 had significantly higher levels of OD and Conduct Problems than individuals in class 2. They did not differ significantly with respect to Affective or Anxiety Problems levels. Individuals in class 3 had significantly higher levels of OD and Conduct Problems than individuals in class 4, but significantly lower levels of Affective and Anxiety Problems.

Within class 1, levels of Affective Problems ($t(651) = -2.30$, $p = .02$) and levels of Anxiety Problems ($t(649) = -2.81$, $p < .01$) were higher in girls than in boys, whereas levels of Conduct Problems were higher in boys than in girls ($t(622) = 2.85$, $p < .01$) and levels of OD Problems did not differ by gender ($t(676) = .07$, $p = .94$).

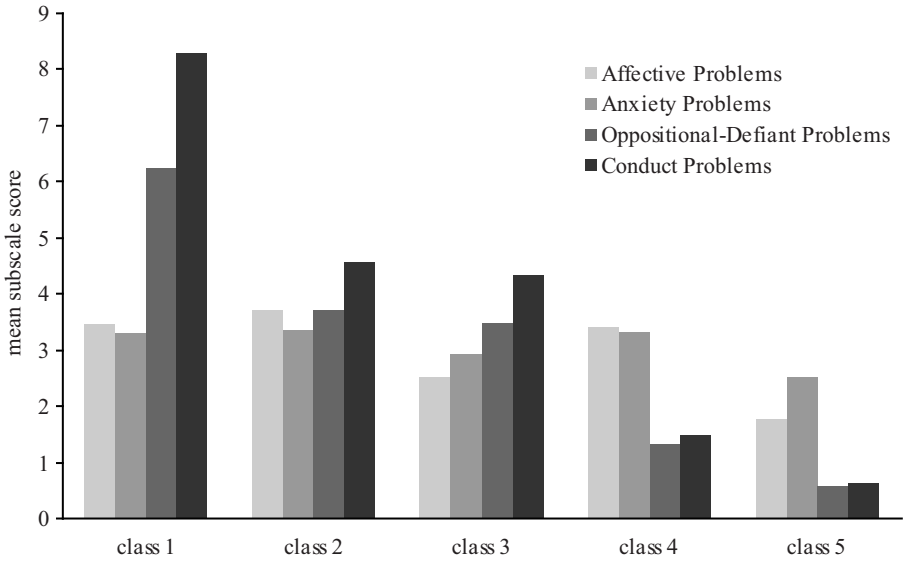

Figure 3.3. Comparison of levels of co-morbidity between ADH Problems classes.
Note: ADH = Attention-Deficit/Hyperactivity.
Significant differences between classes (C = class):
Affective Problems: C1, C2, C3, C4 > C5; C3 < C4; C1, C2 > C3
Anxiety Problems: C1, C2, C4 > C5; C3 < C4; C1 > C3
Oppositional-Defiant Problems: C1, C2, C3, C4 > C5; C1, C2, C3 > C4; C1, C2 > C3; C1 > C2
Conduct Problems: C1, C2, C3, C4 > C5; C1, C2, C3 > C4; C1 > C3; C1 > C2

DISCUSSION

This study was the first that used latent class analysis to investigate patterns of teacher-reported ADH Problems in a clinical sample. In this sample of 4,422 referred children and adolescents, five homogeneous classes were found. Besides a normative class, class 5, three classes showed a profile that resembled the combined type of ADH Problems. Class 1 was characterized by high scores on both Inattention and Hyperactivity-Impulsivity.

Class 2 represented individuals with high scores on Inattention and somewhat lower scores on Hyperactivity-Impulsivity. Individuals in class 3 had medium scores on Inattention and Hyperactivity-Impulsivity. The only class that showed the symptom profile of the predominantly inattentive type of ADH Problems was class 4, in which high Inattention scores and low Hyperactivity-Impulsivity scores were found.

A group of patients with high scores on Hyperactivity-Impulsivity and low scores on Inattention was not found. Thus, a hyperactive-impulsive subtype of ADH Problems was absent. This was in accordance with Neuman et al. (1999), who did not find support for a hyperactive-impulsive subtype of ADHD in a parent-rated sample, which included male and female offspring of families ascertained through an alcoholic proband, as well as female twin pairs from the general population. Our finding was not in accordance, though, with Todd et al. (2001), who found a mild and a severe inattentive, a mild and a severe hyperactive-impulsive, and a mild and a severe combined class of ADHD in a parent-rated sample of female twins from the general population. In the study by Todd et al. (2001) though, all of the subjects in the mild hyperactive-impulsive latent class, as well as 72% of the subjects in the severe hyperactive-impulsive latent class, did not fulfil criteria for an ADHD diagnosis. Concluding, a hyperactive-impulsive symptom pattern, could occur in some subjects in the general population, but does not appear to reach clinical symptom levels.

Individuals in classes with higher levels of ADH Problems had significantly higher levels of OD and Conduct Problems than individuals in classes with lower levels of ADH Problems. This finding was in accordance with earlier findings of high degrees of comorbidity between different types of disruptive behaviors (Loeber and Keenan, 1994) and with previous studies of comorbidity in latent classes of parent and self-reported ADHD symptoms (Neuman et al., 2001; Volk et al., 2005, 2006). Nolan et al. (2001) found higher ODD and CD symptom severity scores in children with combined type ADHD symptoms than in children with inattentive type ADHD symptoms. This is in accordance with the significantly higher OD and Conduct Problems scores in class 1 than in class 4 in our study.

Individuals in classes with higher levels of ADH Problems also had significantly higher levels of Affective and Anxiety Problems than individuals in classes with lower levels of ADH Problems, although to a lesser extent than levels of OD and Conduct Problems. The finding of higher internalising comorbidity in higher-level ADH Problems classes is in accordance with previous studies (Neuman et al., 2001; Volk et al., 2005, 2006). An exception was formed by the levels of Affective and Anxiety Problems in class 4, the inattentive class, which were somewhat higher than in class 3, a class in which more hyperactive and impulsive symptoms were found. These results indicate that there is a connection between inattentive and affective symptoms.

Sex Effects

Classes 1-3 contained more boys than girls. Class 4, the inattentive class, contained 41% girls, while class 5, the normative class, contained more girls than boys. This finding was in accordance with Nolan et al. (2001), who found that boys outnumbered girls for all ADHD subtypes, except for the predominantly inattentive type in young children, and with DuPaul et al. (1997), who reported significant gender differences for the hyperactive/impulsive and combined types, but not for the inattentive type. These findings indicate that the inattentive subtype of ADHD differs from the combined subtype, not only with respect to the relatively high prevalence of affective problems, but also with respect to the larger number of girls affected. Within class 1, levels of Affective and Anxiety Problems were higher in girls than in boys, whereas levels of Conduct Problems were higher in boys than in girls.

Age Effects

The probability of belonging to classes 1-3 was higher for younger children than for older children, whereas the probability of belonging to classes 4, the inattentive class, and 5, the normative class, was higher in older children. This is in accordance with Hart et al. (1995), who found that, in boys, hyperactive and impulsive behaviors decreased with age, whereas inattention did not, and with Nolan et al. (2001), who found that the inattentive type of ADHD was uncommon in young children, whereas the hyperactive-impulsive type was least common in adolescents. Both studies indicate that hyperactive and impulsive behaviors are more prevalent in younger children, whereas inattentive symptoms are more prevalent in adolescents.

Implications

The results of this study indicated that it may not be useful to discern the predominantly hyperactive-impulsive type of ADHD. Whereas previous studies were based on parent or self-report data, the present study added evidence for the lack of a pure hyperactive-impulsive type, by using teacher information. Apparently, this absence of a pure hyperactive-impulsive type was not situation or informant specific. Combined type ADHD and ADD, with inattentive and affective symptoms, may have a different aetiology and may require a different treatment. For instance, Houghton et al. (1999) found a more severe level of perseveration and response inhibition deficit in children with combined type ADHD than in children with inattentive type ADHD, and Lockwood et al. (2001) found differences between these ADHD subtypes on tasks associated with executive control and on selective attention tasks as well.

Strengths

The strengths of this study include the large sample size, which enhanced the statistical power. Hence, it is unlikely that the absence of a hyperactive-impulsive type would be due to a small sample size or a low prevalence of hyperactive and impulsive symptoms, since referred children and adolescents were studied, who had relatively high percentages of positive scores on ADH problems items. Previous studies used general population samples (Hudziak et al., 1998; Neuman et al., 1999; Rasmussen et al., 2002a, 2002b, 2004; Rohde et al., 2001; Todd et al., 2001). In this study, a referred sample was used, in which subtypes of psychopathology can be investigated. Besides, in a referred sample, classes with a low prevalence in the general population, have a higher chance of being detected with LCA. Also, the sample included females, absent in the study by Rasmussen et al. (2002b). In a sample that includes females, classes with a low prevalence in males but a high prevalence in females, have a higher chance of being detected.

Limitations

In this study, patterns of ADH Problems in TRF items were studied using the *DSM-IV* criteria as a guideline. However, actual *DSM-IV* diagnostic information was not available for analyses. The expectation is that, with actual *DSM-IV* diagnostic information, the same patterns will be found, but fewer children and adolescents will be in the high problem class, because age of onset and impairment, influence on daily life, would then also be taken into account. On the other hand, assessing impairment might be of less importance in our sample, since it consists of referred children and adolescents. Also, when using a diagnostic instrument like the DISC for instance, sub-threshold cases would not have been included in the analysis. For this reason, in the present study, a dimensional instead of a categorical approach has been chosen.

Conclusion

In this study, patterns of teacher-reported ADH Problems in a large clinical sample revealed five homogeneous classes, in which a predominantly hyperactive/impulsive subtype was not found. Combined hyperactive-impulsive and inattentive symptoms, more prevalent in boys and in younger children, were distinguished from inattentive and affective symptoms, more prevalent in girls and in adolescents. This distinction may separate two different clinical entities.

Chapter 4

ADHD: parents' judgment about school, teachers' judgment about home

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ABSTRACT

Objective: To separate sources of observer and situational variance in reporting ADHD symptomatology.

Methods: In a sample of 30 children diagnosed with ADHD, ADHD symptomatology was assessed with the Diagnostic Interview Schedule for Children – Parent Version (DISC-P), with parents and teachers as informants. Both parents and teachers reported about the child's ADHD symptomatology at home as well as at school.

Results: Parents and teachers showed high within-observer cross-situational presence of ADHD symptoms. However, the between-observer agreement on the presence of ADHD symptoms within the same situation (home or school) was low. This pattern held equally true for attention/concentration and hyperactivity/impulsivity symptom scores.

Conclusions: In evaluating ADHD symptomatology it is important to obtain independent reports about the child's behavior at school from the teacher and about the child's behavior at home from the parents.

INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is defined in *DSM-IV* (American Psychiatric Association, 1994) by symptoms of inattention and/or symptoms of hyperactivity/impulsivity. Contrary to criteria for other diagnoses, the criteria for ADHD require the presence of symptoms in two or more settings, such as school and home. However, *DSM-IV* does not give guidelines about which informant should report symptoms for each setting (at home and school), although it is known that the level of agreement between different informants is moderate (Achenbach et al., 1987; Klein, 1991). Widely used assessment procedures for *DSM-IV* diagnoses, such as the DISC-IV-P (Diagnostic Interview Schedule for Children – parent version; Shaffer et al., 1998) use parental information regarding behaviors in the classroom to derive diagnoses. However, it may be assumed that parents are optimal informants to provide information about behaviors at home, while teachers are needed to obtain information about the child's functioning at school, because teachers see the child in task-oriented and social situations and because teachers can compare a child's behavior with that of other children in the same situation.

In previous studies using CBCL (Child Behavior Checklist; Achenbach, 1991a) and TRF (Teacher's Report Form; Achenbach, 1991b) ratings, the average correlation between problem scores derived from different types of informants (parent, teacher, self-report) was .28 (Achenbach et al., 1987; Klein, 1991). Variation in the child's behavior across different situations and differences in the way different observers judge the child's behavior are two possible sources of cross-informant variance (Van der Ende, 1999). However, the CBCL and TRF do not specifically ask parents to provide information about the child's problems at home and teachers to provide information about the child's problems in school. Hence, previous studies that applied questionnaires to obtain continuous scores of attention problems did not indicate to which extent parents are capable of providing information about school functioning, independently of their opinion about the child's functioning at home.

Mitsis et al. (2000) assessed seventy-four 7- to 11-year-olds who had been referred to a program for disruptive behaviors. They found that parent reports of in-school ADHD behavior correlated higher with their own reports of their child's behavior at home than with teacher reports of their child's behavior at school. However, it is not clear if the authors obtained information about the child's behavior that was specific for the school situation. Furthermore, different procedures were used to obtain information from parents versus teachers. It is therefore unclear which part of the differences between parents' versus teachers' judgments of ADHD symptoms resulted from differences between assessment procedures used for parents versus teachers.

In the present study, we obtained parents' ratings of the child's ADHD symptoms for the home situation, and, separately, for the school situation. Similarly, we obtained teachers'

ratings of the child's ADHD symptoms for the home situation, and, separately, for the school situation. This enabled us to determine to which extent parents can provide information about symptoms in school, independently of their vision on the child's functioning at home.

METHODS

Sample

From February to June 2001, 30 children who had been diagnosed with ADHD were recruited from two neurology practices. All children who had received a clinical diagnosis of ADHD from a neurologist and who were still in treatment at the neurology practice, were eligible. Of 51 children, 30 cooperated. This study was a substudy of a research project on genetic susceptibility for ADHD in a genetically isolated population (GRIP, Genetic Research in Isolated Populations; Croes et al., 2005). The sample consisted of 24 boys and six girls aged six to 16 years (mean age = 10.4 years). Five children used no medication, 23 used methylphenidate (two used clonidine, and three melatonin as co-medication), and two used clonidine.

Measures

DISC-IV-P. The clinical *DSM-IV* diagnosis of ADHD by the neurologists was verified with the NIMH Diagnostic Interview Schedule for Children – Parent Version (DISC-IV-P; Ferdinand and Van der Ende, 1998; Shaffer et al., 1998). The DISC is a highly structured respondent based psychiatric interview to assess the more common *DSM-IV* diagnoses found in children and adolescents. The time frame of the DISC is the past six months. The DISC has two parallel forms: DISC-C administered directly to the child or adolescent, and DISC-P administered to the parent or caregiver that is passing the largest amount of time with the child. Given the age distribution of individuals who participated in the present study, the DISC-P, and not the DISC-C, was used. Ferdinand and Van der Ende (1998) made an official Dutch translation of the DISC-IV. To obtain an optimal translation, an independent translator re-translated the Dutch DISC-IV back to English. The reverse-translation was compared with the original DISC-IV, which supported the accuracy of the Dutch translation.

Earlier versions of the DISC-P showed good (interrater and test-retest) reliability (Schwab-Stone et al., 1993; Shaffer et al., 1993, 1996) and, in testing its reliability, DISC-IV compared favorably with the earlier versions (Shaffer et al., 2000). In the DISC-IV, for each of the nine *DSM-IV* symptoms of attention/ concentration problems and for each of the nine symptoms of hyperactivity/ impulsivity, the parent first is asked to report about presence or absence of the symptom during the past six months. If a symptom is scored positive, subsequent sub-questions about its presence or absence at home and at school are asked. In the original DISC-IV-P, parents are asked to report if a symptom is present (A) at home, or

(B) in school or elsewhere. For the present study, the parents were asked for each symptom to report its presence (A) at home, (B) in school, and (C) elsewhere (e.g., at friends' places, sports or hobby clubs).

For the present study, psychologists and psychology master students who were trained by the authors of the Dutch DISC-IV administered DISCs. The training schedule used was similar to the schedule used by the authors of the original English version, at Columbia University, New York. Parent DISCs were administered during face-to-face contacts, at a community general health centre or in Sophia Children's Hospital.

DISC-IV-T. Ferdinand and Van der Ende (2001) constructed a Dutch teacher version of the DISC-IV, for ADHD. This teacher version contains questions about ADHD that are identical to the questions for parents. DISC-IV-T was applied via telephone.

Statistics

For each item, we calculated levels of agreement (kappa values, κ) between parents' and teachers' ratings about home and school. For the two *DSM-IV* ADHD subscales, AC (attention/concentration) and HI (hyperactivity/impulsivity), we calculated average measure one-way random intraclass correlations (Shrout and Fleiss, 1979) between parents' and teachers' ratings about home and school.

Ethics

The medical ethics committee of Erasmus Medical Center has approved the study. From all parents (and from participants, if >11 years old) written informed consent was obtained.

RESULTS

Table 4.1 shows levels of agreement (kappa values, κ) between parents and teachers for separate *DSM-IV* ADHD criteria. For each item, we calculated:

- agreement between parents' ratings about home and teachers' ratings about school (PH-TS)
- agreement between parents' and teachers' ratings about home (PH-TH)
- agreement between parents' and teachers' ratings about school (PS-TS)
- agreement between parents' ratings about home and about school (PH-PS)
- agreement between teachers' ratings about home and about school (TH-TS)

Levels of cross-situational agreement between ratings by the same informant (PH-PS and TH-TS) were high. Levels of same-situation-agreement between ratings by different informants (PH-TH and PS-TS) were low. Low levels of agreement were also found between parents' scores about ADHD symptoms at home and teachers' scores about ADHD symptoms at school (PH-TS).

Table 4.1. Agreement between parents' and teachers' judgments of ADHD symptoms at home and in school, at item level.

ADHD criteria (*DSM-IV*)	PH-TS	PH-TH	PS-TS	PH-PS	TH-TS
AC (attention/concentration):					
(a) Often fails to give attention to details or makes careless mistakes	.31	.59**	.37*	.93**	.88**
(b) Often has difficulty sustaining attention in tasks or play activities	.14	.29	.39*	.56**	.78**
(c) Often does not seem to listen when spoken to directly	.33	.33	-.04	.69**	1.00**
(d) Often does not follow instructions and fails to finish work	.23	.27	.46*	.71**	.91**
(e) Often has difficulty organizing tasks and activities	.07	.23	.03	.83**	1.00**
(f) Often avoids tasks that require sustained mental effort	-.35	-.29	-.09	.66**	1.00**
(g) Often loses things necessary for tasks or activities	.16	.19	-.03	.81**	1.00**
(h) Is often easily distracted by extraneous stimuli	.05	-.02	.11	.81**	1.00**
(i) Is often forgetful in daily activities	.16	.19	.26	1.00**	1.00**
HI (hyperactivity/impulsivity):					
(a) Often fidgets with hands or feet or squirms in seat	.25	.28	.21	.66**	1.00**
(b) Often leaves seat	-.01	-.16	.12	.45**	1.00**
(c) Often runs about or climbs excessively	-.12	-.07	-.11	.87**	1.00**
(d) Often has difficulty playing quietly	.41*	.33	.05	.88**	1.00**
(e) Is often "on the go" or often acts as if "driven by a motor"	.19	.14	.25	.48**	1.00**
(f) Often talks excessively	-.19	.17	-.05	.73**	.72**
(g) Often blurts out answers before questions have been completed	-.09	-.10	.11	.57**	1.00**
(h) Often has difficulty awaiting turn	.07	.09	.17	.84**	1.00**
(i) Often interrupts or intrudes on others	-.07	.04	0	.76**	1.00**
Average kappa values AC	**.12**	**.20**	**.16**	**.78**	**.95**
Average kappa values HI	**.05**	**.08**	**.08**	**.69**	**.97**
Average kappa values AC + HI	**.08**	**.14**	**.12**	**.74**	**.96**

P = parent; T = teacher; H = home; S = school; PH = parent - home; PS = parent - school; TS = teacher - school; TH = teacher – home; levels of agreement are expressed as kappa [κ]; * $p < .05$; ** $p < .01$.

In Table 4.2, intraclass correlations between parent- and teacher-reported subscale ratings are reported. Subscale scores for the *DSM-IV* AC (attention/concentration) symptoms were calculated for:

- parents' ratings about home (PH)
- parents' ratings about school (PS)
- teachers' ratings about home (TH)
- teachers' ratings about school (TS)

If there were more than three missing values, the subscale score was not used for calculation. If there were one, two, or three missing values, missing scores were replaced by the mean score on the other items. Average measure one-way random intraclass correlations (Shrout and Fleiss, 1979) between the four subscale scores (PH, PS, TH, TS) were calculated. The same procedure was followed for the hyperactivity/ impulsivity (HI) symptoms.

Intraclass correlations between scale scores obtained from one informant about different situations were high, while correlations between scale scores obtained from different informants about one single situation were, in general, low. As an exception, we found an PS-TS AC intraclass correlation of .51. We found low correlations between parents' ratings about home and teachers' ratings about school.

Table 4.2. Intraclass correlations between parents and teachers reporting on ADHD symptoms at home and in school, at subscale level.

ADHD subscale (*DSM-IV*)	PH-TS	PH-TH	PS-TS	PH-PS	TH-TS
Mean AC (attention/concentration)	.21	-.16	.51*	.84**	.76**
Mean HI (hyperactivity/impulsivity)	.16	-.30	.27	.68**	.89**

P = parent; T = teacher; H = home; S = school; PH = parent - home; PS = parent - school; TS = teacher - school; TH = teacher – home.
Correlations between mean AC/HI scores are (one-way random) intraclass correlations; * $p < .05$; ** $p < .01$.

Table 4.3 shows, in a two-by-two format, the numbers of children fulfilling the *DSM-IV* criteria for ADHD during the past six months, according to the parent and according to the teacher. Predictive values were also calculated (Table 4.3). Positive and negative predictive values for a current ADHD diagnosis based on one informant's report predicting classification of ADHD based on the other informant's ratings ranged from .47 to .73. The positive predictive value for parent report as a predictor of teacher report was .47, meaning that when the parent's ratings would classify the child as having ADHD, in 47% of the cases the teacher's ratings would do so too. And a negative predictive value for teacher report as a predictor of parent report of .58 means that in 58% of the cases when a teacher would classify the child as not having ADHD, the parent would also classify the child as not having ADHD.

Table 4.3. Agreement between parents' and teachers' judgments of ADHD symptoms, at diagnosis level.

	ADHD according to parent's judgment	**No ADHD according to parent's judgment**	
ADHD according to teacher's judgment	**7**	**4**	11
No ADHD according to teacher's judgment	**8**	**11**	19
	15	15	30

Positive predictive value for parent report as a predictor of teacher report	= 7/15	= **.47**
Negative predictive value for parent report as a predictor of teacher report	= 11/15	= **.73**
Positive predictive value for teacher report as a predictor of parent report	= 7/11	= **.64**
Negative predictive value for teacher report as a predictor of parent report	= 11/19	= **.58**

DISCUSSION

In the present study, levels of agreement were determined between parents' and teachers' judgments about children's ADHD symptoms at home and at school, assessed with the DISC-IV (Ferdinand and Van der Ende, 1998, 2001; Shaffer et al., 1998). At symptom level, high levels of cross-situational agreement between ratings by the same informant were found. According to Landis's and Koch's criteria (Landis and Koch, 1977), parents' scores about ADHD symptoms at home were moderately to almost perfectly associated with parental scores regarding ADHD behaviors at school. Similarly, substantial to almost perfect levels of agreement were found for teachers' scores about school and home. Contrarily, slight to moderate levels of same-situation-agreement between ratings by different informants were found. Hence, parent and teacher often disagreed about the child's behaviors in school and at home. Slight to moderate levels of agreement were also found between parents' scores about ADHD symptoms at home and teachers' scores about ADHD symptoms at school. This finding is in line with a generally moderate level of agreement between different informants (Achenbach et al., 1987).

For ADHD AC and HI scales, similar findings were found as for separate items. When intraclass correlations are below .40, the level of clinical significance can be considered as poor, between .40 and .59 as fair, between .60 and .74 as good, and between .75 and 1.00 as excellent, according to Cicchetti (1994). Hence, intraclass correlations between scale scores obtained from one informant about different situations were excellent, while correlations between scale scores obtained from different informants about one single situation were, in general, poor. As an exception, we found that the PS-TS AC intraclass correlation was fair

(.51). Correlations between parents' ratings about home and teachers' ratings about school were low.

At diagnosis level, positive and negative predictive values for a current ADHD diagnosis based on one informant's report predicting classification of ADHD based on the other informant's ratings ranged from .47 to .73. This gives an idea about how the different levels of agreement between informants can be translated to the perspective of the clinician.

Our results suggest that the extent to which parents can provide valuable information about ADHD symptoms in school, independently of their vision on the child's functioning at home, is relatively small. Also, the extent to which teachers can provide information about symptoms at home, independently of their vision on the child's functioning in school, appears to be limited. Parents might have a tendency to base their reports about ADHD symptoms in school on their observations at home, while teachers might have a tendency to base their report about these symptoms at home on their observations in school. However, it is also possible that different raters have a different judgment of similar behaviors.

Some authors have tried to find out whether a single best informant exists for certain types of problems. In the Loeber et al. (1990) study, mental health professionals were asked about which type of informant would be most valuable to inform them about children's hyperactivity/inattentiveness. For these behaviors, mental health professionals in general thought that the teacher was the most useful informant, more useful than the mother. Also in the Phares (1997) study, mothers saw teachers as the most accurate informants for hyperactivity/inattentiveness.

Clinical implications

Since replication studies in general population samples and referred samples are needed, it is premature to make strong recommendations for clinical practice. Because the extent to which parents can provide information about symptoms in school seems to be limited, as well as the extent to which teachers can provide information about symptoms at home, it might be important to ask teachers to judge ADHD symptoms occurring in the classroom, and parents to judge ADHD symptoms occurring at home. This might also be important for the development of future versions of the *DSM* criteria for ADHD.

Limitations

A limitation of the present study is its relatively small sample size, although statistically significant results were obtained. Moreover, the children in our study were ascertained in a genetically isolated population. Therefore, it is unknown to what extent the results are representative for children with ADHD (symptoms) in the general population and/or for children referred to mental health care institutions.

Besides, the children had a known diagnosis of ADHD, and most of them received medication. Informants were aware of that, which may have influenced their ratings. For instance, when a teacher has the general impression that medication influences the presence of symptoms, he or she might minimize symptoms that are still present. A further limitation might be the relatively wide age range of the sample. Children as well as adolescents were included. The child's age could be a factor (differentially) influencing judgment of symptoms by parents and teachers.

Conclusions

Further research could try to further disentangle the different possible sources of cross-informant variance (having little information about the other location, differences in judgment between informants, extrapolating information). Future studies are needed that take account of the amount of information a situation-specific informant has about the other setting, for instance by assessing the level of communication between parents and teachers. Also, more research is needed to investigate if differences in judgment between parents and teachers exist, even if they have to judge a single situation, for instance by asking them to judge the same videotapes.

ABBREVIATIONS

P	parent
T	teacher
H	home
S	school
PH	parents' ratings about home
PS	parent's ratings about school
TS	teacher's ratings about school
TH	teacher's ratings about home
AC	attention/concentration
HI	hyperactivity/impulsivity

Chapter 5

Classes of disruptive behavior problems in referred adolescents

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ABSTRACT

Background: Previous studies have found considerable overlap between attention/hyperactivity problems, aggressive/oppositional problems, and delinquent/conduct problems in adolescents.

Methods: Mothers of 1,965 11- to 18-year-olds (1,116 boys, 849 girls), referred to mental health agencies, completed the Child Behavior Checklist (CBCL). Latent class analysis (LCA) was conducted on the Attention Problems scale (representing problems with attention, impulsivity, and hyperactivity), Aggressive Behavior, and Rule-breaking Behavior scales of the CBCL.

Results: Six latent classes were found. One of these classes contained individuals who suffered predominantly from attention problems, and to a far lesser degree from aggressive or rule-breaking behaviors. The other five classes represented individuals with varying degrees of attention problems, aggressive behaviors, and rule-breaking behaviors.

Conclusions: Contrary to previous studies, the present study indicated that, in a large referred sample, problems with attention, impulsivity, and hyperactivity can be considered as a diagnostic construct that should be distinguished from aggressive or rule-breaking behaviors. However, the present study did not support the existence of diagnostic classes constituted by individuals who primarily suffer from aggressive behaviors or rule-breaking behaviors, and not from attention problems or hyperactivity. Implications of these findings for future research and clinical practice are discussed. The value of the study was limited by the use of parent reports only.

INTRODUCTION

To facilitate and enhance research regarding the etiology, prognosis, and treatment of psychiatric disorders in children and adolescents, development and improvement of taxonomic systems is needed. The taxonomy of disruptive behaviors in children and adolescents generally contains three problem domains: attention/hyperactivity problems, aggressive/ oppositional problems, and delinquent/conduct problems (American Psychiatric Association, 1980, 1987, 1994; Achenbach, 1991a; Achenbach and Edelbrock, 1983; Achenbach and Rescorla, 2001). These three problem areas can be observed in the *DSM*-system (attention-deficit/hyperactivity disorder, oppositional defiant disorder, conduct disorder), which is a categorical system that was based on consensus among experts on the criteria that should be used to describe disorders (American Psychiatric Association, 1980, 1987, 1994). However, the empirically based taxonomic system that was developed by Achenbach and colleagues contains a similar division in diagnostic areas (attention problems, aggressive behavior, rule-breaking behavior) (Achenbach, 1991a; Achenbach and Edelbrock, 1983; Achenbach and Rescorla, 2001). Moreover, empirical evidence is available that the taxonomic constructs of the *DSM* and those developed by Achenbach, despite the considerable difference in the way they were developed, converge strongly. This supports their construct validity (Achenbach and Dumenci, 2001; Edelbrock and Costello, 1988; Ferdinand et al., 2004a; Gould et al., 1993; Jensen et al., 1993, 1996; Kasius et al., 1997; Lengua et al., 2001; Steinhausen et al., 1997).

Many studies found high co-morbidity rates between the three areas of disruptive behavior problems (Burt et al., 2005; Loeber and Keenan, 1994; Loeber et al., 1995; Pfiffner et al., 2005). Further, individuals with different types of disruptive behavior appeared to be very similar with regard to deficiencies in problem-solving skills, pervasiveness of problems across different situations, intelligence and achievement measures, family context measures, and behavioral symptoms (Matthys et al., 1999; Paternite et al., 1995). Other authors used factor analysis to investigate the structure of disruptive behavior problems. Some studies found evidence for separate dimensions of attention/ hyperactivity problems, aggressive/ oppositional problems, and delinquent/conduct problems (Achenbach, 1991a; Achenbach and Edelbrock, 1983; Achenbach and Rescorla, 2001; Burns et al., 1997a, 1997b), whereas others did not (Hartman et al., 2001). These findings, at least, indicated that it can be questioned whether distinctions between three different subtypes of disruptive behaviors should really be made.

To study taxonomy, it is important to investigate which homogeneous groups of individuals can be discerned, according to the presence or absence of symptoms. Such homogeneous groups might need similar treatments or share a common etiology. To shed light on such homogenous groups, many studies have used factor analysis. However, factor

analysis informs us to which extent symptoms group together, but is not informative on homogenous groups of individuals. For instance, although factor analysis may yield a factor solution indicating three factors, e.g. attention problems, aggressive behavior, and rule-breaking behavior. However, factor analysis does not indicate whether distinguishing a group of individuals with high levels of attention problems, and simultaneously low levels of aggressive and rule-breaking behaviors, is a useful way to constitute diagnostic subgroups, or whether such groups exist or not. To analyze which homogeneous subgroups of individuals, that are as different as possible from other groups, exist, latent class analysis (LCA) is more useful (McCutcheon, 1987).

Previous studies (Sondeijker et al., 2005; Van Lier et al., 2003) used LCA to identify groups of children with different profiles of disruptive behavior, but failed to find classes of children with attention-deficit/hyperactivity, oppositional defiant, or conduct problems only. Instead, different types of disruptive behaviors tended to co-occur. Other studies, though, found that different disruptive behavior domains occurred separately. For instance, a study that concerned LCA on *DSM-IV* attention/hyperactivity and oppositional symptoms derived from adolescent and parent ratings on the SSAGA (Semi-Structured Assessment for the Genetics of Alcoholism; COGA, 1996) revealed three attention/hyperactivity problems categories, as well as two clinically relevant oppositional problems classes (Neuman et al., 2001).

Previous studies that applied LCA used samples from the general population or with very young children, that contained a relatively small number of individuals with elevated problem levels (Neuman et al., 2001; Sondeijker et al., 2005; Van Lier et al., 2003). This may have influenced the results. In large referred samples, classes of individuals with 'pure' attention/ hyperactivity, oppositional, or conduct problems might still be present, and might be detected with LCA.

The aim of the present study was to investigate latent classes of disruptive behavior problems in referred adolescents, and to investigate whether these classes are in accordance with separate taxonomic entities or with high levels of co-morbidity.

METHODS

Participants

The sample consisted of 1,965 11- to 18-year-olds (mean age = 13.2 years; 1,116 boys, 849 girls). All participants were referred consecutively to the outpatients' department of child and adolescent psychiatry of the University Hospital Rotterdam/Sophia Children's Hospital (n = 1,582), or to a community mental health centre in Rotterdam (n = 383), between March 1982 and August 2003. The use of data from a university clinic and a community mental

health clinic has probably reduced effects of referral bias, by yielding a sample of adolescents with a broad range of problems and a wide variety of problem levels. Because mothers may rate their children's behavior differently from fathers (Achenbach et al., 1987), only data obtained from mothers and not from fathers were used.

Materials

Child Behavior Checklist. The CBCL is a parent questionnaire for assessing problems in children and adolescents. The first version (Achenbach and Edelbrock, 1983) was developed for 4- to 16-year-olds. It contains 120 items on behavioral or emotional problems in the past six months. The response format is 0 = not true, 1 = somewhat or sometimes true, and 2 = very true or often true. A second version of the CBCL, for ages 4 to 18 years, was developed in 1991 (Achenbach, 1991a), and a third version, for ages 6 to 18 years, in 2001 (Achenbach and Rescorla, 2001).

In the present study, the scales Attention Problems, Aggressive Behavior, and Rule-breaking Behavior of the CBCL were used. In version 3, two items were added to the Attention Problems scale: item 4, "Fails to finish things he/she starts" and item 78, "Inattentive or easily distracted". Four Rule-breaking Behavior items were added as well in version 3: item 2, "Drinks alcohol without parents' approval", item 28, "Breaks rules at home, school, or elsewhere", item 99, "Smokes, chews, or sniffs tobacco", and item 105, "Uses drugs for nonmedical purposes". These items were not included in the analyses, because they were not contained by the first two versions of the CBCL. The good reliability and validity of the American version of the CBCL (Achenbach, 1991a; Achenbach and Edelbrock, 1983; Achenbach and Rescorla, 2001) were confirmed for the Dutch translation (De Groot et al., 1994; Verhulst et al., 1990, 1996).

To investigate the fit of the Attention Problems, Aggressive Behavior, and Rule-breaking Behavior scales in this Dutch clinical sample, we performed a confirmatory factor analysis (CFA). The 39 CBCL Attention Problems, Aggressive, and Rule-breaking Behavior items that were analyzed with CFA, except item 73, "Sexual problems", and item 101, "Truancy, skips school", had a factor loading of at least .3 and could therefore be considered to be representative of the scale they were assigned to. Therefore, items 73 and 101 were not used in LCA. The CFA model fitted the data: Root Mean Square Error of Approximation (RMSEA) = .08; Tucker-Lewis Index (TLI) = .95.

Data analysis

Thirty-seven items of Attention Problems, Aggressive Behavior, and Rule-breaking Behavior were used to conduct LCA with Mplus version 3.0 (Muthén and Muthén, 2004). LCA adds classes until the model does not improve further. To identify the lowest number of classes

that fitted the data well the Bayesian Information Criterium (BIC; Kass and Wasserman, 1995) was used. To control for age and gender, dichotomous variables indicating higher age (15-18 years) and female gender were included as covariates (Dayton and Macready, 1988; Leadbeater et al., 1999; Zoccolillo, 1993).

To compare internalizing co-morbidity levels in the different disruptive behavior problems classes, an ANOVA was performed for the total Internalizing Problems score. The total Internalizing Problems score is the sum of the CBCL scales Anxious/Depressed, Withdrawn/Depressed, and Somatic Complaints. After the ANOVA, post hoc tests were performed, using Gabriel's procedure (Gabriel, 1987).

RESULTS

A two-class model LCA on Attention Problems, Aggressive, and Rule-breaking Behavior items yielded a BIC value of 110,751. Going from a two-class to a three-class solution resulted in a BIC drop of 3,142 points, which means that adding a third class improved the model. BIC values indicated that a six-class solution fitted the data best; going from three to four classes resulted in a BIC drop of 738 points, going from four to five classes resulted in a BIC drop of 411 points, whereas going from five to six classes resulted in a BIC drop of 214 points. A seven-class model did not yield a stable solution. The numbers of adolescents in each of the six classes, as well as their sex distribution, is shown in Table 5.1.

Table 5.1. Numbers and sex distribution for each class.

Class	Number (%[1])	Boys (%[2])	Girls (%[3])
1	278 (14%)	225 (20%)	53 (6%)
2	148 (8%)	96 (9%)	52 (6%)
3	245 (12%)	90 (8%)	155 (18%)
4	261 (13%)	222 (20%)	39 (5%)
5	497 (25%)	284 (25%)	213 (25%)
6	536 (27%)	199 (18%)	37 (40%)

Note: 1 Percentages in this column represent the class members as part of the total sample
2 Percentages in this column represent the boys in the class as part of the total number of boys
3 Percentages in this column represent the girls in the class as part of the total number of girls

LCA yields item score probabilities for individuals for all items that are included in an analysis. These probabilities are different for each class, and indicate the probabilities of item scores 0, 1, and 2, given a specific class membership.

Theoretically, for each class, the probabilities of 0, 1, and 2 scores for each item can be put into a graph. To enhance the comprehensibility of our graph and because of the purpose of this study to focus on the clinically relevant levels of problems, we chose to only present data regarding probabilities of 2-scores on items in a graph and to present mean item endorsement probabilities for 2-scores, separately for the three domains (Attention Problems, Aggressive Behavior, and Rule-breaking Behavior) that were studied. Hence, for instance, Figure 5.1 shows that the mean probability of 2-scores on Attention Problems items was around .5 for individuals in class 1, and smaller than .1 for members of class 5.

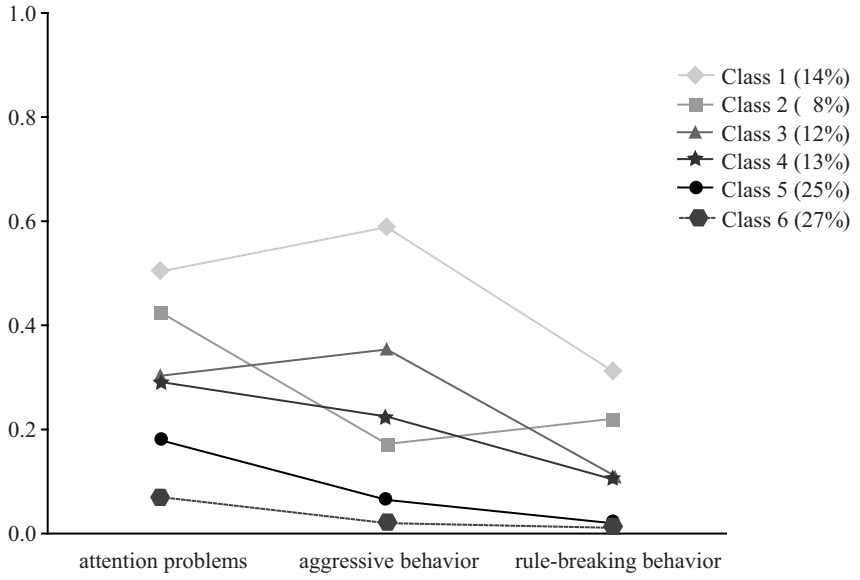

Figure 5.1. Mean probabilities of 2-scores on Attention Problems, Aggressive Behavior, and Rule-breaking Behavior.

Figure 5.1 shows that individuals in classes 1, 3, and 5 displayed attention problems, aggressive behavior, as well as rule-breaking behavior, and that they did not have a higher score on one domain than on the other two behavior clusters. Individuals in classes 2 predominantly showed attention problems and lower levels of aggressive/rule-breaking behavior. Individuals in class 4 had mild attention problems, but low aggressive/rule-breaking behavior. Class 6 was a normative class, with low levels of disruptive behavior problems.

ANOVA showed differences between the classes on the total Internalizing Problems score, $F(5; 1{,}959) = 57.52$, $p < .001$. Post hoc tests, performed using Gabriel's procedure

($\alpha = .05$), showed that individuals in class 1 had significantly higher levels of Internalizing Problems than individuals in classes 2, 4, 5, and 6. Individuals in class 3 had significantly higher Internalizing Problems levels than individuals in all the other classes. Internalizing Problems levels were significantly higher in classes 2, 4, and 5 than in class 6.

DISCUSSION

This study investigated latent classes of disruptive behavior problems in a large referred sample of adolescents. The strengths of the study included the large sample size, which enhanced the power of the study to detect latent classes. Second, referred adolescents were studied, who had relatively high percentages of positive scores on behavior problems items. In a referred sample, clinically significant classes with a low prevalence in the general population have a higher chance to be detected. Third, contrary to previous samples that were studied, the sample included a large proportion of females. Further, previous investigations that investigated co-morbidity patterns of disruptive behavior problems often used categorical *DSM-IV* diagnoses of attention-deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), and conduct disorder (CD) (e.g. Loeber et al., 1995). Use of categorical information results in a loss of possibly important statistical information about sub-threshold symptoms. As a consequence, an individual may be regarded as a 'pure' case of, for instance, oppositional disorder, even if a considerable number of ADHD or conduct disorder symptoms are present. The present study took account of all available statistical information.

LCA revealed six homogeneous classes of individuals. Five of the six lines in Figure 5.1 run parallel. This indicates that the classes (classes 1, 3, 4, 5, and 6) represented by these lines contained individuals with different levels of disruptive behavior problems, but not with differences concerning type of problems. In other words, the lowest line represented a class of individuals with low levels of attention problems, aggressive behaviors, and rule-breaking behaviors, and higher lines represented individuals with higher levels of all these three types of problems. Many previous studies found evidence for high co-morbidity rates of different types of behavior problems (Hartman et al., 2001; Loeber and Keenan, 1994; Loeber et al., 1995; Matthys et al., 1999; Paternite et al., 1995; Sondeijker et al., 2005; Van Lier et al., 2003). Hence, the finding that five of the six lines ran parallel, indicating high levels of co-morbidity rates at each level of problems, was not surprising.

One line represented individuals with high levels of attention problems, and far lower levels of aggressive and rule-breaking behaviors (class 2). Hence, two groups of individuals with high levels of attention problems were identified; one group with high levels of aggressive behaviors and rule-breaking behaviors as well, and one group with lower rates of comorbid aggressive and rule-breaking behaviors. This finding contrasted with previous studies that

used LCA, that did not provide evidence for these two different classes of individuals with high levels of attention problems (Sondeijker et al., 2005; Van Lier et al., 2003). This may be due to the fact that previous studies used general population samples, that contained a relatively small number of individuals with high problem levels, which may have resulted in insufficient power to discriminate between different classes with high problem levels. Instead, all individuals with high problem levels, apparently, were grouped in one single high problem level class.

The findings indicated that referred adolescents with high levels of attention problems can be divided in a group with high, and a group with lower comorbid aggressive and rule-breaking behaviors. Although our findings need to be replicated in independent clinical populations, these two groups might have a different etiological background, and probably require different types of treatments. This is in accordance with studies indicating that genes exist that are specifically responsible for ADHD but not for ODD/CD, or vice versa (Comings et al., 2000; Nadder et al., 2002). For instance, Nadder et al. (2002) found that one common genetic factor determined covariation between different disruptive behavior phenotypes, but that additional genetic factors were specific for ODD/CD symptoms.

A class with high levels of aggressive and rule-breaking behaviors and low levels of attention problems was not detected. This may be due to a referral bias, since it may be the case that those with such symptom profiles are less likely to be admitted to mental health agencies. Therefore, our data reflect the taxonomy of disruptive behavior in those who were referred to mental health services. A similar study in delinquent adolescents could lead to different results. To investigate whether classes with pure aggressive or rule-breaking behaviors are really non-existent, it is important to investigate symptom profiles of incarcerated youths. In such youths, rates of *DSM-IV* ADHD have been reported to be low (Vreugdenhil et al., 2004).

Comparison of internalizing co-morbidity levels for the different disruptive behavior problems classes showed that, generally, classes with higher levels of disruptive behavior also had higher levels of internalizing behavior. We found one class, class 3, that had high scores both on disruptive and internalizing behavior. This means that a large group of clinically referred children had high scores on a broad range of problem behaviors. This could mean that specific therapeutic programs targeted at this group are needed.

The value of the present study was limited by the use of parent reports only. It is known that parents often disagree with other informants – adolescents themselves, teachers – about the presence or absence of disruptive behaviors (Achenbach et al., 1987; De Nijs et al., 2004). Future studies that make use of information from other informants as well may provide valuable additional information regarding latent classes of disruptive behaviors in adolescents.

The results of the present study underscored the necessity of studying clinically relevant taxonomic constructs in a referred sample. Class solutions in the present study were markedly different from those for general population samples. Further, the disadvantage of studies that only used categorical diagnoses to assess associations between different subtypes of behavior problems was demonstrated by the finding that, despite high co-morbidity rates, LCA detected two subgroups of attention-deficit individuals; one with high and one with lower comorbid aggressive or rule-breaking behaviors.

Chapter 6

Outcome of disruptive behavior in referred children and adolescents

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Submitted

ABSTRACT

Objective: To validate an empirical person-oriented disruptive behavior taxonomy in referred children and adolescents by investigating outcome.

Methods: Parents of 1,230 referred 4- to 16-year-olds (mean age = 8.0 years; 71% boys, 29% girls) completed the Child Behavior Checklist (CBCL). Latent class analysis (LCA) was conducted on CBCL items indicating disruptive behavior. At reassessment, after 1 to 15 years (mean follow-up interval = 6.3 years), at age 6 to 21 (mean age = 14.3), their parents completed an outcome questionnaire and the Children's Global Assessment Scale. Logistic regression analysis was used to assess associations between class membership at referral and outcome.

Results: A latent class with a high level of disruptive behavior, an intermediary class, and a low class were found. Members of the high class had a higher risk of all types of poor outcome measures than members of the low class. Intermediary class members had a higher risk of all poor outcome measures except receiving outpatient treatment and alcohol or drug abuse than members of the low class.

Conclusions: Support was found for a taxonomy of disruptive behavior that is based on level of severity, not on specificity of problem behaviors.

INTRODUCTION

Disruptive behaviors in children and adolescents generally contain three problem domains: attention/ hyperactivity problems, aggressive/oppositional problems, and delinquent/conduct problems (Achenbach, 1991a; Achenbach & Edelbrock, 1983; Achenbach & Rescorla, 2001; American Psychiatric Association, 1994). These behaviors form a major health care problem and make life difficult for the children and adolescents themselves, their parents, and their teachers.

The disruptive behavior disorders, Attention-Deficit/Hyperactivity Disroder (ADHD), Oppositional Defiant Disorder (ODD), and Conduct Disorder (CD), generally have an unfavorable outcome. Barkley and colleagues followed a sample of hyperactive children and a matched community control group prospectively (Barkley et al., 1990, 1991, 2004, 2006; Fischer et al., 1990). In adolescence, higher rates of antisocial acts, of cigarette and marijuana use, and of negative academic outcome were found among the hyperactives than among controls. The presence of CD in the hyperactives accounted for most of these outcomes, although only partially for negative academic outcome.

Outcome studies were also performed by Mannuzza and colleagues (Gittelman et al., 1985; Mannuzza et al., 1988, 1989, 1991a, 1991b, 1993, 1997, 1998). They conducted a longitudinal study of male adolescents who had been diagnosed hyperactive in primary school age, and normal controls. They found more conduct and substance use disorders in the former group. More probands than controls had been arrested, convicted, and incarcerated. The presence of an antisocial/conduct disorder in young adulthood almost completely accounted for the increased risk for criminal activities in the former hyperactive children, while continuing attention-deficit disorder with hyperactivity at follow-up, by itself, was not associated with arrest history. The formerly hyperactive children who did not fulfill criteria for a psychiatric diagnosis at follow-up, showed few areas (primarily involving school adjustment) in which they had a worse outcome than the controls without a psychiatric diagnosis at follow-up.

Biederman et al. (2008) conducted a 10-year follow-up study, and compared the outcome of four groups: controls, ADHD, ADHD plus ODD, and ADHD plus CD. They found that only CD, and not ADHD or ODD, was associated with increased risk for substance use disorders.

Most previous studies of outcome of disruptive behavior were based on the *DSM* taxonomic system (American Psychiatric Association, 1994), which is a top-down, a priori system, based on the combined clinical experience of leading clinicians. An alternative approach to taxonomy is exemplified by latent class analysis (LCA; McCutcheon, 1987). LCA is an example of the bottom-up or empirical approach to taxonomy. By using LCA, homogeneous groups of children or adolescents, classes, can be identified, yielding a most probable class membership for each individual; like the *DSM* system, LCA provides a classification for

each individual. When determining the latent classes, co-occurrence of behaviors is being reckoned with. Further, LCA allows for different levels of severity of behaviors. LCA and the *DSM* system can be considered alternative routes to taxonomy, which can be complementary to each other.

A taxonomic system, which is the identification of groups of children sharing patterns of symptoms, can be validated and corroborated in different ways, e.g. by demonstrating different etiologies or different treatment responses for each grouping of individuals within the taxonomy, but also by demonstrating specific outcomes for each grouping of individuals within the taxonomy. This is exemplified by Biederman et al. (2008), who found that only CD, and not ADHD or ODD, was associated with increased risk for substance use disorders.

Finding differential outcome, which means specificity of outcome, can corroborate a taxonomic system. Besides, when differential stability of syndromes is found, e.g. when one grouping of subjects has a greater tendency towards maintaining the same behavior through time than another grouping, which means a higher within-syndrome than cross-syndrome stability, this can also yield external validation to the taxonomic system studied.

Therefore, for the development of taxonomic systems of disruptive behavior disorders, it is important to know the outcome of patients with these disorders and to know whether the outcome differs according to taxonomic grouping. For instance, if one type of disruptive disorder has a different outcome than another, this yields information about the predictive validity of these disorders.

Fergusson and Horwood (1995) compared the efficacy of the *DSM* system with dimensionally scored measures, as predictors of outcome of disruptive behaviors. They found evidence of continuous and generally linear dose-response functions between symptom severity and outcome risks and that dimensionally scored variables were considerably better predictors of outcome than measures based on the *DSM* system. From this it could be inferred that a taxonomic system that allows for different levels of severity of disruptive behavior might receive more external support demonstrated by finding differential outcome than a taxonomic system that uses cut-off levels of symptoms.

LCA identifies homogeneous groups of children, classes, based on categorical data, e.g. the presence or absence of symptoms. In contrast to the *DSM* taxonomic system, in which predetermined cut-off levels of symptoms are used, resulting in the identification of disorders which are present or absent, LCA can identify classes that have different levels of severity of behaviors. Possibly, when different levels of severity of disruptive behavior are being taken into account, as can be done with LCA, more support can be found in differential outcome patterns than when the *DSM* approach is being used.

Previous studies with children from the general population failed to find latent classes of children with attention-deficit/hyperactivity, oppositional defiant, or conduct problems only. Instead, different types of disruptive behaviors tended to co-occur, thus forming only

classes with different severity levels of disruptive behavior, instead of different disruptive symptom patterns (Sondeijker et al., 2005; Van Lier et al., 2003). In a study in a large sample of referred adolescents, on the other hand, six latent classes of disruptive behavior were found. One of these classes contained individuals who suffered predominantly from attention problems and to a far lesser degree from aggressive or rule-breaking behaviors. The other five classes represented individuals with varying degrees of co-occurring attention problems, aggressive behaviors, and rule-breaking behaviors (De Nijs et al., 2007b).

The aim of the present study was to validate an empirical, LCA-based disruptive behavior taxonomy in a sample of referred children and adolescents by investigating the outcome of the members of the latent classes. This outcome was studied in order to determine whether different latent classes have different outcomes.

METHODS

Participants/Subjects

The original sample consisted of 2,441 children, aged 4 to 18, referred to the outpatient clinic of the Erasmus University Medical Center Rotterdam, Sophia Children's Hospital, Department of Child and Adolescent Psychiatry, from 1982 to 1995. This department delivers specialist child and adolescent psychiatric care. Time of referral was indicated as Time 1 (T1). From 1995 to 1997, the children and adolescents, as well as their parents, were contacted again. Time of reassessment was indicated as Time 2 (T2). Parent ratings were obtained from 1,632 of the 2,088 approached parental informants. For those participants who were young adults at T2, parents were asked to fill out only a limited questionnaire with no outcome measures about their child, since young adults were asked to rate outcome measures themselves. Only the 1,256 parent-rated outcome questionnaires were used in the present study. For a complete description of the sample, see Heijmens Visser et al. (1999, 2000, 2003). Parents of the referred children and adolescents completed the 1983 version of the Child Behavior Checklist (CBCL; Achenbach & Edelbrock, 1983) at T1. Twenty-two CBCLs for which the informant was unknown, were not used. Since the CBCL for 4- to 16-year-olds had been used at T1, one 3-year-old and three 17-year-olds at T1 were excluded.

The remaining sample consisted of 1,230 4- to 16-year-olds (873 boys, 357 girls). CBCLs were filled out at T1 by mother (N = 701), father (N = 124), or both parents (N = 405). Mean age at T1 = 8.0 years. Age at T2 = 6-21 years; mean age at T2 = 14.3 years. Time between initial referral and follow-up ranged from 1 to 15 years; mean follow-up interval = 6.3 years.

Measures

Child Behavior Checklist. The CBCL is a questionnaire for assessing problems in children and adolescents. It was developed for 4- to 16-year-olds. It contains 120 items on behavioral or emotional problems in the past six months. The response format is 0 = not true, 1 = somewhat or sometimes true, and 2 = very true or often true. In the present study, we used the scales Attention Problems, Aggressive Behavior, and Rule-Breaking Behavior of the current version of the CBCL (Achenbach & Rescorla, 2001). These scales correspond to behaviors seen in ADHD, ODD, and CD, respectively. In the current version of the CBCL, two items were added to the Attention Problems scale (item 4, 'Fails to finish things he/she starts', and item 78, 'Inattentive or easily distracted') and four items were added to the Rule-Breaking Behavior scale (item 2, 'Drinks alcohol without parents' approval', item 28, 'Breaks rules at home, school or elsewhere', item 99, 'Smokes, chews or sniffs tobacco', and item 105, 'Uses drugs for nonmedical purposes'). These six items were not included in the analyses, because they were not contained in the 1983 version of the CBCL, which was used in this study. The good reliability and validity of the American version of the CBCL (Achenbach & Edelbrock, 1983; Achenbach & Rescorla, 2001) were confirmed for the Dutch translation (Verhulst et al., 1990).

To test the fit of the Attention Problems, Aggressive Behavior, and Rule-Breaking Behavior scales to this Dutch clinical sample, we performed a confirmatory factor analysis (CFA). The CFA model fitted the data: Root Mean Square Error of Approximation (RMSEA) = .090; Tucker-Lewis Index (TLI) also known as the Non-Normed Fit Index (NNFI) = .94. By convention, an RMSEA < .1 indicates a good fit, and an NNFI ≥ .90 indicates an acceptable fit (Hatcher, 1994), although Hu and Bentler (1999) suggested more stringent cutoffs of .06 for RMSEA and .95 for NNFI. This model's $\chi_{215}^2 = 2{,}051$.

The 39 CBCL Attention Problems, Aggressive and Rule-Breaking Behavior items that were analyzed with CFA had a factor loading of at least .3, except item 17, 'Daydreams or gets lost in his/her thoughts' (factor loading = .205), and item 101, 'Truancy, skips school' (factor loading = .134). Since these items could be considered less representative of the domains they were assigned to, CFA was repeated without these two items. This yielded an RMSEA of .091 and a TLI of .94. Since $\chi_{206}^2 = 1{,}990$, $\Delta\chi_9^2 = 61$ ($P < .001$), indicating that omitting these two items significantly improved model fit. Therefore, items 17 and 101 were not used in LCA.

Outcome. A questionnaire was designed to obtain information about multiple, differentiated outcome measures (Heijmens Visser, 2002). Versions of these questionnaires were sent to parents. All questions concern the period since the last contact at the outpatient clinic of the Erasmus University Medical Center Rotterdam, Sophia Children's Hospital, Department of Child and Adolescent Psychiatry. The following outcomes were evaluated: *Serious school problems* (Has your child been suspended or expelled from school?), *School dropout* (Has

your child dropped out of school?), *Work problems*, *Serious work problems* (Has your child been suspended or expelled from his/her job?), *Injuries* (Has your child had an accident for which medical treatment was necessary?), *Outpatient help* (Does your child still visit a psychiatric outpatient clinic?), *Inpatient help* (Is your child admitted to a psychiatric inpatient clinic?), *Help wanted* (Does your child have problems for which he/she wants help?), *Alcohol abuse* (Do you worry about the amount of alcohol your child uses?), *Drug abuse* (Did your child use drugs during the past six months?), *Police contacts* (Has your child been in contact with the police or the judicial system?).

Children's Global Assessment Scale. The CGAS (Shaffer et al., 1983) is an instrument developed to evaluate the overall functioning of an individual during a specified period on a continuum from 1, i.e. psychiatric illness, to 100, i.e. health. Good psychometric properties were found for both the original CGAS and the non-clinician version of the CGAS (Bird & Gould, 1995). Both versions were translated into Dutch. In this study, the CGAS was filled out by the parent(s) at T2. The CGAS score was dichotomized at 60/61, as suggested by Bird and Gould (1995), to obtain a deviant group consisting of 25% of the sample (60 was included in the 'deviant' range, 61 in the 'non-deviant' range).

Data analysis

Thirty-seven CBCL items of the Attention Problems, Aggressive Behavior, and Rule-Breaking Behavior scales were used to conduct LCA with Mplus version 3.0 (Muthén & Muthén, 2004). Classes were added until the model did not improve further. To identify the lowest number of classes that fitted the data well, the Bayesian Information Criterium (BIC; Kass & Wasserman, 1995) was used. Age and sex were included as covariates (Dayton & Macready, 1988; Leadbeater et al., 1999; Zoccolillo, 1993). Since mothers may rate their children's behavior differently from fathers (Achenbach et al., 1987), two variables indicating informant (mother, father) were created. If a CBCL had been filled out by both parents, both variables were assigned the value of 1.

Each child was assigned to its most likely latent class. We used logistic regressions to assess associations between class membership and outcome. To control for age, gender, and informant differences, age, male gender, and the two variables indicating informants were included as covariates.

RESULTS

A two-class model LCA on Attention Problems, Aggressive and Rule-Breaking Behavior items at T1 yielded a BIC value of 67,230. Going from a two-class to a three-class solution resulted in a BIC drop of 1,629 points, which means that adding a third class improved the

model. A four-class model was unstable, i.e. it yielded different solutions when different starting values were applied. Hence, a three-class model fitted the data best. The numbers of children and adolescents in each of the three classes, as well as their sex and age distribution, are shown in Table 6.1.

Table 6.1. Numbers, sex and age distribution for each class.

Class	Number (%[1])	Boys (%[2])	Girls (%[3])	Age at T1	
				Mean (years)	SD (years)
1	336 (27%)	279 (83%)	57 (17%)	7.6	2.3
2	513 (42%)	378 (74%)	135 (26%)	8.1	2.7
3	381 (31%)	216 (57%)	165 (43%)	8.3	2.8

Note: 1 Percentages in this column represent the class members as part of the total sample
2 Percentages in this column represent the boys in the class as part of the total number of members of the class
3 Percentages in this column represent the girls in the class as part of the total number of members of the class
SD = standard deviation

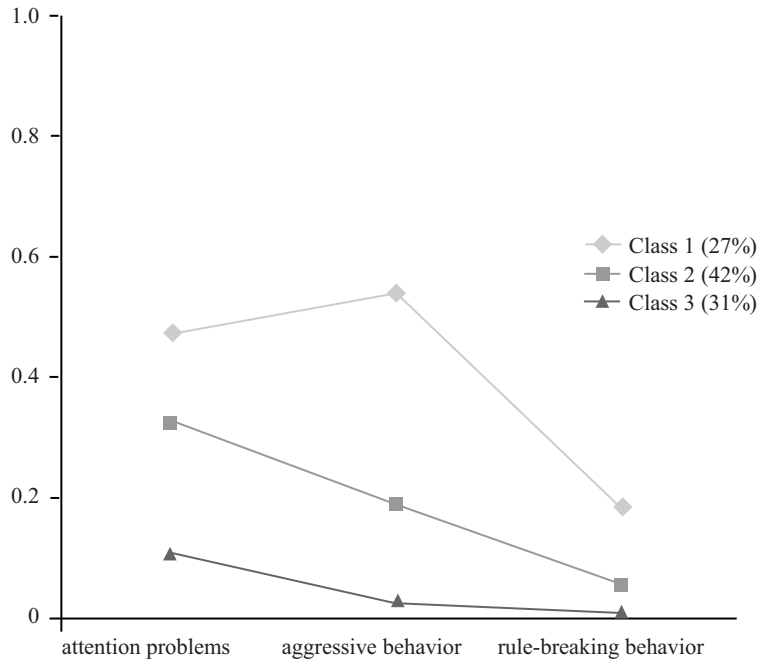

Figure 6.1. Mean probabilities of item score 2 on Attention Problems, Aggressive Behavior, and Rule-Breaking Behavior.

Table 6.2. Poor outcome of disruptive behavior problems.

Class or covariate		Serious school problems	School dropout	Work problems	Serious	Injuries	Out-patient help	In-patient help	Help wanted	Alcohol abuse	Drug abuse	Police contacts	CGAS ≤ 60
1	OR	*3.80*	*9.95*	*5.40*	*10.53*	*1.60*	*2.04*	*5.33*	*2.86*	*11.39*	*2.82*	*7.21*	*5.62*
	LCI	2.67	4.11	1.73	2.86	1.10	1.13	3.42	2.08	2.58	1.38	3.66	3.89
	UCI	5.41	24.09	16.81	38.78	2.31	3.70	8.32	3.93	50.29	5.77	14.19	8.10
2	OR	*2.03*	*3.49*	*3.32*	*4.37*	*1.47*	1.23	*1.76*	*1.50*	4.17	1.45	*2.09*	*2.56*
	LCI	1.46	1.42	1.09	1.22	1.05	.76	1.12	1.13	.92	.73	1.04	1.83
	UCI	2.82	8.57	10.10	15.65	2.07	1.97	2.76	1.99	18.96	2.91	4.23	3.59
Sex	OR	.95	1.38	.99	.96	*1.38*	1.00	.96	.93	2.89	*2.93*	*2.12*	1.07
	LCI	.71	.75	.45	.41	1.00	.63	.67	.71	.86	1.35	1.17	.80
	UCI	1.27	2.55	2.16	2.22	1.91	1.60	1.38	1.21	9.72	6.32	3.84	1.45
Age	OR	.97	*1.11*	1.00	*1.28*	.96	*1.09*	.92	.94	.97	*1.15*	*1.13*	.96
	LCI	.92	1.01	.88	1.12	.91	1.00	.87	.90	.84	1.04	1.04	.91
	UCI	1.02	1.21	1.14	1.47	1.01	1.19	.99	.99	1.12	1.27	1.22	1.00
Mother	OR	.88	.78	.83	1.31	.75	*2.61*	.63	1.14	1.83	.46	.61	1.25
	LCI	.56	.31	.23	.39	.45	1.08	.34	.75	.55	.13	.26	.79
	UCI	1.40	1.97	2.97	4.37	1.24	6.31	1.18	1.75	6.12	1.57	1.44	1.98
Father	OR	.92	.96	.98	1.06	.84	*1.86*	.89	1.24	1.37	1.03	.89	1.18
	LCI	.70	.58	.49	.48	.63	1.20	.64	.95	.63	.60	.57	.89
	UCI	1.21	1.59	1.98	2.33	1.12	2.88	1.24	1.60	2.99	1.78	1.38	1.57

Note: OR = odds ratio (italicized when significant, $P < .05$)
LCI = lower margin of 95% confidence interval
UCI = upper margin of 95% confidence interval

LCA yields item score probabilities for individuals for all items that are included in an analysis. These probabilities are different for each class and indicate the probabilities of item scores 0, 1, and 2, given a specific class membership. For each class, the probabilities of score 0, 1, and 2 for each item can be put into a graph. To enhance the comprehensibility of our graph and because of the purpose of this study to focus on the clinically relevant levels of problems, we chose to only present data regarding probabilities of score 2 on items in a graph and, since the profiles of the three latent classes were non-overlapping on the item level, to present mean item endorsement probabilities for score 2, separately for the three domains (Attention Problems, Aggressive Behavior, and Rule-Breaking Behavior) that were studied. Hence, for instance, Figure 6.1 shows that the mean probability of score 2 on Attention Problem items was around .5 for individuals in class 1, and around .1 for members of class 3.

The three classes are shown in Figure 6.1: class 1, the high class, with a high level of disruptive behavior, including a high score on Aggressive Behavior; class 2, the intermediary class; and class 3, the low class. Individuals in classes 1 and 2 displayed all three types of disruptive behavior. Members of class 3 only displayed a low probability of scoring on the Attention Problems scale, while the probabilities of scoring on the Aggressive and Rule-Breaking Behavior scales were nearly zero.

Odds ratios were determined, as well as their confidence intervals, for the outcomes at T2 for members of each of the three latent classes determined at T1. These odds ratios, as well as those for the covariates, are shown in Table 6.2.

DISCUSSION

This study investigated latent classes of disruptive behavior in a large referred sample of children and adolescents, as well as the outcome associated with membership of each of the latent classes. At T1, three latent classes of disruptive behavior were found: a class with a high level of disruptive behavior, including a high level of aggressive behavior; an intermediary class; and a low class, which only displayed a low level of attention problems.

The lines of the three classes in Figure 6.1 run parallel, with two slight deviations from this pattern: a high level of aggressive behavior in class 1, and a low level of attention problems but nearly absent aggressive and rule-breaking behavior in class 3. The classes represented by these lines contained individuals with different levels of severity of disruptive behavior, but not with differences concerning the type of problems. This indicates that comorbidity of disruptive behavior, symptoms of ADHD, ODD, and CD, is common. Many previous studies also found evidence for high comorbidity rates of different types of disruptive behavior (Angold et al., 1999; Rowe et al., 2002, 2005). The study by De Nijs et al. (2007b), in a

sample of referred adolescents, displayed high disruptive behavior comorbidity rates as well. Loeber and Keenan (1994) indicated that the co-occurrence of ADHD, ODD, and CD is greater than can be expected by chance. Further, individuals with different types of disruptive behavior appeared to be very similar with regard to deficiencies in problem-solving skills, pervasiveness of problems across different settings, intelligence and achievement measures, family context measures and behavioral symptoms (Matthys et al., 1999; Paternite et al., 1995).

Individuals who were at T1 in the classes with elevated levels of disruptive behavior, classes 1 and 2, showed poor outcome. Members of the high class had a higher risk of all types of poor outcome measures than members of the low class. Members of the intermediary class had, at follow-up, compared with members of the low class, a higher risk of having school problems, work problems, injuries, receiving inpatient treatment, having problems for which they need professional help, having had police contacts, and showing impaired global functioning.

Poor educational outcome was shown previously by Hansen et al. (1999), who found that young men diagnosed with ADHD in childhood, were more likely to have dropped out of high school than controls. Mannuzza et al. (1997) had followed-up boys with ADHD for 15 to 21 years, and found that they had completed about two years less of formal schooling, on average, than a control group. Van Bokhoven et al. (2006) found, in a sample of adolescents who had been treated as children in an inpatient and/or day-treatment setting because of disruptive behavior, that 42% of the subjects for whom school attendance was mandatory but only on a part-time basis, were not attending school at all. Harada et al. (2002) found that children and adolescents with ADHD comorbid with ODD had more problems in the relationship with teachers in comparison with patients with ADHD only, and that school refusal occurred more frequently in the comorbid ADHD-ODD patients than in those with ADHD only and less than in those with ODD only.

Poor occupational outcome of ADHD was found previously by Barkley et al. (2006) and by Mannuzza et al. (1993, 1997). Mannuzza et al. (1997) found that young adults who had been diagnosed with ADHD at an average age of 7 years, had lower-ranking occupational positions than controls. This difference could not be accounted for by adult mental status.

Increased risk of injury in individuals with ADHD symptoms was shown previously by Lam et al. (2006) and by Lee et al. (2007). Schwebel et al. (2006) showed that children with behavior disorders, and those with oppositional behavior patterns in particular, have increased risk of injury.

An increased need of help as an outcome of ADHD was found previously by Hansen et al. (1999). They found that young adult men who had been diagnosed with ADHD in childhood, were significantly more likely than controls to be using mental health services and to report psychological problems.

An increased risk of alcohol and drug abuse in disruptive behavior disorders has been shown in previous studies (August et al., 2006; Barkley et al., 1990, 2003, 2004; Biederman et al., 1997, 2006; Ernst et al., 2006; Flory & Lynam, 2003; Flory et al., 2003; Gittelman et al., 1985; Mannuzza et al., 1991b, 1993, 1998; Marshal & Molina, 2006; Molina & Pelham, 2003; Van Bokhoven et al., 2006). ADHD with comorbid externalizing disorder, primarily oppositional defiant disorder, is associated with an elevated risk of drug use, while ADHD without a comorbid externalizing disorder is not (August et al., 2006). ADHD and CD may interact to afford a higher risk for substance abuse than may either disorder alone (Flory & Lynam, 2003; Flory et al. 2003; Marshal & Molina, 2006). Ernst et al. (2006) found impulsivity to be associated with alcohol use, while aggression was associated with marijuana use. With regard to alcohol abuse, Jain et al. (2007) found evidence for co-segregation of ADHD and other disruptive behaviors with alcohol abuse and dependence, linked to a number of genetic loci.

Criminal behavior and police contacts as an outcome of disruptive behavior have been found in previous studies (Barkley et al., 2004; Hansen et al., 1999; Mannuzza et al., 1989; Satterfield & Schell, 1997; Satterfield et al., 2007; Sourander et al., 2006; Van Bokhoven et al., 2006). Hyperactive boys were found to be at risk for both juvenile and adult criminality. The risk for becoming an adult offender, though, was associated with conduct problems in childhood and serious antisocial behavior (repeat offending) in adolescence. Hyperactive children who did not have conduct problems did not show an elevated risk for later criminality (Satterfield & Schell, 1997; Satterfield et al., 2007). However, in the study by Sourander et al. (2006) teacher reports of hyperactivity problems when the child was 8 years old, independently predicted a high level of criminal offenses when the subject was 16 to 20 years old.

The high class in the present study contained a higher percentage of boys (83%) than the other classes. In this way, sex could be considered a predictor of poor outcome, since it was associated with a higher level of disruptive behavior. After correction for class membership, male sex was, for the majority of the poor outcome measures investigated in this study, not a significant predictor of poor outcome, except for predicting injuries, drug abuse, and police contacts.

Age appeared to contribute only to a modest extent to poor outcome, as shown by odds ratios around 1. However, since age was included in the analyses as a continuous variable, the odds ratios based on a unit of 1 year have been shown in Table 6.2. To calculate the odds ratio for the comparison of two T1 ages which differ more than one year, the odds ratio should be raised to the power of the difference in years. For instance, the risk for someone who is 16 years old at T1 to have dropped out of school at follow-up is $1.11^{12} = 3.5$ times greater than the risk for a four-year-old at T1 to have serious work problems at follow-up.

It can be concluded that being a member of a class with an elevated level of disruptive behavior is a predictor of poor outcome, as compared to being a member of a class with a low level of disruptive behavior. Since members of different latent classes have different outcomes, this supports the predictive validity of the empirical, LCA-based disruptive behavior taxonomy in a referred sample.

In the multiple logistic regression analyses on the same data by Heijmens Visser (2002), significant odds ratios ranging from 1.3 to 3.9 were found for prediction of poor outcome measures by the sum scores on the three externalizing behavior scales of the CBCL. Although in those analyses the Attention Problems scale only yielded a significant odds ratio for prediction of receiving inpatient treatment, and not for the other outcome measures, while the other two scales predicted more poor outcome measures significantly, that approach did not give insight in how the disruptive behavior scores on the different scales at T1 were linked to each other in homogeneous groups of individuals.

Previous studies have shown that children with disruptive behavior have poor outcome later in life. Most studies were based on the *DSM* taxonomic system, which is a top-down, a priori system. The present study confirmed these previous findings by using a bottom-up, empirical approach, LCA, in which we found classes of disruptive behavior which differed in severity, not in type of disruptive behaviors, and which differed with regarding to outcome. In this way, we found support for a taxonomy of disruptive behavior that is based on level of severity.

The strengths of the present study included the large sample size, which enhanced the power of the study to detect latent classes. Second, referred children and adolescents were studied, who had relatively high percentages of positive scores on behavior problem items. In a referred sample, clinically significant classes with a low prevalence in the general population have a higher chance to be detected. Third, contrary to a number of previous studies, this sample included a large proportion of females (29%).

Limitations

The study has several limitations. First, only parent reports were used. It is known that parents often disagree with other informants, e.g. adolescents themselves and teachers, about the presence or absence of disruptive behaviors (Achenbach et al., 1987; De Nijs et al., 2004). Second, actual *DSM-IV* diagnostic information was not available for analyses. The expectation is that, with actual *DSM-IV* diagnostic information, the same patterns will be found, but fewer children and adolescents will be in the high problem class, because age of onset and impairment, influence on daily life, would then also be taken into account. On the other hand, assessing impairment might be of less importance in our sample, since it consists of referred children and adolescents. Also, when using a diagnostic instrument like the DISC for instance, sub-threshold cases would not have been included in the analysis.

Clinical implications

The findings of this study have implications for clinical practice as well as for the development of future taxonomic systems. Children and adolescents with an elevated level of disruptive behavior have a worse prognosis than individuals with a lower level of disruptive behavior. Despite treatment, disruptive behavior has an unfavorable prognosis.

In the present study, latent class analysis showed that in a clinical sample comorbidity of disruptive behavior, symptoms of ADHD, ODD, and CD, is common. For the development of future taxonomic systems, in particular *DSM-V*, an implication of this finding could be that in clinical practice it is less useful to distinguish the three problem domains of disruptive behavior.

Chapter 7

General discussion

The taxonomy of disruptive behavior in children and adolescents was studied in this thesis, using different samples, different informants, different methods (interviews as well as questionnaires), and different taxonomic systems. More specifically, the topics addressed in this thesis include *taxonomy of ADHD* (chapters 2 and 3), *assessment of ADHD* (chapter 4), and *taxonomy of disruptive behavior* (chapters 5 and 6). An overview of the studies reported in this thesis, with their characteristics (sample size and age range, instruments, informants, measured behaviors) is given in Table 7.1.

Table 7.1. Overview of studies within this thesis.

Chapter	Samples (N)	Age range	Instruments	Informants	Measured behaviors
2	Referred (161); general population (211)	8-12	DISC-IV	P	ADHD symptoms
3	Referred (4,422)	6-18	TRF	T	ADH problems + comorbidity
4	Referred (30)	6-16	DISC-IV	P; T	ADHD symptoms
5	Referred (1,965)	11-18	CBCL	P	Disruptive behavior
6	Referred (1,230), T1	4-16	CBCL	P	Disruptive behavior
6	Referred (1,230), T2	6-21	CGAS; outcome questionnaire	P	Outcome

Note: ADH = attention-deficit/hyperactivity
ADHD = Attention-Deficit/Hyperactivity Disorder
CBCL = Child Behavior Checklist
CGAS = Children's Global Assessment Scale
DISC-IV = Diagnostic Interview Schedule for Children Version IV
TRF = Teacher's Report Form
P = Parent
T = Teacher

TAXONOMY OF ADHD

When, in one of the studies described in this thesis, different approaches to taxonomy of ADHD symptoms, i.e. the top-down *DSM* approach and the bottom-up LCA approach, were compared in a mother-rated combined sample of general population as well as referred primary school children, these taxonomies tended to converge. With both taxonomic approaches, all three ADHD subtypes – the predominantly inattentive type, the predominantly hyperactive-impulsive type, and the combined type – were found. We found comparable results in both the referred and the general population children, but the hyperactive-impulsive type or class of ADHD only appeared in the referred sample.

When we used teacher information to examine the taxonomy of inattention and hyperactivity/impulsivity symptoms in a referred broad age range sample, a hyperactive-impulsive-only group was not found. From this result, combined with the ADHD subtypes found in a parent-rated sample, it could be inferred that ADHD taxonomy might be informant-specific. The parent-specific taxonomy of ADHD could include the three subtypes as mentioned in the *DSM* taxonomic system, while in the teacher-specific taxonomy of ADHD, only two subtypes, i.e. the inattentive and the combined, but not the hyperactive-impulsive, could be present.

The difference between these two informant-specific ADHD taxonomies could be explained by differences in behavior by the children themselves in different contexts (the task-oriented context of the classroom versus the less task-oriented home environment). Possibly, a subgroup of children who are hyperactive at home, manage to maintain sufficient attention at home, but are unable to display sufficient attention in school, where attention requirements are generally higher than at home. The difference between the teacher- and parent-specific ADHD taxonomies could also be explained by differences in types of interactions teachers and parents have with a child, by differences in number and quality of items scored on the teacher- versus the parent-rated checklist, by differences in interpretation of behavior (teachers can compare same-age children, whereas this is often not possible for parents), and by differences of observation style between teachers and parents. For teachers to attain their goal of trying to teach children, attention is required, which could imply that teachers are more focused at children's attention than parents, since the situation at home requires attention to be present to a lesser extent. Hence, teachers could be more sensitive to inattention than parents, causing teachers to observe inattention even in those children who, at home, predominantly display hyperactivity and impulsivity.

Our findings could also point into a different direction: since the methods we used for the assessment of inattentive, hyperactive, and impulsive behavior in parents and teachers were different (we used an interview for the parent assessment and a questionnaire for the teacher assessment), there could as well, or alternatively, be a method-specific taxonomy of ADHD. This would imply an interview-specific ADHD taxonomy with three subtypes, and a questionnaire-specific ADHD taxonomy with two subtypes, in which the hyperactive-impulsive subtype would be lacking. Firm conclusions may not be drawn on this point until, in future research, questionnaires and interviews would be compared for both parent and teacher assessments (multi-method, multi-trait approach).

The finding of differences in taxonomy when different informants are being used, possibly implying informant-specific taxonomies, but as well when different assessment methods are being used, implying method-specific taxonomies, raises questions about the nature of taxonomy, classification, and diagnosis. The question can be raised whether diagnosis in psychiatry is dependent on the informant as well as on the method used. Diagnoses can

be considered to be nothing but man-made abstractions (Kendell, 1975; Oulis, 2008), a statement underlining the relative nature of diagnosis and taxonomy. On the other hand, differences between informants can sometimes be sources of information, e.g. regarding outcome (Ferdinand et al., 2003, 2004b, 2007), and informant-specific taxonomies can be combined to a cross-informant taxonomy, as was done by Achenbach, who derived cross-informant syndromes (Achenbach, 1991c; Achenbach et al., 1995).

Although our findings indicated that differences in ADHD taxonomy across different informants could exist, they confirm the existence of two symptom domains within ADHD. These domains, inattention and hyperactivity/impulsivity, had previously been demonstrated using the variable-oriented approach of factor analysis (Gomez et al., 1999; Hudziak et al., 1998), whereas we used the person-oriented LCA approach. This convergence of findings increases confidence in the relevance of these two ADHD symptom domains.

ASSESSMENT OF ADHD

When parents and teachers of referred children and adolescents were asked to report about ADHD symptoms at home as well as in school, high levels of cross-situational agreement between symptom ratings of by the same informant were found. However, the between-observer agreement on the presence of ADHD symptoms within the same setting (home or school) was low, indicating that parent and teacher often disagreed about the child's behaviors in school and at home.

From these findings, it could be concluded that the extent to which parents can provide information about ADHD symptoms in school, independently of their vision on the child's functioning at home, and the extent to which teachers can provide information about ADHD symptoms at home, independently of their vision on the child's functioning in school, are limited.

Both parents and teachers seem to think that the child's behavior will be the same in the setting they do not observe directly. From our findings, the picture emerges that both informants are not very aware of the setting-specificity of a child's behavior.

This lack of awareness, combined with the reported differences in ADHD symptoms we found when informants were being asked to report about their own setting, might yield disagreement and possibly conflict between for instance parents and teachers. In clinical practice, this phenomenon is not uncommon.

Our findings raise questions about cross-setting assessment of ADHD symptoms. Although frequently used in clinical practice, this does not seem to be a valid procedure to derive a diagnosis. And when we keep in mind as well that we also found indications for informant-specific ADHD taxonomies, as described previously, it seems most valid to

use setting-specific, informant-specific assessment both for studying informant-specific taxonomies of ADHD, within a research context, and for collecting diagnostic information, within a clinical context.

TAXONOMY OF DISRUPTIVE BEHAVIOR

When the bottom-up LCA approach was applied to mother-reported disruptive behavior problems, we found that, in referred adolescents, the three domains of disruptive behavior – inattention/hyperactivity, aggressive/oppositional, and rule-breaking/conduct problems – tended to co-occur, as had also been found in a general population sample (Sondeijker et al., 2005). Contrary to the findings from the study by Sondeijker et al. (2005), we also found one class of individuals who displayed predominantly attention problems, and to a far lesser degree aggressive or rule-breaking behaviors. The opposite pattern – aggressive or rule-breaking behaviors with only low levels of attention problems or hyperactivity – was not found. Such behavior patterns could be expected to be found only in samples of incarcerated youths (Vreugdenhil et al., 2004).

Possibly, the difference between the findings by Sondeijker et al. (2005) and those from our study in referred adolescents could be explained by the difference in sample source, general population versus referred individuals. A different explanation could be that in the Sondeijker et al. study the individuals were somewhat younger than in our adolescent sample. In line with this is our finding that in a referred broader age range sample of both children and adolescents, with a mean age of 8 years old, only classes in which the three domains of disruptive behavior tended to co-occur, were found, while in that sample a class with predominantly attention problems, and to a lesser degree aggressive or rule-breaking behaviors, was lacking. Similar classes were found in the study by Van Lier et al. (2003), in which seven-year-old children from the general population were studied.

Our findings indicated that problems with attention, impulsivity, and hyperactivity can be considered as a diagnostic construct that should be distinguished from aggressive or rule-breaking behaviors. It is unclear whether development of disruptive behavior can explain our finding of the presence of a class with predominantly attention problems in the adolescent-only sample but its absence in the broader age range sample of both children and adolescents, with a lower mean age. Possibly, a specific group of children which displayed combined disruptive behavior, gradually lost their aggressive and rule-breaking behavior during childhood and adolescence, yielding a class with predominantly attention problems when they were adolescents.

In both parent- and teacher-rated samples, we found disruptive comorbidity to be present especially in groups with higher levels of attention problems and hyperactivity, especially

when these two types of ADHD symptoms were combined. Apparently, oppositional defiant and conduct problems tend to go together with higher-level combined-type ADH problems, irrespective of informant. Teacher-rated affective and anxiety problems followed the same pattern of co-occurrence with subgroups of ADH problems as oppositional and conduct problems.

When we investigated the outcome of referred individuals who were members of latent classes with different levels of severity of predominantly combined disruptive behaviors, we found that members of classes with higher levels of disruptive behaviors showed a poorer outcome. The members of the high class had a higher risk of all types of poor outcome measures than members of the low class, while intermediary class members had a higher risk of all poor outcome measures except receiving outpatient treatment and alcohol or drug abuse than members of the low class. This supported the predictive validity of the LCA-based disruptive behavior taxonomy.

Our finding that ADH behaviors can be, in some individuals, independent or separate from oppositional/conduct problems, is in accordance with previous studies indicating that genes exist which are specifically responsible for ADHD but not for ODD/CD, or vice versa (Comings et al., 2000; Nadder et al., 2002). For instance, Nadder et al. (2002) found that one common genetic factor determined covariation between different disruptive behavior phenotypes, but that additional genetic factors were specific for ODD/CD symptoms. Bartels et al. (2003) found that 80% of the covariance between aggressive and rule-breaking behavior could be explained by genetic influences. Christiansen et al. (2008) found a higher relative risk to develop ADHD with comorbid conduct problems for siblings of children who also had ADHD with comorbid conduct problems than for siblings of children with ADHD only.

Also, neuropsychological differences were found between ADHD on the one hand and ODD/CD on the other. For instance, Clark et al. (2000) found that executive function deficits were specific to adolescents with ADHD and with comorbid ADHD and ODD/CD, as compared to normal controls and to adolescents with ODD/CD only.

In sum, contrarily to what is often being observed in clinical practice as well as in general population studies (e.g., Sondeijker et al., 2005; Van Lier et al., 2003), ADHD does not always present with ODD/CD comorbidity, but can be present as a separate disorder without comorbidity as well. As far as both research and clinical practice stand today, discriminating between ADHD and ODD does not seem to imply fundamentally different treatments, since medication as well as psychosocial treatments are the same for both ADHD and ODD, and have comparable effects on both (Van der Oord et al., 2008). However, since ADHD can both present as a separate disorder and in combination with ODD/CD, we recommend the development and testing of more specific treatments, as well as the search for more specific etiological factors.

STRENGTHS AND LIMITATIONS

Strengths of the studies reported in this thesis include the following. First, sample sizes were large, which enhanced statistical power, for instance to detect latent classes. Second, referred samples were used, while previous studies using LCA were often performed in general population samples, in which low-prevalent classes with high or medium symptom levels have a fairly low chance of being detected with LCA. In referred and enriched general population samples, those low-prevalent classes in the general population have a higher chance of being detected. Third, our samples included fair proportions of females, which were absent from some previous studies. Fourth, both parent- and teacher-specific taxonomies were investigated; and finally, both categorical and dimensional measures of psychopathology were used and compared.

The value of the studies reported in this thesis was limited by the use of a single type of informant as well as a single method (interview or questionnaire) in some studies, instead of being able to combine assessments by several informants and by several methods, making possible the investigation of cross-informant taxonomies of all types of disruptive behavior problems, as well as the investigation of method-specific taxonomies that might exist (multi-method, multi-trait approach). Second, some studies only investigated a limited age range, e.g. children aged 8-12, or adolescents. Third, some studies investigated patterns of *DSM* disorders using instruments like CBCL and TRF, but without actual (clinical) *DSM* diagnostic information being available for analyses. Fourth, in the study in which latent class and *DSM* taxonomies were compared, both were based on the same measure, DISC-IV-P. Finally, symptoms of autism and other PDDs were not investigated, although some of the individuals in the clinical samples were referred for PDD diagnostic evaluation.

CLINICAL AND RESEARCH IMPLICATIONS

The studies described in this thesis lead to the following clinical and research implications:

1. For the development of future taxonomic systems, in particular *DSM-V*, it is important to take recent findings into account. According to our and previous findings, taxonomy of disruptive behavior in children and adolescents should describe ADHD and ODD/CD as sometimes occurring separately and sometimes occurring concurrently. ADHD taxonomy should be informant-specific. The parent-specific ADHD taxonomy should include all three ADHD subtypes currently described in *DSM-IV*, whereas in the teacher-specific ADHD taxonomy a hyperactive-impulsive subtype would be lacking. Development of informant-, setting-specific criteria for ADHD could help the clinician in performing

setting-specific assessments as well as the researcher in further exploring and refining ADHD taxonomy.

2. For the clinician, it is important to realize that the taxonomy of ADHD may be informant-specific. This may imply that in collecting diagnostic information about the child or adolescent from the teacher, a hyperactive-impulsive subtype might not be found, as opposed to when collecting diagnostic information from the parents. The use of a cross-informant taxonomy, of cross-informant syndromes (Achenbach, 1991c; Achenbach et al., 1995) in clinical practice is advocated.
3. Because the extent to which parents can provide information about symptoms in school seems to be limited, as well as the extent to which teachers can provide information about symptoms at home, it might be important to ask teachers to judge ADHD symptoms occurring in the classroom, and parents to judge ADHD symptoms occurring at home. Based on our findings, cross-setting assessment of ADHD symptoms, although frequently being used in current clinical practice, does not seem to be a valid procedure to derive a diagnosis. Therefore, this assessment practice is to be discouraged. And when we keep in mind as well that we also found indications for the existence of informant-specific ADHD taxonomies, it seems most valid to use setting-specific, informant-specific assessment both for studying informant-specific taxonomies of ADHD, within a research context as well as for collecting diagnostic and treatment effect information, within a clinical context.
4. Both parents and teachers seem to imply that the child's behavior will be the same in the setting they do not observe directly. From our findings, the picture emerges that both informants are not very aware of the setting-specificity of a child's behavior. This lack of awareness, combined with the reported differences in ADHD symptoms we found when informants were being asked to report about their own setting, might yield disagreement and possibly conflict between for instance parents and teachers. In clinical practice, this phenomenon is not uncommon. Awareness in clinicians for this phenomenon could contribute to their staying out of these conflicts but instead showing respect for each informant's view and trying to integrate these views into a cross-informant diagnostic formulation.
5. Although comorbidity of symptoms of ADHD, ODD, and CD is common, ADHD in some individuals will, according to our findings, occur without high levels of ODD/CD symptomatology. For the clinician, it may be less important to distinguish between ADHD only and ADHD combined with ODD, since this distinction does not, currently, inform treatment options (Van der Oord et al., 2008). However, hopefully, in the future this distinction will imply differences in etiology and in treatment choice.

6. The level of severity of disruptive behavior is an important predictor for prognosis. Children and adolescents with elevated levels of disruptive behavior have a worse prognosis than individuals with lower levels of disruptive behavior. As was already known from previous studies, disruptive behavior problems have an unfavorable prognosis. The clinician should be aware that disruptive behavior problems, but also affective and anxiety problems, are frequent forms of comorbidity, especially in children with combined type ADHD or with higher levels of ADH problems. Therefore, it is very important for the clinician to assess disruptive as well as internalizing comorbidity in each patient presenting with attention problems, hyperactivity, or impulsivity; when this assessment is done at a young age, early intervention intended to improve prognosis is still possible.

SUGGESTIONS FOR FUTURE RESEARCH

Our findings might generate future studies:

1. Development of taxonomic systems is an ongoing process. Present and future taxonomic systems should be tested and adjusted on the basis of new findings. In our studies, we found indications for the existence of informant-specific as well as setting-specific ADHD taxonomies. Further research is needed to determine whether informant-specific and/or setting-specific ODD/CD taxonomies exist as well. Also, latent class analysis can be performed on teacher-rated *DSM* ADHD items, preferably in both referred and general population samples, to further investigate teacher-specific ADHD taxonomy. Further, it is important to investigate whether a specific ADHD taxonomy based on self-report also exists. This would have consequences for adult psychiatry as well, e.g. when ADHD is being diagnosed at adult age, since in adult psychiatry the primary informant is usually the patient. Finally, the development and subsequent testing of informant- and setting-specific criteria for ADHD and possibly other disorders as well could not only help the clinician, but the researcher as well.
2. The sources and determinants of cross-informant and cross-setting variation in reporting disruptive behavior are not well-known. These could be further investigated, possibly giving more insight in how informant- and setting-specific taxonomies relate to each other and how, by combining them, cross-informant taxonomies that describe psychopathology in a reliable and valid way, should be constructed.
3. Our findings raise questions not only about the cross-setting assessment of ADHD symptoms, but about the cross-setting assessment of other symptom areas as well. The validity of cross-setting assessment of ODD and CD symptoms, but also internalizing behaviors, should be subject to further investigation.

4. Different subtypes of ADHD, e.g. combined type ADHD and ADD, might have a different etiology and might require a different treatment. Further research is needed to clarify both and, possibly to develop more specific treatments for ADHD subtypes.
5. Since ADHD and ODD/CD seem to be different taxonomic modalities, that can co-occur but also occur more or less separately, it can be expected that different etiological factors play a role and that treatments can be more specific for ADHD or ODD/CD than they are in current clinical practice. More research is needed both to further clarify these etiological factors and to develop and test more specific pharmacological and psychosocial treatments.
6. Future studies should also further investigate the longitudinal evolution of phenotypically homogeneous groups, latent classes of disruptive behavior, especially measured by *DSM* criteria, both in the general population and in referred samples. These studies could enhance our knowledge about the development of these classes, whether they are stable over time or change. These developmental pathways can be a good basis for further neurobiological and genetic research of disruptive behavior.

CONCLUSION

This thesis aimed at extending the existing knowledge on the taxonomy of disruptive behavior in children and adolescents. The main findings were:

1. When the *DSM* and the latent class approach to taxonomy of ADHD symptoms were applied to a parent-rated sample of children, all three ADHD subtypes (the predominantly inattentive type, the predominantly hyperactive-impulsive type, and the combined type) were found with both approaches. When teacher information was used, a hyperactive-impulsive-only group was not found.
2. With regard to the assessment of ADHD, we found a high within-observer cross-situational presence of ADHD symptoms between parents and teachers, but a low between-observer agreement on the presence of these symptoms within the same setting (home or school).
3. In referred children and adolescents, high levels of comorbidity of disruptive behaviors were found using LCA. Membership of higher-level disruptive behavior classes predicted poor outcome. A class with individuals who showed predominantly attention problems, and to a far lesser degree aggressive or rule-breaking behavior, was only found in an adolescents-only sample.

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Summary

Disruptive or externalizing behavior disorders include Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD). Disruptive behaviors in the broader sense, as used in the present thesis, generally contain three problem domains: attention/hyperactivity problems, aggressive/oppositional problems, and rule-breaking/conduct problems. The objective of the studies described in this thesis was to investigate taxonomy of disruptive behavior in children and adolescents.

In **chapter 1**, the background and the aims of the studies in this thesis were presented. Taxonomy is the process of the identification of groups of individuals according to their properties, hence according to intrinsic criteria, e.g. individual problems or symptoms. Assessment identifies the distinguishing features of each individual case, which, in child and adolescent psychiatry, can be expressed in behavioral, emotional, or physical measures. Assessment can be used to classify an individual in the proper taxonomic category.

Different approaches to taxonomy in child and adolescent psychiatry are possible, e.g. the top-down approach of the *DSM* (*Diagnostic and Statistical Manual of Mental Disorders*) system and the bottom-up approach of latent class analysis (LCA), a person-oriented approach which makes use of categorical latent variables.

In the present thesis, the taxonomy of disruptive behavior in children and adolescents was investigated, using different samples, different informants, different methods (interviews as well as questionnaires), and different taxonomic systems. The main research questions addressed in this thesis were:

- Do the *DSM* and the LCA approaches to taxonomy of ADHD (Attention-Deficit/ Hyperactivity Disorder) symptoms yield different or comparable results, especially regarding the three subtypes of ADHD (inattentive, hyperactive-impulsive, and combined subtypes)?
- Which taxonomy arises when the LCA approach is applied to teacher-reported inattention and hyperactivity/impulsivity symptoms in referred children and adolescents?
- To which extent can parents provide information about ADHD symptoms in school, independently of their vision on the child's functioning at home; to which extent can teachers provide information about ADHD symptoms at home, independently of their vision on the child's functioning in school?
- Which taxonomy arises when the LCA approach is applied to mother-reported disruptive behavior in referred adolescents?
- Can a taxonomy of disruptive behaviors in referred children and adolescents found by application of LCA be validated by studying the outcome of these children and adolescents?

In **chapter 2**, a study is described in which mothers of 372 8- to 12-year-olds, 161 from a clinical and 211 from a general population sample, were interviewed with the Diagnostic Interview Schedule for Children-Parent Version (DISC-P). LCA of ADHD symptom scores

yielded four ADHD classes: a combined class, an inattentive-impulsive class, a predominantly hyperactive-impulsive class, and a low class. The hyperactive-impulsive class as well as the hyperactive-impulsive type of ADHD according to *DSM-IV* were only found in the referred sample. We concluded that the LCA and *DSM-IV* taxonomies of ADHD yielded comparable classifications. Disruptive comorbidity was most frequently found in the combined class.

In **chapter 3**, LCA was conducted on Attention-Deficit/Hyperactivity (ADH) Problems scored on the Teacher's Report Form (TRF) by the teachers of 4,422 referred 6-18 year old children and adolescents. LCA yielded three different groups of individuals with both Inattention and Hyperactivity-Impulsivity, and one group with high scores on Inattention but low scores on Hyperactivity-Impulsivity. A group of patients with predominantly hyperactivity and impulsivity was not found. Individuals in groups with higher levels of ADH Problems had significantly higher levels of Oppositional Defiant (OD) and Conduct Problems, and, although to a lesser extent, significantly higher levels of Affective and Anxiety Problems than individuals in groups with lower levels of ADH Problems. From the findings in this teacher-rated sample it was concluded that it may not be useful to discern the hyperactive-impulsive type of ADHD.

In **chapter 4**, a study is described in which ADHD symptoms were assessed with the DISC in a sample of 30 6-16 year old children and adolescents diagnosed with ADHD, with parents and teachers as informants. Both parents and teachers reported about the child's ADHD symptoms at home as well as in school. Both parents and teachers showed high within-observer cross-situational presence of ADHD symptoms, but the between-observer agreement on the presence of ADHD symptoms within the same situation (home or school) was low. It was concluded that, in evaluating ADHD symptoms, it is important to obtain independent reports about the child's behavior at school from the teacher and about the child's behavior at home from the parents.

In **chapter 5**, a study is described in which mothers of 1,965 11-18 year old adolescents, referred to mental health agencies, completed the Child Behavior Checklist (CBCL). LCA was conducted on the Attention Problems scale (representing problems with attention, impulsivity, and hyperactivity), Aggressive Behavior, and Rule-Breaking Behavior scales of the CBCL. Six latent classes were found. One of these classes contained individuals who suffered predominantly from attention problems and to a far lesser degree from aggressive or rule-breaking behaviors. The other five classes represented individuals with varying degrees of attention problems, aggressive behaviors, and rule-breaking behaviors. This study indicated that problems with attention, impulsivity, and hyperactivity can be considered as a diagnostic construct that should be distinguished from aggressive or rule-breaking behaviors.

In **chapter 6**, a study is described in which parents of 1,230 referred 4-16 year old children and adolescents completed the CBCL. LCA was conducted on CBCL items indicating disruptive behavior. A latent class with a high level of disruptive behavior, an intermediary

class, and a low class were found. At reassessment, after 1 to 15 years (mean follow-up interval = 6.3 years), at age 6 to 21, the parents completed an outcome questionnaire and the Children's Global Assessment Scale (CGAS). Members of the high class had a higher risk of all types of poor outcome measures than members of the low class. Intermediary class members had a higher risk of all poor outcome measures except receiving outpatient treatment and alcohol or drug abuse than members of the low class. It was concluded from this study that support was found for a taxonomy of disruptive behavior that is based on level of severity, not on specificity of problem behaviors.

In **chapter 7**, the main findings and conclusions were discussed. When findings from the different studies described in this thesis were combined, it could be inferred that ADHD taxonomy might be informant-specific. The parent-specific taxonomy of ADHD could include the three subtypes as mentioned in the *DSM* taxonomic system, while in the teacher-specific taxonomy of ADHD, only two subtypes, i.e. the inattentive and the combined, but not the hyperactive-impulsive, could be present. Further, our findings raise questions about cross-setting assessment of ADHD symptoms, e.g. when parents report about symptoms in school or when teachers report about symptoms at home. Instead, it seems most valid to use setting-specific, informant-specific assessment both for studying informant-specific taxonomies of ADHD, within a research context, and for collecting diagnostic information, within a clinical context. Our findings also indicated that ADH behaviors can be considered as a diagnostic construct that should be distinguished from oppositional/conduct problems, and that an LCA-based disruptive behavior taxonomy could be validated by studying outcome.

Considering the results of the studies described in this thesis, it appears important for future research (1) to determine whether informant-specific and/or setting-specific ODD/CD taxonomies exist, and whether a specific ADHD taxonomy based on self-report can be found. (2) The sources and determinants of cross-informant and cross-setting variation in reporting disruptive behavior should be further investigated. (3) The validity of cross-setting assessment of ODD and CD symptoms, but also internalizing behaviors, should be subject to further investigation. (4) Further research is needed to clarify whether different subtypes of ADHD, but also different disorders within the disruptive behavior spectrum (ADHD vs. ODD/CD), have a different etiology and whether they require different, more specific treatments. (5) Future studies which focus on the longitudinal evolution of latent classes of disruptive behavior, could enhance our knowledge about the development of these classes, whether they are stable over time or change. These developmental pathways can be a good basis for further neurobiological and genetic research of disruptive behavior.

Samenvatting

Tot de disruptieve of externaliserende gedragsstoornissen behoren de oppositioneel-opstandige stoornis (ODD, *Oppositional Defiant Disorder*) en de gedragsstoornis (CD, *Conduct Disorder*). Met disruptief gedrag in bredere zin, zoals in dit proefschrift gebruikt, worden in het algemeen de volgende drie gebieden van probleemgedrag bedoeld: aandachtsproblemen/hyperactiviteit, agressief/oppositioneel gedrag en regeloverschrijdend/delinquent gedrag. De doelstelling van de onderzoeken beschreven in dit proefschrift was het bestuderen van de taxonomie van disruptief gedrag bij kinderen en jongeren (adolescenten).

In **hoofdstuk 1** worden achtergrond en doelstellingen van de deelstudies van dit proefschrift gepresenteerd. Taxonomie is het proces van identificeren van groepen individuen op basis van hun eigenschappen, dat wil zeggen op basis van intrinsieke criteria, bijvoorbeeld individuele problemen of symptomen. Met de term *assessment* wordt bedoeld het vaststellen van de onderscheidende kenmerken van een individu, die in de kinder- en jeugdpsychiatrie uitgedrukt worden in diverse gedragsmatige, psychologische en lichamelijke grootheden. *Assessment* kan gebruikt worden om een individu in de correcte taxonomische categorie te classificeren.

Verschillende benaderingen van taxonomie zijn mogelijk in de kinder- en jeugdpsychiatrie, namelijk de *top-down*-benadering van het DSM (*Diagnostic and Statistical Manual of Mental Disorders*)-systeem en de *bottom-up*-benadering van de latente-klassenanalyse (LCA, *latent class analysis*), een benadering die met behulp van latente (dat wil zeggen niet direct gemeten, maar door de computer berekende) variabelen individuen in homogene groepen (latente klassen) indeelt.

In het onderhavige proefschrift wordt de taxonomie van disruptief gedrag bij kinderen en adolescenten bestudeerd, waarbij verschillende *samples*, verschillende informanten, verschillende methoden (zowel interviews als vragenlijsten), en verschillende taxonomische systemen gebruikt worden. De voornaamste onderzoeksvragen van dit proefschrift zijn:

- Leiden de *DSM*- en de latente-klassenbenadering van de taxonomie van ADHD (*Attention-Deficit/Hyperactivity Disorder*)-symptomen tot verschillende of vergelijkbare resultaten, in het bijzonder met betrekking tot de drie subtypen van ADHD (het aandachtstekorttype, het hyperactieve-impulsieve type en het gecombineerde type)?
- Welke taxonomie komt naar voren wanneer de latente-klassenbenadering toegepast wordt op door de leerkracht gerapporteerde aandachtsproblemen, hyperactiviteit en impulsiviteit bij (naar een ambulante GGZ-instelling/afdeling) verwezen kinderen en adolescenten?
- In welke mate kunnen ouders informatie geven over ADHD-symptomen op school, onafhankelijk van hun visie op het functioneren van hun kind thuis? In welke mate kunnen leerkrachten informatie geven over ADHD-symptomen thuis, onafhankelijk van hun visie op het functioneren van hetzelfde kind op school?

- Welke taxonomie komt naar voren wanneer de latente-klassenbenadering toegepast wordt op door moeders gerapporteerd disruptief gedrag bij verwezen adolescenten?
- Is het mogelijk een door LCA gevonden taxonomie van disruptief gedrag bij verwezen kinderen en adolescenten te valideren door de *outcome* van deze kinderen en jongeren te bestuderen?

In **hoofdstuk 2** wordt een studie beschreven waarin de moeders van 372 acht- tot twaalfjarigen, te weten een klinische *sample* van 161 kinderen en een *sample* uit de algemene bevolking van 211 kinderen, werden geïnterviewd met de DISC-P (*Diagnostic Interview Schedule for Children-Parent Version*). Latente-klassenanalyse van ADHD-symptoomscores leverde vier ADHD-klassen op: een gecombineerde klasse, een aandachtstekort-/impulsieve klasse, een overwegend hyperactieve-impulsieve klasse en een lage klasse (met lage ADHD-symptoomniveaus). De hyperactieve-impulsieve klasse en het hyperactieve-impulsieve subtype van ADHD volgens DSM-IV warden alleen in de verwezen *sample* gevonden. We concludeerden dat de LCA- en de DSM-IV-taxonomieën van ADHD vergelijkbare classificaties opleverden. Disruptieve comorbiditeit werd het vaakst aangetroffen in de gecombineerde klasse.

In **hoofdstuk 3** werd LCA uitgevoerd op ADH (*Attention-Deficit/Hyperactivity*)-problemen gescoord op de TRF (*Teacher's Report Form*) door de leerkrachten van 4422 verwezen kinderen en adolescenten in de leeftijd van 6-18. LCA leverde op: drie verschillende groepen individuen met zowel aandachtstekort als hyperactiviteit-impulsiviteit, en één groep met hoge scores op aandachtstekort maar lage scores op hyperactiviteit-impulsiviteit. Een groep patiënten met vooral hyperactiviteit-impulsiviteit werd niet gevonden. Zij die behoorden tot groepen met hogere niveaus van ADH-problemen hadden significant hogere niveaus van oppositioneel-opstandige en gedragsproblemen, en – hoewel in mindere mate – significant hogere niveaus van affectieve problemen en angst dan degenen die behoorden tot groepen met lagere niveaus van ADH-problemen. Uit de bevindingen van deze leerkracht-gescoorde *sample* concludeerden we dat het wellicht niet zinvol is het hyperactieve-impulsieve subtype van ADHD als apart subtype aan te merken.

In **hoofdstuk 4** wordt een studie beschreven waarin ADHD-symptomen werden gemeten met de DISC in een *sample* van dertig kinderen en adolescenten met ADHD, die 6-16 jaar oud waren, met ouders en leerkrachten als informanten. Zowel ouders als leerkrachten rapporteerden over de ADHD-symptomen van het kind thuis en op school. Binnen dezelfde informant werd zowel voor ouders als leerkrachten gevonden dat scores voor thuis en school een hoge mate van overeenstemming vertoonden, terwijl de mate van overeenstemming tussen ouder en leerkracht over het al dan niet aanwezig zijn van ADHD-symptomen in dezelfde omgeving (thuis of op school) laag was. We concludeerden dat het bij het beoordelen van ADHD-symptomen van belang is om onafhankelijke rapportages te trachten te verkrijgen, over het gedrag van het kind op school van de kant van de leerkracht, en over het gedrag van het kind thuis van de kant van de ouders.

In **hoofdstuk 5** beschrijven we een studie waarin moeders van 1965 adolescenten, 11-18 jaar oud, verwezen naar een ambulante GGZ-instelling/afdeling, de CBCL (*Child Behavior Checklist*) invulden en waarin vervolgens LCA werd verricht op de CBCL-schalen *Attention Problems* (deze bevat zowel aandachtsproblemen-, impulsiviteit- als hyperactiviteit-items), *Aggressive Behavior* en *Rule-Breaking Behavior*. Zes latente klassen werden gevonden. Eén van deze klassen bevatte individuen die voornamelijk scoorden op de schaal *Attention Problems* en in veel mindere mate op items van de schalen *Aggressive Behavior* en *Rule-Breaking Behavior*. De adolescenten in de overige vijf klassen hadden per klasse verschillende niveaus van problemen op de gebieden van alle drie genoemde schalen. Deze studie liet zien aandachtsproblemen, impulsiviteit en hyperactiviteit beschouwd kunnen worden als een diagnostisch construct dat onderscheiden dient te worden van agressief/regeloverschrijdend gedrag.

In **hoofdstuk 6** wordt een studie beschreven waarin ouders van 1230 verwezen kinderen en adolescenten, 4-16 jaar oud, de CBCL invulden en waarin vervolgens LCA werd verricht op de disruptief-gedragsitems van de CBCL (T1). Een latente klasse met een hoog niveau van disruptief gedrag, een klasse met een matig niveau van disruptief gedrag en een klasse met een laag niveau van disruptief gedrag werden gevonden. Bij heronderzoek, 1-15 jaar later (gemiddeld *follow-up*-interval = 6,3 jaar), op dat moment met de leeftijd in de *range* 6-21 jaar, werden door de ouders een *outcome*-vragenlijst en de CGAS (*Children's Global Assessment Scale*) ingevuld (T2). Leden van de hoog-disruptieve klasse op T1 hadden een hoger risico op alle soorten *poor outcome* op T2 dan leden van de laag-disruptieve klasse op T1. Leden van de matig-disruptieve klasse hadden eveneens een hoger risico dan leden van de laag-disruptieve klasse op alle soorten *poor outcome*, behalve op het hebben van ambulante behandeling op T2 en op alcohol- of drugsmisbruik op T2. We concludeerden dat deze bevindingen een taxonomie van disruptief gedrag die gebaseerd is op niveau van ernst maar niet op type probleemgedragingen ondersteunen.

In **hoofdstuk 7** worden de voornaamste bevindingen en conclusies besproken. Wanneer de bevindingen van de verschillende studies die in dit proefschrift beschreven worden, gecombineerd worden, kan geconcludeerd worden dat de taxonomie van ADHD informantspecifiek lijkt te zijn. De ouderspecifieke ADHD-taxonomie zou dan drie subtypes kennen, zoals genoemd in de DSM, terwijl er in de leerkrachtspecifieke ADHD-taxonomie maar twee subtypes, namelijk het aandachtstekorttype en het gecombineerde type, maar niet het hyperactieve-impulsieve type, zouden zijn. Verder doen onze bevindingen vragen rijzen over het vaststellen van ADHD-symptomen 'over settings heen', dat wil zeggen wanneer ouders rapporteren over symptomen op school of wanneer leerkrachten rapporteren over symptomen thuis. Het lijkt daarentegen het meest valide om settingsspecifieke, informantspecifieke *assessment* toe te passen, zowel voor het bestuderen van informantspecifieke taxonomieën van ADHD in een researchcontext als voor het verzamelen van diagnostische informatie

in een klinische context. Onze bevindingen wezen er ook op dat ADH-gedrag beschouwd kan worden als diagnostisch construct dat onderscheiden dient te worden van oppositioneel gedrag en gedragsproblemen, en dat een op LCA gebaseerde taxonomie van disruptief gedrag gevalideerd kan worden door het bestuderen van de *outcome*.

De resultaten van de studies beschreven in dit proefschrift beschouwend lijkt het van belang voor toekomstig wetenschappelijk onderzoek (1) om te bepalen of informantspecifieke en/of settingsspecifieke ODD/CD-taxonomieën bestaan, en of een specifieke ADHD-taxonomie op basis van zelfrapportage gevonden kan worden. (2) De bronnen en determinanten van varia(n)tie tussen informanten en tussen settings bij het rapporteren van disruptief gedrag dienen verder onderzocht te worden. (3) De validiteit van het vaststellen van ODD- en CD-symptomen, maar ook van internaliserend gedrag, 'over settings heen' dient verder onderzocht te worden. (4) Verder onderzoek is ook nodig om op te helderen of verschillende subtypes van ADHD, maar ook verschillende stoornissen in het disruptieve-gedragsspectrum (ADHD ten opzichte van ODD/CD) een verschillende etiologie hebben en of ze verschillende, meer specifieke behandelingen vereisen. (5) Toekomstige studies die zich richten op het beloop van latente klassen van disruptief gedrag kunnen onze kennis over de ontwikkeling van deze klassen – of ze stabiel zijn in de tijd dan wel veranderen – uitbreiden. Deze ontwikkelingspaden kunnen een goede basis vormen voor verder neurobiologisch en genetisch onderzoek van disruptief gedrag.

Dankwoord

Aan de totstandkoming van dit proefschrift hebben vele mensen – direct dan wel indirect – bijgedragen. Aangezien het gevaar groot is, dat ik niet iedereen in dit dankwoord zal noemen, bij voorbaat mijn excuses indien u niet genoemd wordt.

Allereerst bedank ik de vele ouders en leerkrachten van kinderen en adolescenten die onze polikliniek bezochten de afgelopen decennia, voor het bereidwillige invullen van vragenlijsten, die zowel aan de diagnostiek en behandeling van hun kinderen, maar via dit proefschrift ook aan de verdere ontwikkeling van de kinder- en jeugdpsychiatrie hebben bijgedragen.

Prof.dr. Frank Verhulst, mijn promotor. Beste Frank, in de inmiddels tien jaar dat ik op je afdeling werkzaam ben, heb je mij steeds gestimuleerd tot verdere ontwikkeling. De *éducation permanente* van je medewerkers, en daardoor ook van de afdeling kinder- en jeugdpsychiatrie als geheel, is bij jou al vele jaren in goede handen. Op de cruciale momenten in het schrijven van dit proefschrift stelde jij de cruciale vragen, maakte je de relevante opmerkingen en droeg je literatuur van o.a. je eigen mentor prof. Tom Achenbach aan, die, nog meer dan wij beide vermoed hadden, een tijdloos karakter en een blijvende betekenis blijkt te hebben.

Dr. Robert Ferdinand, in de beginfase van het schrijven van dit proefschrift was jij mijn begeleider. Zonder jouw niet aflatende *drive* was ik waarschijnlijk nooit aan dit proefschrift begonnen en was de vaart er waarschijnlijk niet in gebleven. Drs. Jan van der Ende, jij begeleidde mij in de afrondende fase. Met je rustige en betrokken stijl droeg je bij aan zowel mijn statistisch-wetenschappelijke als persoonlijke ontwikkeling.

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Prof.dr. Michiel Hengeveld, bedankt dat je lid van de leescommissie wilde zijn. Rondom het onderwijs aan geneeskundestudenten hebben we al menig maal samengewerkt. Ons eerste contact zul je je wellicht niet meer herinneren, maar dat dateert al uit 1994, tijdens mijn coschappen in Utrecht.

Prof.dr. Rutger Jan van der Gaag, ook ons eerste contact dateert uit die periode. Via jouw bemiddeling ben ik in Rotterdam gekomen, toen de beschikbare opleidingsplaatsen kinder- en jeugdpsychiatrie in Oost-Nederland beperkt in aantal bleken te zijn. Jouw en mijn belangstelling voor autisme leidde vervolgens tot contacten naar aanleiding van het promotieonderzoek van Esther de Bruin en bij menig congres kwamen we elkaar tegen. Daarom waardeer ik het zeer dat je lid van de leescommissie wilde zijn.

Verder – en nu wordt het gevaarlijk om mensen te vergeten – bedank ik alle bijzonder fijne en aardige collega's van mijn huidige werkplekken, de afdeling kinder- en jeugdpsychiatrie van Erasmus MC, Sophia Kinderziekenhuis, en, op maandagen maar ook wel daarbuiten, de Sarr, autisme-expertisecentrum van Parnassia Bavo Groep. Iedereen, ook degenen die inmiddels elders werken, bedank ik voor de niet aflatende steun en interesse in wanneer nou toch de promotiedatum zou komen. Elk jaar was mijn antwoord: "Volgend jaar." Kennelijk bedoelde ik dit recursief.

In het bijzonder wil ik voormalig Erasmus MC-collega dr. Pol van Lier bedanken. Pol, jij hebt me geholpen bij mijn eerste schreden op het Mplus-pad, totdat ik zelf – mede na lezing van de handleiding op vakantie – me voldoende vertrouwd begon te voelen in het uitvoeren van latente-klassenanalyse. Daarnaast was je een promotor van *haute cuisine*, zowel in fysische als in culinaire zin. We hebben veel gelachen, op de *Digue de la mer de l'ouest*, met de SBC & Friends (inclusief de geroyeerde leden), over de ridders van de *Holy ASEBA Triangle* en tijdens de Heerenlunch, goed voor de *male bonding*, samen met dr. Victor Kallen en drs. Jochem van Ommen en eventueel andere Heeren, wat soms ook dames mochten zijn. Dames zijn ook mijn paranimfen drs. Ingrid Goossens en drs. Gwen Dieleman. Bij hen is het herstel van de letterlijke betekenis van dit begrip in goede handen. Ook dr. Esther de Bruin, met wie ik veel research-lief-en-leed heb gedeeld, en drs. Boukje Haas, heb ik gevraagd om (zonodig) als paranimf op te treden, maar volgens mij is het aantal paranimfen per promotie in Rotterdam helaas gelimiteerd tot twee…

Verder wil ik iedereen uit mijn persoonlijke omgeving bedanken, mijn vrienden en vriendinnen, onder wie ik drs. Menno Koning (zie ook in mijn portfolio) in het bijzonder noem, en Margriet en Ernst Visser-Brink voor het steeds warme contact door de jaren heen, en de vele koorleden met wie ik de afgelopen kwart eeuw als organist en dirigent heb samengewerkt in diverse plaatsen in Nederland, evenals de bestuursleden van de NSGV.

Maar als je de trein niet op de rails zet, zal hij nooit rijden, zei een buurman van mijn ouders ooit. Hij doelde op de geloofsopvoeding, maar aangezien de westerse wetenschap in kloosters begonnen is, geldt dit *mutatis mutandis* natuurlijk ook voor de wetenschappelijke ontwikkeling. En daarom wil ik mijn vader en moeder hartelijk danken voor hun niet aflatende steun en stimulering van kleuterschool tot doctoraat (en daarvoor en daarna natuurlijk ook). Mijn moeder kan helaas de voltooiing van wat ze 'oe scriptie' noemde niet meer meebeleven op deze aarde, maar ze was zeker verguld geweest met het resultaat.

Curriculum vitae

Pieter Franciscus Alfons de Nijs werd geboren op 10 februari 1969 te Hulst. In 1987 behaalde hij het diploma Gymnasium B aan de Jansenius Scholengemeenschap te Hulst. In hetzelfde jaar begon hij met de studie Geneeskunde aan de Rijksuniversiteit te Utrecht, waar hij het artsexamen behaalde in 1995. Tijdens deze studie liep hij een keuze-co-assistentschap neuromusculaire ziekten (supervisor: Prof.dr. J.H.J. Wokke) en deed hij onderzoek naar het poetsgedrag van de rat (begeleider: Prof.dr. Tj.B. van Wimersma Greidanus). Als student-assistent gaf hij practica neuro-anatomie, proefdiertechnieken en autonome bloeddrukregulatie aan studenten Geneeskunde.

Daarnaast begon hij eveneens in 1987 met de studie hoofdvak orgel en bijvak piano aan de Hogeschool voor de Kunsten Utrecht, Utrechts Conservatorium, waar hij het examen docerend musicus orgel behaalde in 1993 (hoofdvakdocenten: K. van Houten en drs. R. Smits).

In 1995 kwam hij als assistent-geneeskundige in opleiding tot psychiater in dienst bij Psychiatrisch Centrum *De Wellen* te Apeldoorn (A-opleider: dr. J.W. Hummelen). De stage sociale psychiatrie volgde hij bij RIAGG Noord-Veluwe te Harderwijk/Barneveld (stage-opleider: drs. Z. Kosutić).

In 1999 begon hij aan de opleiding tot kinder- en jeugdpsychiater bij de Afdeling Kinder- en Jeugdpsychiatrie van het Academisch Ziekenhuis Rotterdam (thans: Erasmus MC), Sophia Kinderziekenhuis (hoofd: Prof.dr. F.C. Verhulst). De registratie als psychiater vond plaats in 2000. De aantekening kinder- en jeugdpsychiatrie werd behaald in 2001.

Sinds 2000 is hij werkzaam als staflid op de polikliniek van de afdeling Kinder- en Jeugdpsychiatrie van Erasmus MC, Sophia Kinderziekenhuis. Hij is coördinator van het team voor ontwikkelingsstoornissen en onderwijscoördinator van de afdeling Kinder- en Jeugdpsychiatrie. Hij is daarnaast via detachering sinds 2000 werkzaam bij de Sarr, expertisecentrum autisme van Parnassia Bavo Groep.

Hij voerde een promotieonderzoek uit binnen de afdeling Kinder- en Jeugdpsychiatrie van Erasmus MC onder begeleiding van zijn promotor Prof.dr. F.C. Verhulst en onder dagelijkse begeleiding van dr. R.F. Ferdinand (2001-2006) en drs. J. van der Ende (2006-2008). De resultaten van dit promotieonderzoek staan beschreven in dit proefschrift.

In de periode 2001-2008 was hij voorzitter van de diocesane Nederlandse Sint-Gregoriusvereniging in het Bisdom Rotterdam en eindredacteur van het tijdschrift *Stemvork*. In 2006 vierde hij zijn vijfentwintigjarig jubileum als kerkorganist.

Erasmus MC
Universitair Medisch Centrum Rotterdam

PhD Portfolio Summary

Summary of PhD training and teaching activities

Name PhD student: Pieter F.A. de Nijs Erasmus MC Department: Child & Adolescent Psychiatry Research School: none	PhD period: Sept. 1, 2001 – April 8, 2009 Promotor(s): Prof. Frank C. Verhulst PhD Supervisor: Jan van der Ende MSc

1. PhD training

	Year	Workload (Hours/ECTS)
Research skills		
- Statistics: Short Courses *Latent Variable Modeling Using Mplus*, Washington, DC; Fulda, Germany	2002	c. 2 ECTS
In-depth courses (e.g. Research school, Medical Training)		
- Nihes Course CC02, *Classical Methods for Data-analysis*, Rotterdam; overall mark: 8.8	2001	c. 6 ECTS
Presentations		
- *Co-morbid psychiatric symptoms in children with PDD-NOS*, IACAPAP (International Association for Child and Adolescent Psychiatry and Allied Professions), Melbourne	2006	c. 0.3 ECTS
- *MCDD: A sub-group of PDD-NOS or a psychotic disorder?* World Autism Congress & Exhibition, Cape Town	2006	c. 0.3 ECTS
- *Herkenning ziektebeeld en diagnosestelling*, conference *Autisme verkend*, post-graduate course for paediatricians, Rotterdam	2001	c. 0.3 ECTS
- *Oudertraining in praktijk*, conference *Ontwikkelingsstoornissen langs de levenslijnen*, Rotterdam	2003	c. 0.3 ECTS
- *Geen verklarende psychologische theorie*, conference *Ontwikkelingsstoornissen langs de levenslijnen*, Rotterdam	2003	c. 0.3 ECTS
- *Wetenschappelijk onderzoek als vorm van patiëntenzorg*, conference *Kinder- en jeugdpsychiater worden: een werkconferentie over de opleiding en functie van kinder- en jeugdpsychiater*, Rotterdam	2004	c. 0.3 ECTS
- *Taxonomie van disruptief gedrag in een klinische sample*, Voorjaarscongres NVvP (Dutch Association of Psychiatry), The Hague	2005	c. 0.3 ECTS
- Chair, *Meetinstrumenten en taxonomie bij denk- en contactstoornissen bij kinderen*, Voorjaarscongres NVvP, The Hague	2005	c. 0.1 ECTS
- *Weg met die poppenkast?* conference *Efficiënter werken in de kinder- en jeugdpsychiatrie*, Amersfoort	2005	c. 0.3 ECTS
- *Agressie, gedragsproblemen, hyperactief gedrag: apart of comorbide?* Voorjaarscongres NVvP, Groningen	2006	c. 0.3 ECTS
- Chair, *Diagnostiek en behandelprogramma's van ASS: praktische toepasbaarheid en wetenschappelijke bevindingen*, Voorjaarscongres NVvP, Groningen	2006	c. 0.1 ECTS
- *PDD: palliatie of curatie?* conference on autism, Rotterdam	2006	c. 0.3 ECTS

- *Weg met die poppenkast?* conference VKJP (Association for Child & Adolescent Psychotherapy), *De spelkamer, een ruimte met vele gezichten*, Driebergen	2006	c. 0.3 ECTS
- *Agressie, gedragsproblemen, ADHD: welke indeling, welke subtypes?* Voorjaarscongres NVvP, Maastricht	2007	c. 0.3 ECTS
- *Overview over de symptomatologie*, conference *Pervasieve ontwikkelingsstoornissen langs de levenslijnen*, Rotterdam	2007	c. 0.3 ECTS
- *Behandeling van ontwikkelingsstoornissen, hoe voorkom je erger?* Voorjaarscongres NVvP, Amsterdam	2008	c. 0.3 ECTS
International conferences		
- IACAPAP (International Association for Child and Adolescent Psychiatry and Allied Professions), Melbourne	2006	c. 1 ECTS
- World Autism Congress & Exhibition, Cape Town	2006	c. 1 ECTS
- IMFAR (International Meeting for Autism Research), London	2008	c. 1 ECTS
2. Teaching activities		
	Year	**Workload (Hours/ECTS)**
Lecturing		
- Lectures on autism, language disorders, learning disorders; undergraduate medical students, Erasmus MC, Rotterdam	2004-2006	c. 3 ECTS
- Teacher & Coordinator, module *Ontwikkelingsstoornissen*, residents in child psychiatry, Rotterdam	2002-2008	c. 7 ECTS
- Lectures on autism, undergraduate psychology students, Leiden University, Leiden	2006-2007	c. 1 ECTS
- Lecture on autism/PDD, post-graduate training SGV (Association for Social Medicine), The Hague	2005	c. 0.4 ECTS
- Lecture on autism, post-graduate health care psychology training, Rotterdam	2006-2009	c. 1.6 ECTS
- Lecture on autism, post-graduate child psychical therapy training, Rotterdam	2007-2008	c. 0.8 ECTS
Supervising practicals and excursions		
- Teacher & Coordinator, Vaardigheidsonderwijs (practicals) *Normale psychologische ontwikkeling*, *Ziektebeelden bij jonge kinderen*, *Anamnese en observatietechnieken bij kinderen en jongeren*, *Differentiële diagnose van druk kleutergedrag*, *Middelengebruik bij adolescenten*, undergraduate medical students, Erasmus MC, Rotterdam	2004-2008	c. 10 ECTS
Supervising Master's theses		
- S. Dieleman & M. v./d. Hout; subject: comorbidity in PDD	2004	c. 2 ECTS
- M. Koning; subject: risperidone in PDD	2005	c. 2 ECTS
Other		
- Supervising research project, post-graduate clinical psychology training: R. Vuijk; subject: character & temperament in adults with PDD	2007-2009	c. 1 ECTS