

Two-year predictive validity of conduct disorder subtypes in early adolescence: a latent class analysis of a Canadian longitudinal sample

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Background: Investigating the latent structure of conduct disorder (CD) can help clarify how symptoms related to aggression, property destruction, theft, and serious violations of rules cluster in individuals with this disorder. Discovering homogeneous subtypes can be useful for etiologic, treatment, and prevention purposes depending on the qualitative or quantitative nature of the symptomatology. The aim of the present study is twofold: identify subtypes of CD in young adolescents based on latent class analysis (LCA) and investigate the two-year predictive validity of CD subtypes on deviant and criminal lifestyles. **Methods:** Adolescent-reported CD symptoms were collected using the National Longitudinal Survey of Children and Youth. Three cohorts of 12–13-year-olds were assessed during 1994–1995, 1996–1997, and 1998–1999 ($N = 4,125$). **Results:** Latent class analyses yielded 4 distinct subtypes: *No CD* (82.4%); *Non-Aggressive CD* ('NACD', 13.9%); *Physically Aggressive CD* ('PACD', 2.3%); and *Severe-Mixed CD* ('SMCD', 1.4%). Predictive validity at age 14–15 was non-specific, although the SMCD type had, by far, the highest odds of deviant and criminal lifestyle outcomes in comparison to youth with PACD or NACD. NACD and PACD had similar odds of deviant outcomes, even if most NACD youth were subthreshold CD (fewer than three symptoms). **Conclusion:** In early adolescence, CD is qualitatively and quantitatively heterogeneous, suggesting multiple developmental pathways. However, they appear to predict similarly violent and non-violent outcomes. **Keywords:** DSM-V, Conduct disorder, latent class analysis, adolescence, predictive validity. **Abbreviations:** CD: conduct disorder; NACD: non-aggressive conduct disorder; PACD: physically aggressive conduct disorder; SMCD: severe-mixed conduct disorder; DSM: Diagnostic Statistical Manual; CBCL: Child Behavior Checklist; ABQ: Antisocial Behavior Questionnaire; LCA: latent class analysis; BIC: Bayesian information criterion.

Conduct disorder (CD) is a psychiatric syndrome beginning in childhood or adolescence and defined by a pattern of repetitive and persistent behavior that violates others' rights of others and/or age-appropriate social norms and rules. This syndrome includes behavior symptoms related to heterogeneous dimensions, such as: 1) verbal or physical aggression toward people or animals; 2) destruction of property; 3) deceitfulness or theft; and 4) serious violation of rules. As discussed in a recent review by Moffitt et al. (2008), many issues need to be clarified to understand this general and complex syndrome before modifying DSM-V's definition of CD. Most notably, the nosology of CD (such as the presence of homogeneous subtypes), which suggests specific developmental pathways (Loeber & Stouthamer-Loeber, 1998; Loeber et al., 1993; Moffitt, 1993; Tremblay, 2000, 2010) leading to similar or distinct outcomes, requires further inquiry (Cicchetti & Rogosch, 1996). Therefore, in this research, we used

latent class analysis (LCA) to identify the number of classes (subtypes) optimal to explain the response patterns of CD symptoms. Second, we tested the predictive validity of these CD subtypes on later deviant lifestyles while controlling for childhood disruptive behaviors such as hyperactivity-inattention and physical aggression (Loeber, Burke, & Pardini, 2009; Loeber, Burke, Lahey, Winters, & Zera, 2000).

Since the creation of the DSM-III, CD subtypes have arisen as a research question (Hinshaw, Lahey, & Hart, 1993; Loeber et al., 2000; Moffitt et al., 2008; Phillips, First, & Pincus, 2005). According to the DSM-IV, to be diagnosed with CD, a child must display three out of 15 symptoms, creating more than 30,000 possible 'three symptoms' subtypes. This cut-off point for CD has been challenged recently by some epidemiological studies, which found that symptom count is somewhat a continuum in the severity of the disorder (Gelhorn et al., 2009; Lahey et al., 1994). The DSM-IV suggests the presence of subtypes based primarily on developmental patterns

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of onset (e.g., childhood versus adolescent onset), but also on the severity of the disorder (e.g., mild, moderate, and severe). Before this, DSM-III subtyping systems began with a matrix of four subtypes: socialized, unsocialized, aggressive and non-aggressive (American Psychiatric Association, 1980). These were followed by three subtypes in the DSM-III-R: solitary aggressive, socialized, and undifferentiated with mixed features (American Psychiatric Association, 1987). Unfortunately, very few studies were conducted to validate this classification, and it was later abandoned in favor of a more developmental approach (Moffitt, 1993; Moffitt et al., 2008).

CD subtypes, based on age of onset, have been preferred (Lahey et al., 1998; Moffitt et al., 2008). Investigating patterns of onset and course of CD symptoms or antisocial behaviors through growth mixture models has yielded hundreds of publications in the past 15 years. These studies have successfully validated the notion of developmental subtypes and have even identified more subtypes (i.e., childhood-limited, low-level chronic, adult onset) than the theory expected (Barker et al., 2007; Lacourse et al., 2002; Lacourse, Dupéré, & Loeber, 2008; Moffitt, 2003; Moffitt et al., 2008; Odgers et al., 2007; Shaw, Lacourse, & Nagin, 2005). Few studies have explored the CD diagnosis based uniquely on the information provided by the symptoms' content (Gelhorn et al., 2009; Nock, Kazdin, Hiripi, & Kessler, 2006).

Using factor analysis, past studies on the dimensional aspects of CD have generally found two or more correlated factors, although some have found only one dimension varying in severity (Gelhorn et al., 2009). Empirical dimensions such as overt symptoms (e.g., physical fighting) and covert ones (e.g., stealing), and aggressive and non-aggressive symptoms have been proposed (Frick et al., 1993; Loeber & Stouthamer-Loeber, 1998; Tremblay, 2000, 2010). These dimensions suggest that a multidimensional classification would be needed to characterize subtypes (Nock et al., 2006). In this respect, LCA is a useful statistical tool in analyzing categorical data because there are no assumptions about the shape of the latent distribution (Heinen, 1996). Moreover, LCA provides prevalence estimates of subtypes and information about the symptom endorsement patterns and probabilities. Although there have been many latent class studies on disruptive behaviors in children (e.g., physical aggression, attention deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD)) (Baillargeon et al., 2007; Hudziak et al., 1998; Rasmussen et al., 2002), and some on antisocial personality disorder in adulthood (Markon & Krueger, 2005), few LCA studies have been carried out on CD behaviors during early adolescence.

To our knowledge, only one study has investigated CD subtypes according to symptoms covering

all four of the dimensions proposed in the DSM-IV. Indeed, Nock et al. (2006) used retrospective data of adults (National Co-morbidity Survey Replication) and found three specialized CD subtypes ('Rule Violations,' 'Deceit/Theft,' and 'Aggressive') and two general subtypes ('Severe Covert' and 'Pervasive CD'). The most prevalent classes were related to non-aggressive symptoms as only one class (2.1%) was purely aggressive. Nock et al. (2006) concluded that CD is characterized more by non-aggressive symptoms than by aggressive ones. Empirical validation of CD subtypes using self-reported prospective youth data from a nationally representative sample is still lacking. Predictive validity of these subtypes could provide contrasting explanations of the disorder's developmental aspects (Loeber et al., 2009, 2000; Moffitt et al., 2008; Nagin & Tremblay, 1999; Nock et al., 2006; Odgers et al., 2007).

Predictive validity of CD subtypes

Many longitudinal studies have found that children and youth diagnosed with CD suffer from both short- and long-term impairments, including mental and physical health problems, accidents, injuries, legal problems, incarceration, and premature mortality (Kim-Cohen et al., 2005, 2009; Laub & Vaillant, 2000; Odgers et al., 2007). The current study investigated the links between CD subtypes at age 12–13 and deviant lifestyle behaviors at age 14–15. These included selling drugs, carrying a weapon, being part of a gang, committing aggravated assault, and being arrested by the police. Theoretical rationale led us to expect general and specific classes as in Nock et al.'s (2006) study. We posited that latent classes presenting symptoms of aggression would be more strongly linked to serious violence than other deviant behaviors and predictive validity would be salient if the CD classes were more likely to have worst outcomes than the non-CD class (Loeber & Stouthamer-Loeber, 1998).

Risk factors for CD have been consistently identified in multiple domains of the human ecology, as have CD outcomes (Loeber et al., 2009, 2000; Moffitt et al., 2008). Models using the notions of multifinality and equifinality have been proposed to explain the developmental processes of CD (Loeber et al., 2009; Patterson, 1993). In the present study, we statistically controlled for the most consistently identified risk factors in late childhood, age 10–11 (e.g., hyperactivity/inattention and physical aggression) (Loeber et al., 2009, 2000; Moffitt et al., 2008). Some authors have suggested that early hyperactivity and mostly physical aggression should be more specifically related to later violent behaviors but somewhat less to theft and violation of rules (Dodge & Pettit, 2003; Nagin & Tremblay, 1999; Tremblay, 2000, 2010).

Methods

Study sample

We selected participants among the 6,168 12–13-year-olds that participated in Cycles 2, 3 and 4 of the National Longitudinal Survey of Children and Youth (NLSCY). The NLSCY was launched in 1994–1995, with follow-up surveys conducted every two years thereafter. It uses a clustered probability sample of private households in the 10 Canadian provinces, but excludes children living in remote areas, institutional settings, and on First Nations reserves. We selected participants who had both complete data at age 10–11 control variables and self-reported CD symptoms. The response rate was 67% ($n = 4,125$). The response rate for the outcome variables at age 14–15 ranged from 50 to 55% (Bennett & Offord, 2001). The sample was approximately evenly divided across both sexes, and more than 90% of the participants were Caucasians. After a complete description of the study, parents and adolescents provided informed consent. To take account of attrition, non-response, and the stratified sampling design, all analyses were conducted using normalized longitudinal survey weights provided by Statistics Canada. Missing data techniques, such as multiple imputation, were used to compare parameter estimates of models and all provided similar results (Allison, 2002).

Measures

Conduct disorder. Following Kim-Cohen et al.'s (2009) recent study, we derived a research diagnosis of adolescent CD by using a combination of self-reported behavioral items for 13 of the 15 DSM-IV CD symptoms (Kim-Cohen et al., 2005). The Child Behavior Checklist (CBCL; Achenbach, 1991) and the Antisocial Behaviour Questionnaire (ABQ; Lacourse et al., 2002) provided items that were semantically similar to the Diagnostic Interview Schedule for Children (Costello, Edelbrock, Kalas, Kessler, & Klaric, 1982). Two items of the DSM-IV CD diagnosis were excluded because they were not available ('has been physically cruel to animals') or because the prevalence was lower than 1% ('has forced someone into sexual activity'). One symptom ('has been physically cruel to people') was substituted by a CBCL item ('has been physically attacking people'). Several recent studies have used similar strategies (Gelhorn et al., 2009; Kim-Cohen et al., 2009).

An adolescent was considered to manifest a symptom if he or she reported it as being 'very true or often true' on the CBCL. Owing to the severity of the behavior, 'I physically attack people' was coded positive, even if 'sometimes or somewhat true' was reported. For this reason, this symptom is slightly more prevalent than the other aggression symptoms. In the DSM-IV, some symptoms are considered to be clinically significant if exhibited only once in the previous 12 months. These items were scored as positive ($no = 0$; $once\ or\ more = 1$) if they were reported to have occurred one or more times on the ABQ. Original items were coded in a Likert format: 1 (never), 2 (once), 3 (3 or 4 times), or 4 (5 times or more). Symptom counts ranged from 0 to 13 and the prevalence of CD, based on the DSM-IV cut-off, was 8.7%. This prevalence is slightly higher than those

found in most previous studies (Fergusson, Horwood, & Lynskey, 1993; Fombonne, 1994; Kessler, Berglund, Demler, Jin, & Walters, 2005; Maughan, Rowe, Messer, Goodman, & Meltzer, 2004).

Sociodemographic characteristics. Family SES was measured through a Statistics Canada index based on parental education, parental professional attainment, and household income. The index ranged from -3.51 to 2.80 ($M = .00$; $SD = .69$). The *nonintact family* variable distinguished those who were not living with either biological or adoptive parents from those living in intact families. Neighborhood characteristics were measured using the 2001 Census of Canada. Two neighborhood disadvantage scales were derived, one representing neighborhood concentrated economic disadvantage and the other representing residential instability (Dupéré, Lacourse, Willms, Vitaro, & Tremblay, 2007; Sampson, Raudenbush, & Earls, 1997; Wikstrom & Loeber, 2000).

Age 14–15 deviant lifestyle outcomes. Deviant and criminal lifestyle outcomes were measured using adolescent reports on the ABQ. The answer format was binary for all outcomes (yes/no). *Drug selling* was measured by one item ('During the past 12 months, have you sold any drugs?'), the prevalence of which was found to be 7.9%. *Gang membership* was also measured by one item ('During the past 12 months, were you part of a gang that broke the law, by stealing, hurting someone, damaging property, etc.?') and its prevalence was 5.4%. *Carrying a weapon* was measured by one item ('During the past 12 months, have you carried a weapon, such as a stick, a club, or a knife?') and this outcome showed a prevalence of 7.2%. *Physical assault* was measured by one item ('During the past 12 months, have you fought with someone to the point where they needed care for their injuries (for example, because they were bleeding, or had broken bones)?'), the prevalence of which was found to be 8.2%. *Contact with the police* was measured by one item ('During the past 12 months, were you questioned by the police about anything that they thought you did?'). The prevalence of this outcome was 20.0%.

Age 10–11 disruptive behaviors control variables. *Hyperactivity-inattention* symptoms were adapted from the CBCL and measured on an 8-item scale reported by the *person most knowledgeable* (PMK) of the child, generally the mother. Examples of items are: 'can't sit still, is restless, or is hyperactive'; 'is impulsive or acts without thinking'; 'fidgets'; 'can't concentrate, can't pay attention for too long'; 'is inattentive'. This scale has been validated in previous studies (Boyle et al., 1987). In the present study, scores ranged from 0 to 16 ($M = 4.14$, $SD = 3.55$), and 15% of youth were considered high level, 35% medium level, and 50% low level. The Cronbach alpha reliability coefficient was .85. *Physical aggression/bullying* symptoms were measured with a PMK-reported 6-item scale. Example of items are: 'gets into many fights'; 'reacts with anger and fighting'; 'threatens people, is cruel, bullies or is mean to others' (Nagin & Tremblay, 1999). Scores ranged from 0 to 12 ($M = 1.21$, $SD = 1.74$); 15% of youth were considered

high level, 35% medium level, and 50% low level. The Cronbach alpha reliability coefficient was .84.

Statistical analyses

The latent structure of the 13 CD symptoms was analyzed using LCA, an appropriate statistical model for binary indicators measuring a discrete unobserved latent structure (McCutcheon, 1987). First, we identified the optimal number of mutually exclusive latent classes that could explain the relationships between the 13 binary symptoms. The LCA model provided two main pieces of information: 1) the latent class probabilities (e.g., prevalence in each class); and 2) the symptom probabilities for each class (e.g., percentages of class members reporting each symptom). Models were tested sequentially, beginning with a 1-class model and then fitting models with increasing number of classes. Though other criteria can be used to compare models, testing the difference in likelihood chi-squared statistics between two models is often suggested for nested models while the Bayesian information criterion (BIC; Kass & Raftery, 1995) is recommended for comparisons of non-nested models. This is because this latter occurs the most often in LCA and the BIC favors the most parsimonious model. The software LEM was used to estimate the LCA models (Vermunt, 1997). We examined the association between the deviant lifestyle outcomes and the latent classes using a generalized linear model (e.g., multinomial logistic regression) in SAS, version 9.2 (SAS Institute Inc., Cary, North Carolina). For these analyses, participants were assigned to the latent classes based on their largest posterior probability. To take the imperfect nature of the classification into account, we multiplied sampling weights by the posterior probabilities for each participant in each class.

Results

LCA models were fitted by increasing the number of latent classes at each step. Based on the goodness of fit indices, a 4-class model best fitted the data (BIC = -66410), in comparison to a 3-class model (BIC = -66381) and a 5-class model (BIC = -66340). Table 1 presents the prevalence and symptoms' probabilities for the CD classes. Identified as the 'No CD' class, Class 1 was the most prevalent latent class (82.4%). Symptoms' probabilities were low, ranging between $p \leq .001$ and .08. On average, youth in this group reported .3 symptoms and none met the criteria for CD. Class 2 which was referred to as 'NACD' (13.9%), was mainly characterized by symptoms related to theft ($p = .50$) and destruction of property ($p = .46$) and, to a lesser extent, by symptoms of serious rule violations. On average, respondents in this group reported 2.3 symptoms (aggressive = .5; non-aggressive = 1.8) and 39.1% met CD diagnostic criteria. Labeled 'PACD', Class 3 manifested symptoms of physical aggression and had an estimated prevalence of 2.3%. Respondents in this group were more likely to have attacked people ($p = .85$), to be often involved in physical fights ($p = .63$), to have attacked someone with a weapon ($p = .36$), and to have stayed out late ($p = .42$). On average, respondents in this class reported 3.5 symptoms (aggressive = 2.2; non-aggressive = 1.3) and 73.1% met CD criteria. Class 4 was identified as 'SMCD' and accounted for 1.4%. Symptoms' probabilities were high (varying between .23 and .92) and were over .50 for eight out of 13 symptoms. This class displayed an average 8.3 symptoms (aggressive = 2.8; non-aggressive = 5.5) and all youth in this

Table 1 Latent class analysis of conduct disorder (CD) symptom profiles ($N = 4,125$)

	Symptom prevalence (%)	Class 1 No CD	Class 2 Non-aggressive CD	Class 3 Physically aggressive CD	Class 4 Severe/Mixed CD
Symptoms					
Bullying or intimidating others	1.2	.00 (.00)	.01 (.01)	.20 (.06)	.27 (.06)
Physically fighting with others	3.1	.01 (.00)	.03 (.01)	.63 (.12)	.44 (.08)
Using a weapon	5.9	.02 (.00)	.16 (.02)	.36 (.07)	.77 (.07)
Physically attack people	13.3	.08 (.01)	.28 (.03)	.85 (.07)	.87 (.06)
Stealing with confrontation	1.8	.00 (.00)	.04 (.01)	.14 (.04)	.49 (.08)
Fire setting causing damage	1.7	.00 (.00)	.06 (.01)	.04 (.03)	.56 (.08)
Destroying others' property	10.2	.02 (.00)	.46 (.04)	.23 (.06)	.92 (.05)
Breaking and entering	2.4	.00 (.00)	.09 (.02)	.00 (.00)	.60 (.08)
Lying	1.5	.00 (.00)	.04 (.01)	.16 (.05)	.23 (.06)
Stealing items of value	13.7	.06 (.01)	.50 (.04)	.13 (.06)	.79 (.06)
Staying out late	8.3	.04 (.00)	.25 (.03)	.42 (.07)	.61 (.07)
Running away	5.2	.02 (.00)	.20 (.02)	.16 (.05)	.47 (.07)
Skipping school	6.2	.02 (.00)	.22 (.02)	.15 (.06)	.60 (.07)
Prevalence of class		82.4	13.9	2.3	1.4
Prevalence of CD in class		.0	39.1	73.1	99.9
Average number of CD symptoms		.3	2.3	3.5	8.3
Average number of aggressive symptoms		.1	.5	2.2	2.8
Average number of non-aggressive symptoms		.2	1.8	1.3	5.5

Note: Standard deviations are in parentheses. Values in the column for Classes 1-4 are symptoms' probabilities for respondents in each class.

class met the CD diagnostic criteria. In summary, results suggested quantitative differences between the classes, a finding shown by variation in the average number of symptoms but also qualitative differences between individuals in the 'PACD' and 'NACD' classes and by the symptoms' probabilities that were not perfectly ordered among classes.

Sociodemographic correlates of CD subtypes

Table 2 presents descriptive results from bivariate multinomial regressions. Age, sex, marital status, family SES, neighborhood instability, and neighborhood economic disadvantage could discriminate between subtypes. Marital status, neighborhood economic disadvantage and age were the strongest predictors of the 'SMCD' vs. the 'No CD' class with odds ratios greater than 2. Being 12, being male, and living in high average economically disadvantaged neighborhood was associated to the 'PACD' subtype. All sociodemographic characteristics were associated to the 'NACD' class but the odds ratio were generally lower than 2.

Predictive validity of CD subtypes

Table 3 presents results from multivariate multinomial regression where age 14–15 deviant lifestyle outcomes were made conditional on assignment to the latent classes. Controls for age, gender, hyper-

activity, and physical aggression were added to the analyses. The 'No CD' class was used as the reference group. The 'SMCD' class had the strongest association with age 14–15 deviant lifestyle outcomes. Respondents in this class were more likely to have sold drugs ($OR = 6.0$; $95\% CI = 2.9-12.6$), to have been part of a gang ($OR = 8.9$; $95\% CI = 4.0-19.5$) to have carried a weapon ($OR = 11.4$; $95\% CI = 5.6-23.2$), to have been involved in an aggravated assault ($OR = 13.5$; $95\% CI = 6.7-27.5$), and to have had contact with the police ($OR = 7.84$; $95\% CI = 3.9-15.7$). The odds ratios were two or three times greater than for the two other classes ('NACD' and 'PACD'), which had similar probabilities of deviant lifestyle outcomes. The odd ratios varied between 1.5 and 4.0. These two subtypes differed mainly on one outcome. The 'NACD' subtype was more likely to have sold drugs ($OR = 4.7$; $95\% CI = 2.1-3.8$) than the 'PACD' subtype.

Discussion

Using LCA, this study identified four CD subtypes and their prevalence in 12–13-year-old Canadian boys and girls, providing epidemiological support for the variability of CD both in type (e.g., non-aggressive, aggressive, and mixed) and in severity (e.g., number of symptoms). Very few studies have used LCA or other clustering techniques to explore the

Table 2 Sociodemographic correlates of conduct disorder (CD) subtypes

	Non-aggressive CD vs. No CD		Aggressive CD vs. No CD		Severe/Mixed CD vs. No CD	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Age						
12	–	–	–	–	–	–
13	1.39*	1.16–1.66	.60*	.39–.90	2.23*	1.27–3.91
Sex						
Female	–	–	–	–	–	–
Male	1.89*	1.58–2.27	2.59*	1.67–4.03	1.74*	1.02–2.97
Marital Status						
Intact	–	–	–	–	–	–
Non-intact	1.68*	1.39–2.03	1.64*	1.07–2.51	3.28*	1.94–5.54
Family SES						
Low	–	–	–	–	–	–
Low av.	1.02	.79–1.30	.83	.49–1.38	1.29	.65–2.54
High av.	.77*	.59–.99	.53*	.30–.93	.72	.34–1.53
High	.80	.60–1.05	.46*	.24–.89	.40	.15–1.09
Neighbourhood instability						
Low	–	–	–	–	–	–
Low av.	.99	.76–1.31	.67	.35–1.28	1.93	.83–4.46
High av.	1.31	1.00–1.70	1.35	.77–2.39	.89	.34–2.32
High	1.60*	1.21–2.11	1.37	.73–2.55	2.71*	1.15–6.40
Neighbourhood economic disadvantage						
Low	–	–	–	–	–	–
Low av.	1.23	.94–1.62	1.54	.79–3.02	1.47	.65–3.33
High av.	1.55*	1.19–2.03	2.04*	1.06–3.91	1.28	.55–2.97
High	1.43*	1.07–1.92	1.70	.83–3.48	1.90	.81–4.43

Note: Odds ratios (ORs) and 95% confidence intervals (CI) were estimated in bivariate multinomial logistic regressions weighted by longitudinal sample weights and posterior probabilities of assignment to the latent classes. * Significant at the .05 level.

Table 3 Deviant lifestyle outcomes at age 14–15 by conduct disorder (CD) subtypes

	Sold drugs (<i>N</i> = 3,231)		Part of a gang (<i>N</i> = 3,238)		Carried a weapon (<i>N</i> = 3,235)		Physical assault (<i>N</i> = 3,011)		Contact with the police (<i>N</i> = 2,977)	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Controls and risk factors										
Age										
12	–	–	–	–	–	–	–	–	–	–
13	1.5*	1.2–2.0	.8	.6–1.1	.8	.6–1.0	1.2	.9–1.6	1.3*	1.1–1.6
Gender										
Boys	1.2*	.9–1.6	.5*	.3–.7	2.8*	2.0–3.8	2.0*	1.5–2.7	2.1*	1.7–2.5
Girls	–	–	–	–	–	–	–	–	–	–
Hyperactivity-inattention										
Low	–	–	–	–	–	–	–	–	–	–
Medium	1.3	.9–1.7	2.7*	1.8–3.9	1.0	.7–1.4	1.8*	1.3–2.5	1.3*	1.1–1.7
High	1.1	.7–1.6	2.9*	1.8–4.5	1.3	.9–1.8	1.9*	1.3–2.7	1.3*	1.0–1.8
Physical aggression										
Low	–	–	–	–	–	–	–	–	–	–
Medium	1.5*	1.1–2.0	.9	.6–1.3	1.3	.9–1.8	2.0*	1.4–2.8	1.1	.9–1.3
High	1.2	.8–1.8	1.1	.7–1.7	1.7*	1.1–2.4	2.2*	1.5–3.2	1.5*	1.2–2.0
CD latent classes										
No CD	–	–	–	–	–	–	–	–	–	–
Non-aggressive CD	2.9*	2.1–3.8	4.1*	2.9–5.8	3.5*	2.6–4.8	2.6*	1.9–3.6	3.1*	2.5–3.9
Physically aggressive CD	1.6	.7–3.5	2.8*	1.2–6.4	3.1*	1.6–5.9	2.9*	1.5–5.6	2.9*	1.7–4.9
Severe/Mixed CD	6.0*	2.9–12.6	8.9*	4.0–19.5	11.4*	5.6–23.2	13.5*	6.7–27.5	7.8*	3.9–15.7

Note: Odds ratios (ORs) and 95% confidence intervals (CI) were estimated in multivariate multinomial logistic regressions weighted by longitudinal sample weights and posterior probabilities of assignment to the latent classes. * Significant at the .05 level.

configuration of DSM-IV CD symptoms (Nock et al., 2006). Most studies have explored CD dimensions through factor analysis and, more recently, item response theory (Gelhorn et al., 2009). We identified two more specialized groups: 1) a larger group 'NACD' (13.9%) involved mostly in minor and/or property offenses such as theft, vandalism, and rule violations; and 2) a smaller group 'PACD' (2.3%) involved mostly in acts of physical aggression. We also identified a more general and severe group 'SMCD' (1.4%), whose members displayed a wide range of symptoms. Like Nock et al. (2006), we found that CD in early adolescence is predominantly characterized by non-physically aggressive symptoms, such as stealing and vandalizing, given that there is only one subtype for physical aggression, and that it accounts for a small proportion of CD youth. The prevalence of CD based on DSM-IV cut-off was estimated at 8.4%. This prevalence is similar to findings by Nock et al. (2006) and in the middle range of the spectrum of previous studies (Bennett & Offord, 2001; Loeber et al., 2000; Maughan et al., 2004; Romano, Tremblay, Vitaro, Zoccolillo, & Pagani, 2001).

While the latent structure of CD symptoms is more complex than the binary classification used by the DSM-IV, it nonetheless shares some commonality (the importance of considering the severity of the disorder based on symptom counts). In our study, children displaying between two and five symptoms were more likely to be classified as presenting a milder non-aggressive form of CD. This finding highlights the importance of considering subthreshold CD (fewer than three symptoms) as a group that could benefit

from prevention and intervention programs. Children displaying six or more symptoms were considered to have severe CD. Our results also share the vision developed by earlier versions of the DSM, in that they subdivide physically aggressive, non-aggressive and mixed subtypes (Loeber et al., 1993; Patterson, 1993; Tremblay, 2000, 2010). This classification should go along with the developmental classification based on age of onset (Moffitt, 1993; Moffitt et al., 2008). The latent structure of CD subtypes also fits well with Loeber's pathway model of overt and covert behaviors (Loeber et al., 1993).

Our study also tested the predictive validity of the CD subtypes previously identified on age 14–15 deviant and criminal outcomes while controlling for age, gender, childhood hyperactivity/inattention and physical aggression. A strong association for all CD subtypes was found. The strongest association was for youth presenting the severe and mixed form of CD. Odds ratios were much greater for this group, varying between 4.8 and 13.6. Some research has suggested that conduct problems might create a cascade of other life stressors that increase the likelihood of future negative outcomes (Odgers et al., 2007). Similarities in predictive validity for the NACD and PACD were notable, although most of the NACD was subthreshold CD (e.g., fewer than three symptoms). Empirical results did not confirm our first hypothesis (that youth who were physically aggressive would present the worst outcomes) (Nagin & Tremblay, 1999; Tremblay, 2000, 2010). Overall, PACD and NACD had similar odds of violent and non-violent outcomes at age 14–15. This implies that

there are multiple pathways to deviant lifestyles during adolescence. These results also confirm the significance of CD during adolescence beyond early childhood disruptive behaviors (Odgers et al., 2007).

Limitations

There are several limitations to this study. First, the analyses were conducted on self-reported items of CD from two questionnaires, the CBCL (Achenbach, 1991) and the ABQ, and some symptoms were not readily available. Results and their interpretation might have been different if data had been collected in other contexts such as standardized interviews in a clinical setting. Future studies should try to apply the Diagnostic Interview Schedule for Children (DISC; Costello et al., 1982) whenever possible. Second, using other sources of information (e.g., official criminal records, parents, and teachers) could also have provided information not readily available through self-reporting. Third, the conceptualization of the presence or absence of symptoms based on Likert-type scales has some drawbacks. For example, symptoms that are worded along frequency lines in the DSM-IV (e.g., often steal) were dichotomized to the best of our knowledge. Ideally, future studies would explore how variation in each symptom's frequency influences the classification and predictive validity (Angold & Costello, 2009). Fourth, a large longitudinal national sample means that the most severe cases are underrepresented and, as a result, its use contributes to reduced statistical power. Fifth, we use a limited number of outcomes compared to other recent studies (Odgers et al., 2007). Future studies should also explore the consistency of the present findings across gender and neighborhoods, and examine subtypes' stability over time and across

multiple developmental periods. Unfortunately, the stability of CD from ages 10–11 to 12–13 and from ages 12–13 to 14–15 could not be assessed reliably since behavior symptoms assessed in the NLSCY vary from one cycle of the study to the next.

Clinical and prevention implications

Our results provide epidemiological validity for the presence of multiple CD subtypes. Clinicians should consider both the pattern of symptoms and symptoms' severity and explore responses to treatment for these specific subtypes. Our results confirm that CD can be conceptualized as both a categorical and continuous latent variable. Although timing of onset has been important for diagnostic purposes, the present classification focuses on symptom content during the clinical interview and does not require knowledge about symptoms limited to childhood or adolescence (Nock et al., 2006).

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Key points

- In the DSM-IV, subtyping of CD is mainly based on the timing of onset and symptoms' count to define the chronicity and severity of the disorder.
- In our study of Canadian teenagers, CD manifested in three subtypes: severe-mixed, physically aggressive and non-aggressive.
- The severe-mixed subtype was much more likely to present deviant and criminal lifestyle outcomes later in adolescence than the two other subtypes.
- Our study suggests CD subtypes in early adolescence may play a specific role on later deviancy over and above childhood hyperactivity/inattention and physical aggression behaviors.

References

- Achenbach, T.M. (1991). *Manual for the Child Behavior Checklist/4-18 and 1991 Profile*. Burlington, VT: University of Vermont Department of Psychiatry.
- Allison, P.D. (2002). *Missing data*. Thousand Oaks, CA: Sage.
- American Psychiatric Association. (1980). *Diagnostic and statistical manual of mental disorders* (2nd edn). Washington, DC: American Psychiatric Association.
- American Psychiatric Association. (1987). *Diagnostic and statistical manual of mental disorders* (3rd edn, rev.). Washington, DC: American Psychiatric Association.
- Angold, A., & Costello, E.J. (2009). Nosology and measurement in child and adolescent psychiatry. *Journal of Child Psychology and Psychiatry*, 50, 9–15.
- Baillargeon, R. H., Zoccolillo, M., Keenan, K., Côté, S., Pérusse, D., Wu, H.-X., et al. (2007). Gender differences in physical aggression: A prospective population-based

- survey of children before and after 2 years of age. *Developmental Psychology*, 43, 13–26.
- Barker, E.D., Séguin, J.R., White, H.R., Bates, M.E., Lacourse, E., Carbonneau, R., et al. (2007). Developmental trajectories of male physical violence and theft: Relation to neurocognitive performance. *Archives of General Psychiatry*, 64, 592–599.
- Bennett, K.J., & Offord, D.R. (2001). Screening for conduct problems: Does the predictive accuracy of conduct disorder symptoms improve with age? *Journal of the American Academy of Child and Adolescent Psychiatry*, 40, 1418–1425.
- Boyle, M.H., Offord, D.R., Hofmann, H.G., Catlin, G.P., Byles, J.A., Cadman, D.T., et al. (1987). Ontario Child Health Study: 1. Methodology. *Archives of General Psychiatry*, 44, 826–831.
- Cicchetti, D., & Rogosch, F.A. (1996). Equifinality and multifinality in developmental psychopathology. *Development and Psychopathology*, 8, 597–600.
- Costello, A., Edelbrock, C., Kalas, R., Kessler, M., & Klaric, S.A. (1982). *Diagnostic Interview Schedule for Children (DISC)*. Bethesda, MD: National Institute of Mental Health.
- Dodge, K.A., & Pettit, G.S. (2003). A biopsychosocial model of the development of chronic conduct problems in adolescence. *Developmental Psychology*, 39, 349–371.
- Dupéré, V., Lacourse, E., Willms, J.D., Vitaro, F., & Tremblay, R.E. (2007). Affiliation to youth gangs during adolescence: The interaction between childhood psychopathic tendencies and neighborhood disadvantage. *Journal of Abnormal Child Psychology*, 35, 1035–1045.
- Fergusson, D.M., Horwood, L.J., & Lynskey, M.T. (1993). Prevalence and comorbidity of DSM-III-R diagnoses in a birth cohort of 15 year olds. *Journal of the American Academy of Child and Adolescent Psychiatry*, 32, 1127–1134.
- Fombonne, E. (1994). The Chartres Study. 1. Prevalence of psychiatric disorders among French school-aged children. *British Journal of Psychiatry*, 164, 69–79.
- Frick, P.J., Lahey, B.B., Loeber, R., Tannenbaum, L., Van Horn, Y., Christ, M.A.G., et al. (1993). Oppositional defiant disorder and conduct disorder: A meta-analytic review of factor analyses and cross-validation in a clinic sample. *Clinical Psychology Review*, 13, 319–340.
- Gelhorn, H., Hartman, C., Sakai, J., Mikulich-Gilbertson, S., Stallings, M., Young, S., et al. (2009). An item response theory analysis of DSM-IV conduct disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, 48, 42–50.
- Heinen, T. (1996). *Latent class and discrete latent trait models: Similarities and differences*. Thousand Oaks, CA: Sage.
- Hinshaw, S.P., Lahey, B.B., & Hart, E.L. (1993). Issues of taxonomy and comorbidity in the development of conduct disorder. *Development and Psychopathology*, 5, 31–49.
- Hudziak, J.J., Heath, A.C., Madden, P.F., Reich, W., Bucholz, K.K., Slutske, W., et al. (1998). Latent class and factor analysis of DSM-IV ADHD: A twin study of female adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry*, 37, 848–857.
- Kass, R.E., & Raftery, A.E. (1995). Bayes factors. *Journal of the American Statistical Association*, 90, 773–795.
- Kessler, R.C., Berglund, P., Demler, O., Jin, R., & Walters, E.E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the national comorbidity survey replication. *Archives of General Psychiatry*, 62, 593–602.
- Kim-Cohen, J., Arseneault, L., Caspi, A., Tomas, M.P., Taylor, A., & Moffitt, T.E. (2005). Validity of DSM-IV conduct disorder in 4½–5-year-old children: A longitudinal epidemiological study. *American Journal of Psychiatry*, 162, 1108–1117.
- Kim-Cohen, J., Arseneault, L., Newcombe, R., Adams, F., Bolton, H., Cant, L., et al. (2009). Five-year predictive validity of DSM-IV conduct disorder research diagnosis in 4½–5-year-old children. *European Child and Adolescent Psychiatry*, 18, 284–291.
- Lacourse, É., Côté, S., Nagin, D.S., Vitaro, F., Brendgen, M., & Tremblay, R.E. (2002). A longitudinal-experimental approach to testing theories of antisocial behavior development. *Development and Psychopathology*, 14, 909–924.
- Lacourse, É., Dupéré, V., & Loeber, R. (2008). Developmental trajectories of violence and theft. In R. Loeber, D. Farrington, M. Stouthamer-Loeber, & H.R. White (Eds.), *Violence and serious theft: Development and prediction from childhood to adulthood* (pp. 231–268). New York: Routledge/Taylor & Francis.
- Lahey, B.B., Applegate, B., Barkley, R.A., Garfinkel, B., McBurnett, K., Kerdyk, L., et al. (1994). DSM-IV field trials for oppositional defiant disorder and conduct disorder in children and adolescents. *American Journal of Psychiatry*, 151, 1163–1171.
- Lahey, B.B., Loeber, R., Quay, H.C., Applegate, B., Shaffer, D., Waldman, I., et al. (1998). Validity of DSM-IV subtypes of conduct disorder based on age of onset. *Journal of the American Academy of Child and Adolescent Psychiatry*, 37, 435–442.
- Laub, J.H., & Vaillant, G.E. (2000). Delinquency and mortality: A 50-year follow-up study of 1,000 delinquent and nondelinquent boys. *American Journal of Psychiatry*, 157, 96–102.
- Loeber, R., Burke, J.D., Lahey, B.B., Winters, A., & Zera, M. (2000). Oppositional defiant and conduct disorder: A review of the past 10 years, part I. *Journal of the American Academy of Child and Adolescent Psychiatry*, 39, 1468–1484.
- Loeber, R., Burke, J., & Pardini, D.A. (2009). Perspectives on oppositional defiant disorder, conduct disorder, and psychopathic features. *Journal of Child Psychology and Psychiatry*, 50, 133–142.
- Loeber, R., & Stouthamer-Loeber, M. (1998). Development of juvenile aggression and violence: Some common misconceptions and controversies. *American Psychologist*, 53, 242–259.
- Loeber, R., Wung, P., Keenan, K., Giroux, B., Stouthamer-Loeber, M., Van Kammen, W.B., et al. (1993). Developmental pathways in disruptive child behavior. *Development and Psychopathology*, 5, 103–133.
- Markon, K.E., & Krueger, R.F. (2005). Categorical and continuous models of liability to externalizing disorders: A direct comparison in NESARC. *Archives of General Psychiatry*, 62, 1352–1359.
- Maughan, B., Rowe, R., Messer, J., Goodman, R., & Meltzer, H. (2004). Conduct disorder and oppositional defiant disorder in a national sample: Developmental epidemiology. *Journal of Child Psychology and Psychiatry*, 45, 609–621.
- McCutcheon, A.L. (1987). *Latent class analysis*. Newbury Park, CA: Sage.
- Moffitt, T.E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: A developmental taxonomy. *Psychological Review*, 100, 674–701.

- Moffitt, T.E. (2003). Life-course persistent and adolescence-limited antisocial behavior: A 10-year research review and a research agenda. In B. Lahey, T.E. Moffitt, & A. Caspi (Eds.), *The causes of conduct disorder and serious juvenile delinquency*. New York: Guilford.
- Moffitt, T.E., Arseneault, L., Jaffee, S.R., Kim-Cohen, J., Koenen, K.C., Odgers, C.L., et al. (2008). Research Review: DSM-V conduct disorder: Research needs for an evidence base. *Journal of Child Psychology and Psychiatry*, *49*, 3–33.
- Nagin, D., & Tremblay, R.E. (1999). Trajectories of boys' physical aggression, opposition, and hyperactivity on the path to physically violent and nonviolent juvenile delinquency. *Child Development*, *70*, 1181–1196.
- Nock, M.K., Kazdin, A.E., Hiripi, E., & Kessler, R.C. (2006). Prevalence, subtypes, and correlates of DSM-IV conduct disorder in the national comorbidity survey replication. *Psychological Medicine*, *36*, 699–710.
- Odgers, C.L., Caspi, A., Broadbent, J.M., Dickson, N., Hancox, R.J., Harrington, H., et al. (2007). Prediction of differential adult health burden by conduct problem subtypes in males. *Archives of General Psychiatry*, *64*, 476–484.
- Patterson, G.R. (1993). Orderly change in a stable world: The antisocial trait as a chimera. *Journal of Consulting and Clinical Psychology*, *61*, 911–919.
- Phillips, K.A., First, M.B., & Pincus, H.A. (2005). *Advancing DSM*. Washington, DC: American Psychiatric Association.
- Rasmussen, E.R., Neuman, R.J., Heath, A.C., Levy, F., Hay, D.A., & Todd, R.D. (2002). Replication of the latent class structure of attention-deficit hyperactivity disorder (ADHD) subtypes in a sample of Australian twins. *Journal of Child Psychology and Psychiatry*, *43*, 1018–1028.
- Romano, E., Tremblay, R.E., Vitaro, F., Zoccolillo, M., & Pagani, L. (2001). Prevalence of psychiatric diagnoses and the role of perceived impairment: Findings from an adolescent community sample. *Journal of Child Psychology and Psychiatry*, *42*, 451–461.
- Sampson, R.J., Raudenbush, S.W., & Earls, F. (1997). Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science*, *277*, 918–924.
- Shaw, D.S., Lacourse, E., & Nagin, D.S. (2005). Developmental trajectories of conduct problems and hyperactivity from ages 2 to 10. *Journal of Child Psychology and Psychiatry*, *46*, 931–942.
- Tremblay, R.E. (2000). The development of aggressive behavior during childhood: What have we learned in the past century? *International Journal of Behavioral Development*, *24*, 129–141.
- Tremblay, R.E. (2010). Developmental origins of disruptive behaviour problems: The 'original sin' hypothesis, epigenetics and their consequences for prevention. *Journal of Child Psychology and Psychiatry*, *51*, 341–367.
- Vermunt, J.K. (1997). *Log-linear models for event histories*. Thousand Oaks, CA: Sage.
- Wikstrom, P.O.H., & Loeber, R. (2000). Do disadvantaged neighborhoods cause well-adjusted children to become adolescent delinquents? A study of male juvenile serious offending, individual risk and protective factors, and neighborhood context. *Criminology*, *38*, 1109–1142.

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