Nice traits or nasty states : dispositional and situational correlates of prosocial and antisocial behavior in childhood

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Chapter 2

Early childhood aggression trajectories: Associations with teacher-reported problem behavior

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Abstract

High and stable levels of aggression and the presence of aggressive behavior in multiple settings according to different informants are risk factors for later problems. However these two factors have not been investigated in early childhood. The present study investigates trajectories of parent-reported child aggression from 1.5 up to 6 years of age and their association with aggressive behavior, attention problems and rule breaking behavior in a different setting, as reported by the teacher. In a longitudinal population-based cohort study, parent-reported measures of aggressive behavior were obtained using the CBCL when children were 1.5, 3 and 6 years of age (n = 4,781). Teacher-reported problem behavior at school was assessed at age 6.5, using the TRF questionnaire (n = 2,756). Growth mixture modeling yielded three aggression trajectories, with high increasing (3.0%), intermediate (21.3%) and low decreasing (75.7%) aggression levels. Children in trajectories with higher and increasing levels of aggression showed more teacher-reported aggressive behavior, attention problems and rule breaking behavior. However, parent-reported aggression at age six predicted problem behavior at school to the same extent as did the aggression trajectories, suggesting that the incremental value of trajectories is not always self-evident.

Introduction

Childhood aggression increases the risk of the development of problems later in life, such as physical violence, delinquency, relational problems and the continuation of aggressive behavior (Brame, Nagin, & Tremblay, 2001; Broidy et al., 2003; Côté, Vaillancourt, LeBlanc, Nagin, & Tremblay, 2006; Pouwels & Cillessen, 2013). In addition to an early onset of aggressive behavior, (severity) levels, patterns over time, and aggression across different settings are indicators for a heightened risk of later problems (Campbell, Spieker, Burchinal, Poe, & the NICHD Early Child Care Research Network, 2006; Moffitt, 1993; Loeber, 1990). Whereas several studies have focused on the longitudinal patterns and levels of aggression in young children (e.g. Tremblay et al., 2004 ; Vaillancourt, Miller, Fagbemi, Côté, & Tremblay, 2007), few studies have tested whether these factors are related to the reports of aggression and other forms of problem behavior by a different informant from a different setting. The current study investigates early childhood levels and patterns of parent-reported aggression and tests whether these are associated with aggression and related problem behaviors reported by the teacher.

While some studies point to a decrease in (physical) aggression as children grow older (Alink et al., 2006; Bongers, Koot, Van der Ende, & Verhulst, 2004), a substantial percentage of children remain highly aggressive or show increasing levels of aggression over time (e.g. Campbell et al., 2006; Côté et al., 2006; Côté, Vaillancourt, Barker, Nagin, & Tremblay, 2007; Tremblay et al., 2004). Trajectories may be more informative than group mean levels of aggressive behavior, and help to identify heterogeneity in the development of aggression (Nagin & Tremblay, 1999; Tremblay, 2000). Emerging different trajectories may be predictive of distinct developmental outcomes. Several studies reported that higher levels and increasing patterns of childhood aggression were predictive of aggression and related behaviors at later ages (Kokko & Pulkkinen, 2005; Kokko, Pulkkinen, Huesmann, Dubow, & Boxer, 2009; Reef, Diamantopoulou, Van Meurs, Verhulst, & Van der Ende, 2010; Temcheff et al., 2008). For example, school-age children who followed a peer-rated trajectory with increasing levels of aggression had higher ratings of externalizing problem behavior, poorer school performance and were more often rejected by their peers as compared to children who showed a stable pattern of moderate or low aggression. Moreover, children in the moderate trajectory were also worse off than the children with a low

aggression pattern (Van Lier & Crijnen, 2005). In a similar vein, Campbell et al. (2006) reported that even trajectories with modest or low, but stable levels of aggression were predictive of adjustment problems at later ages. These findings illustrate that both *patterns* and *levels* of aggressive behavior may be predictive of persistent aggression and the development of other problems later in life (Campbell et al., 2006).

Another important aspect indicating the pervasiveness of aggression is stability across informants. Multiple informants, who report each on different settings such as parents and teachers, show overlap in their reports of antisocial behavior, but they also add unique contributions (Achenbach, 2006; Arseneault et al., 2003). These unique contributions could be indicative of measurement error but may also provide information about context-specific child behavior (De Los Reyes et al., 2013; Kraemer, et al., 2003). Agreement could indicate the pervasiveness of these problems (De Los Reyes et al., 2013; Veenstra et al., 2008). The inclusion of multiple informants may thus provide a more detailed observation of the behavior studied.

Whereas some studies report that the presence of problem behavior in one setting was equally predictive of later problems such as crime and substance dependence as compared to problem behavior reported by both parents and teachers (e.g. Fergusson, Boden, & Horwoord, 2009), other studies report that especially the agreement between informants on the presence of problem behavior places children at risk for persistent problems. According to Loeber (1990), the manifestation of problem behavior in multiple settings increases the risk for deviant behavior later in life. When parents and teachers agreed on the occurrence of problem behavior, children were at a heightened risk for future police / judicial contacts and scored worse on effortful control and academic performance (Ferdinand, Van der Ende, & Verhulst, 2007; Veenstra et al., 2008). Campbell et al. (2010) reported that children with the highest teacher-reported physical aggression trajectories were rated by their parents as having the most externalizing problems in sixth grade, while higher parent-reported trajectories of aggression were predictive of teacher reported externalizing problem behavior, ADHD and ODD symptoms at age 12 (Campbell et al. 2006). Thus, both the heterogenic longitudinal aspect of aggression captured in trajectories and the presence of aggression according to multiple informants in different settings are important factors to include.

The studies discussed so far focused on longitudinal patterns of aggressive behavior and examined whether these patterns were related to the occurrence of the broader construct of externalizing problem behavior in middle childhood, reported by a different informant in a different setting. In the current study we examined how levels and patterns of parent-reported aggression (which comprises physical and non-physical aggressive behaviors, such as defiant behavior) in early childhood are related to aggression problems as reported by the teacher, testing whether this specific behavior is pervasive across settings and time at a young age. Since attention problems and rule breaking behavior often co-occur with aggression in childhood (Bartels et al., 2003; Jester et al., 2005; Nagin & Tremblay, 2001; Niv, Tuvblad, Raine, & Baker, 2013), we also investigated how levels and patterns of parent-reported aggression are related to teacher-reported attention problems and rule breaking behavior. We investigate whether we could identify a group of children with a general tendency to show pervasive problem behavior, using reports of different informants in multiple settings. Since it has been argued that the differentiation between physical and other forms of aggressive behavior is important (Tremblay, et al., 1999) we not only examined aggression in general, but also explored whether parent-reported physical and non-physical aggression is related to teacher-reports of these subtypes of aggression.

The importance of a developmental perspective on aggression using trajectory modelling has been repeatedly stressed (e.g. Brame et al., 2001; Nagin & Tremblay, 1999). At the same time, studies generally do not test for the *additional* power of this approach as compared to a single measure of aggression at one point in time (e.g. Campbell et al., 2006; Harachi et al., 2006). We tested whether the use of aggression trajectories is more informative in terms of the power to predict later teacher-reported problem behavior than the use of a single time point assessment of aggression. We hypothesized that children in trajectories with high and stable or increasing levels of aggression will, on average, show higher levels of teacher-reported problem behavior. Furthermore, we tested the superiority of trajectories over single measurements of aggression by examining the strength of the relation with problem behavior at age 6 as reported by the teacher.

Methods

Participants

The participants were recruited from the Generation R study, a population-based prospective cohort from early fetal life onwards in Rotterdam, the Netherlands (Jaddoe et al., 2012). All mothers who were residents in Rotterdam and had an expected delivery date between April 2002 and January 2006 were invited to participate in the study. Children with at least two measures of parent-reported CBCL aggressive behavior scores available up to 6 years of age were eligible for the study, which resulted in a sample of 5,227 participants. In total, 446 (8.5%) siblings were randomly excluded to prevent paired data. Hence, aggression trajectories were modeled in a sample of 4,781 children (n = 4,778 for physical aggression and n = 4,771 for non-physical aggression). Children were included in further analyses when teacher-reported ratings of problem behavior were available. This resulted in a final sample of 2,756 children (n = 2,753 for physical and n = 2,749 for non-physical aggression). For sample characteristics of the n = 2,756 sample see **TABLE 2.1.** The study was approved by the Medical Ethical Committee of the Erasmus Medical Center, Rotterdam . Written informed consent was obtained from all adult participants.

Measures

Parent-reported aggression. The Child Behavior Checklist/1½–5 (CBCL, Achenbach & Rescorla, 2000) is a self-administered parent-report questionnaire including 99 items concerning emotional and behavioral problems of the child, rated on a 3 point scale (0 = not true, 1 = somewhat true or sometimes true, 2 = very true or often true). The current study used the CBCL aggression scale, which comprised 19 items such as '*Hits others*' and '*Destroys things belonging to his/her family or other children*'. All aggression items were summed, with higher scores representing higher levels of aggression. A maximum of 25% missing items was allowed for each scale score. Good psychometric properties have been reported for the CBCL (Achenbach & Rescorla, 2000). The aggression scale was administered at 1.5, 3 and 6 years of age and had adequate internal consistencies in the current study, respectively α = .86, α = .86 and α = .88. For reasons of continuity

and comparability and because 66.8% of all children were younger than age 6 at the third measurement of parent-reported aggression, we chose to use the CBCL/1½–5 for all three assessment waves. When the children were 1.5 and 6 years of age, the questionnaire was completed by the primary caregiver (95.0% and 92.3% mothers respectively). At age 3, both the primary and secondary caregiver filled out the questionnaire.

TABLE 2.1
Sample Characteristics

Sample characteristics	Values	CBCL and TRF measures	*M* (*SD*)
Child		CBCL total aggr.	
Gender, No. boy (%)[a]	1,386 (50%)	1.5 years	8.48 (5.19-5.21)
Ethnicity, No. (%)[1]		3 years	6.94 (4.86-4.88)
Dutch	1,782 (65%)	6 years	5.59 (4.90-4.92)
Other Western	239 (9%)		
Non-Western	735 (27%)	CBCL physical aggr.	
Parity, No. ≤ 1 (%)[c]	2,297 (83%)	1.5 years	0.77 (1.07-1.11)
Age TRF, *M* (*SD*), months[d]	78.45 (13.99-14.00)	3 years	0.60 (0.95-0.97)
Birth weight, *M* (*SD*), g[a]	3,440.37 (559.21-560.12)	6 years	0.32 (0.76-0.77)
Mother		CBCL non-physical aggr.	
Age, *M* (*SD*), years[a]	31.53 (4.71)	1.5 years	7.72 (4.56-4.59)
Marital status, No. (%)[c]		3 years	6.35 (4.33-4.34)
Married/living together	2,419 (88%)	6 years	5.27 (4.48-4.50)
No partner	337 (12%)		
Education, No. (%)[c]		TRF total aggr.[d]	1.97 (4.25)
None or primary	96 (4%)	TRF attention[d]	5.50 (7.72)
Secondary	1073 (39%)	TRF rule breaking[d]	0.61 (1.46)
Higher	1587 (58%)	TRF physical aggr.[d]	0.32 (1.01)
Hostility, *M* (*SD*)[b]	0.18 (0.27-0.28)	TRF non-physical aggr.[d]	1.65 (3.46)

n = 2,753 for CBCL and TRF physical aggression. *n* = 2,749 for CBCL and TRF non-physical aggression. *n* = 2,756 for all other measures.
Note. Multiple imputed variables are reported in this table. For all continuous variables we report the pooled mean and the range of the standard deviation. For categorical variables we report the pooled N and percentages.
[a]Data collected prior to or at birth.
[b]Data collec ted at age 3.
[c]Data collected at age 6.
[d]Data collected at age 6.5.

Ratings of the primary caregiver were used (94.7% mothers). For 1.1% of the children, primary but not secondary caregiver ratings were missing. Since previous studies found very high agreement among mother-reported and father-reported CBCL externalizing problems (e.g. Duhig et al., 2000; Seifge-Krenke & Kollmaer, 1998), ratings of the secondary caregiver were used for these children. We will refer to the CBCL aggression scale as 'total aggression', to make a clear distinction with the physical and non-physical aggression scales.

For the analyses on physical and non-physical aggression we subdivided the CBCL aggression scale into physical and non-physical aggression items. The physical aggression scale was constructed based on prior studies (Bongers et al., 2004; NICHD, 2004). The items *Gets in many fights, Physically attacks people, Hits others,* and *Destroys things belonging to his/her family or other children* were included in the physical aggression scale. The other 15 items comprised the non-physical aggression scale. A maximum of 25% missing items was allowed for each scale. The sample sizes for the physical and non-physical aggression scale scores were slightly smaller (n = 4,778 and n = 4,771 respectively) than for total aggression (n = 4,781) because some extra children had > 25 % missing items on the subscales. The internal consistency for the physical aggression scale was α = .59, α = .58 and α =. 64 at 1.5, 3 and 6 years of age respectively. For non-physical aggression, internal consistencies were α = .84, α = .85 and α = .88 at 1.5, 3 and 6 years of age respectively.

Teacher-reported problem behavior. The Teacher's Report Form (TRF, 6-18 years, Achenbach & Rescorla, 2001) is a questionnaire for teachers to report on children's academic performance, adaptive functioning, and behavioral- and emotional problems. Teachers filled out the questionnaire when the children were on average 6.5 years of age. The Aggressive Behavior, Attention Problems and Rule Breaking Behavior scales were used in the present study. The Aggressive Behavior scale consists of 20 items such as '*Physically attacks people*' and '*Cruelty, bullying or meanness to others*'. The CBCL and TRF both assess aggressive behavior, but several items are unique to each specific questionnaire. The TRF Attention Problems scale includes 26 items such as '*Disturbs others*' and '*Can't concentrate*'. Examples of the 12-item TRF Rule Breaking Behavior scale are '*Lies, cheats*' and '*Breaks rules*'. All items were rated on a 3-point scale (0 = not true, 1 = somewhat true or sometimes true, 2 = very true or often true). For each scale, items were summed, with higher scores representing higher problem levels. Good psychometric properties have been reported for the TRF (Achenbach & Rescorla, 2001). Cronbach's alpha in this sample was α =.92 for Aggressive Behavior, α = .93 for Attention Problems and α = .71 for Rule Breaking Behavior. Because of substantial postive skewness, the scales were transformed using a log10 transformation, to approach normality (Tabachnick & Fidell, 2007).

For the analyses on physical and non-physical aggression we subdivided the TRF aggression scale into physical and non-physical aggression items. The physical aggression scale was constructed based on previous studies

(Bongers et al., 2004; NICHD, 2004). The items *Gets in many fights, Physically attacks people, Destroys property belonging to others, Destroys his/her own things, Cruelty, bullying or meanness to others,* and *Threatens people* were included in the physical aggression scale. The other 14 items comprised the non-physical aggression scale. A maximum of 25% missing items was allowed for each scale. Internal consistencies for the physical and non-physical aggression scale were $\alpha = .77$ and $\alpha = .90$ respectively. Because of positive skewness of both scales, physical aggression was transformed using a square root transformation and non-physical aggression was transformed using a log10 transformation to approach normality (Tabachnick & Fidell, 2007).

Covariates. The variables listed below were considered potential confounders, because previous research found associations between these variables and aggression in childhood (e.g. Campbell et al., 2010; Elgen, et al., 2012; Huijbregts et al., 2009; Tremblay et al., 2004). These variables are included in the model when they were significantly related to both the predictor and the outcome variable(s). At the time of enrollment, information on the age of the mother and ethnicity of the child was obtained. In accordance with the criteria of Statistics Netherlands (2004), ethnicity of the child was classified into the categories 'Dutch', 'Western' and 'Non-Western'. Gender and birth weight were obtained from midwives and hospital registries. Data on hostility of the mother was assessed using the Brief Symptom Inventory (BSI, Derogatis & Melisaratos, 1983) when children were 3 years of age. Data on parity, educational level of the mother, and marital status were obtained at age 6. Parity was dichotomized into 'none' and 'one or more siblings'. Educational level was subdivided into three categories: 'none or primary education', 'secondary education' and 'higher education'. Marital status was dichotomized into the categories 'married/living together' and 'no partner'. Furthermore, age of the child at which the TRF was filled out was considered as a potential covariate. Because of skewness, this variable and hostility of the mother were transformed using a log10 and square root transformation respectively, to approach normality (Tabacknick & Fidell, 2007). Individual probabilities were included as a covariate, to take the individual variation in the probability of belonging to a specific class into account. The individual probabilities made the categorical class membership variable continuous, which facilitates the comparison with teacher-reported problems.

Statistical analyses

Developmental trajectories of aggression, measured with the CBCL at three time points, were constructed using Growth Mixture Modeling (GMM, Muthén & Shedden, 1999) in Mplus version 7 (Muthén & Muthén, 1998-2012). In GMM, unobserved heterogeneity in growth is captured in categorical latent classes, allowing for within and between class variation of intercept and slope. Within class variation enables the individuals within a class to vary freely, whereas between class variation implies that variances between classes are free to vary (Jung & Wickrama, 2007). Mplus used full information maximum likelihood estimation in cases of missing data. As previous studies found up to seven aggression trajectories (for a review see Jennings & Reingle, 2012) we estimated one to seven trajectories, which enabled us to test the number of classes that optimally represent this data. Posterior probabilities indicated the likelihood of a child to be assigned to a certain class. Children were assigned to the class for which they obtained the highest posterior probability. The final number of classes was determined on the basis of several criteria. First, Nylund, Asparouhov, and Muthén (2007) showed that from all fit indices available in Mplus, the BIC and BLRT are the most appropriate for selecting the final number of classes. Smaller BIC values indicate a better model fit and significant BLRT values imply that the current model has a better fit than the more parsimonious model. Apart from these fit indices, a number of other criteria are also important to consider, such as class size, posterior probabilities, and interpretability (Jung & Wickrama 2007; Nylund et al., 2007). Class membership based on most likely class membership was used to predict teacher-reported problem behavior. Because we restricted the data to the cases with complete TRF data, the sample was reduced to n = 2,756 (n = 2,753 and n = 2,749 for physical and non-physical aggression respectively). Further analyses were performed on this smaller sample.

Data on the TRF Rule Breaking Behavior scale was missing for three children and on the TRF non-physical aggression scale for two children. Missing data on covariates was less than 10% in all cases. The multiple imputation (Markov chain Monte Carlo) method with five imputations and ten iterations was used to compute missing values on the TRF scales and covariates. Classes were compared on several background variables using chi-square tests and analysis of variance.

MAN(C)OVA models were used to test whether total aggression class membership was related to teacher-reported problems. First, unadjusted analyses were done, including class membership as independent variable and aggression, attention problems and rule breaking behavior as dependent variables. In a second analysis, we added probability of class membership to the MANCOVA model, to show the effect of this specific variable. Third, a fully adjusted MANCOVA was run, including all covariates that were significantly related to the predictor and outcome(s). All three MANCOVA models were followed by univariate tests to evaluate the relation between class membership and the TRF scales separately. For the fully adjusted model, Bonferroni corrected post hoc tests were used to test for differences between classes on each specific TRF scale. AN(C)OVA models were used for physical and non-physical aggression. The same three models (unadjusted, adjusted for probability and fully adjusted) were run for both physical and non-physical aggression separately. For the fully adjusted model, Bonferroni corrected post hoc tests were used to test for differences between classes on the physical and non-physical aggression subscales. Pooled estimates for the MAN(C)OVA are not provided in SPSS 21. Furthermore, the statistics provided for the MAN(C)OVA in SPSS cannot simply be averaged. Therefore we reported the results of the first dataset in text and the range of statistics in Supplementary Material when results in all five imputed datasets were significant. When results were significant in some but not all datasets, we reported the range of statistics in text.

Per total aggression class we report on the percentage of children in the borderline, clinical and the combined (borderline and clinical) range of the three TRF scales. U.S. national sample norms, which are applicable to the Netherlands (Achenbach & Rescorla, 2007), were used to define these ranges. We tested whether group percentages differed between the classes using chi-square tests. Percentages will not be reported for the physical and non-physical aggression scale because no borderline and clinical norm scores are available for these scales.

On average, the TRF was administered 6 months after the last CBCL (age 6) assessment. However the time interval between these measures differed between children. Therefore we performed additional analyses with the time interval as a covariate to control for a potential effect of the difference in time between these assessments. Because the time interval was highly correlated with the age at which the TRF was administered, this

latter covariate was excluded from these analyses. Due to moderate skewness of the time interval covariate, we used a square root transformation to approach normality (Tabachnick & Fidell, 2007).

To test whether the use of longitudinal trajectories of aggression was more informative than a single measure of aggression, we also examined parent-reported aggressive behavior at age 6 as predictor of teacher-reported problem behavior instead of class membership. Aggressive behavior at age 6 was the last time point used in the GMM analyses. The same covariates as in the former models were added to make the models comparable. To compare whether the effect size for aggression measured at a single time point (age 6) was different from the effect size for class membership, we converted the partial η^2 to a Cohen's d and computed the 85% confidence intervals using the Comprehensive Meta-Analysis (Borenstein, Rothstein, & Cohen, 2000) program. Confidence intervals that (partly) overlap indicate that the effect sizes for class membership and a single time point assessment of aggression are comparable (Goldstein & Healy, 1995; Julious, 2004; Payton, Greenstone, & Schenker, 2003). An 85% confidence interval was computed for the first imputed dataset because in contrast to a 95% confidence interval it enables testing differences in effect sizes with an error rate of approximately 5% (Julious, 2004).

Non-response analyses

Children included in the final sample (n = 2,756) did not differ on gender, birth weight and parent-reported total aggression at age 1.5, 3 and 6 from the children not incorporated in this sample. However, the included children were more often Non-Western than the excluded children (res_{adj} = 4.0) and the excluded children were more often Western than the included children (res_{adj} = 2.8), $\chi^2(2, n = 5209) = 19.89$, $p < .001$, $\varphi = .06$. Mothers of the included children did not differ on age at intake and the level of hostility reported at age 3, compared to mothers of the excluded children. However, mothers of excluded children had more often higher educational levels than mothers of included children (res_{adj} = 9.1) and mothers of the included children had more often secondary (res_{adj} = 8.6) or none / primary education (res_{adj} = 2.0) compared to the mothers of excluded children, $\chi^2(2, n = 4771) = 83.12$, $p < .001$, $\varphi = .13$.

Results

Trajectories of total aggressive behavior

Growth mixture models (GMM) with one to seven classes were tested for all children who had at least two measures of the CBCL total aggression scale available (n = 4,781). Models for which within-class and between-class variation were allowed did not converge. Allowing between-class variation only, led to models that converged. See **TABLE 2.2** for class solutions of one to seven classes. The BIC decreased with an increasing number of classes and the BLRT remained significant. Consequently, no definite conclusion on the number of classes could be drawn from those two fit indices. Therefore other criteria should be used for model selection. The posterior probabilities, as well as the number of participants per class decreased with an increasing number of classes, which are important factors in model selection (Jung & Wickrama, 2007; Nylund et al., 2007). This indicated that solutions with more classes were less suitable in terms of certainty of class assignment and group size. The three-class model was considered to be more informative than the two class model because it added a class with intermediate, relatively stable levels of aggression, in line with previous studies on the development of aggression (e.g. Côté et al., 2006). Solutions with four to seven classes contained multiple very small groups, with accompanying replication problems in future research. Therefore we chose the more parsimonious three class solution with higher posterior probabilities (> .80) and relatively large classes (***FIGURE 2.1***). The first class of the three class estimated model had the lowest levels of aggression with significantly decreasing aggression levels over time, $p < .001$. This class is referred to as 'low decreasing'. The second class had intermediate aggression levels that significantly increased over time, $p = .033$. This class is named 'intermediate'. The third class had intermediate aggression levels at the start that increased significantly over time, $p < .001$. The third class is referred to as 'high increasing'. TRF scores were available for 2,164 children in the low decreasing class, 527 children in the intermediate class and 65 children in the high increasing class. Between the three classes, children did not differ on ethnicity, parity, birth weight and age of the mother in all imputed datasets. However, there were more boys in the intermediate (res_{adj} = 4.4) and high increasing class (res_{adj} = 3.1) and more girls in the low decreasing class (res_{adj} = 5.3), χ^2 (2, n = 2,756) = 30.74, p < .001, φ = .1 (the range of the five imputed datasets is reported in **TABLE S2.4**).

TABLE 2.2
Class Solutions for GMM Models for Total, Physical and Non-Physical Aggression

	1	2	3	4	5	6	7
Total aggression							
BIC	77,748.82	76,927.39	76,548.91	76,372.09	76,274.62	76,061.43	75,996.88
BLRT	N/A	< .001	< .001	< .001	< .001	< .001	< .001
Entropy	1.00	0.84	0.82	0.84	0.82	0.81	0.82
N class (%)							
1	4,781 (100%)	4,176 (88%)	3,620 (76%)	3,556 (74%)	3,498 (73%)	2,863 (60%)	2,782 (58%
2		605 (13%)	1,017 (21%)	970 (20%)	217 (5%)	1,229 (26%)	1,239 (26%
3			144 (3%)	138 (3%)	167 (4%)	291 (6%)	287(6%)
4				117 (3%)	771 (16%)	197 (4%)	227 (5%)
5					128 (3%)	141 (3%)	167 (4%)
6						60 (1%)	45 (1%)
7							34 (1%)
Physical aggression[a]							
BIC	34,093.33	31,154.92	29,321.75	25,865.17			
BLRT	N/A	< .001	< .001	< .001			
Entropy	1.00	0.97	0.96	0.97			
N class (%)							
1	4,778 (100%)	4,377 (92%)	3,780 (79%)	3,777 (79%)			
2		401 (8%)	843 (18%)	601 (13%)			
3			155 (3%)	346 (7%)			
4				54 (1%)			
Non-physical aggression[b]							
BIC	74,612.61	73,883.63	73,545.51	73,387.52	73,307.71		
BLRT	N/A	< .001	< .001	< .001	< .001		
Entropy	1.00	0.80	0.80	0.79	.81		
N class (%)							
1	4,771 (100%)	4,053 (85%)	3,395 (71%)	2,844 (60%)	2,849 (60%)		
2		718 (15%)	1,169 (25%)	1,343 (28%)	1,301 (27%)		
3			207 (4%)	494 (10%)	472 (10%)		
4				90 (2%)	84 (2%)		
5					65 (1%)		

Total aggression *n* = 4,781; Physical aggression *n* = 4,778;
Non-physical aggression *n* = 4,771.
[a]Models with > 4 classes did not converge.
[b]Models with > 5 classes did not converge.

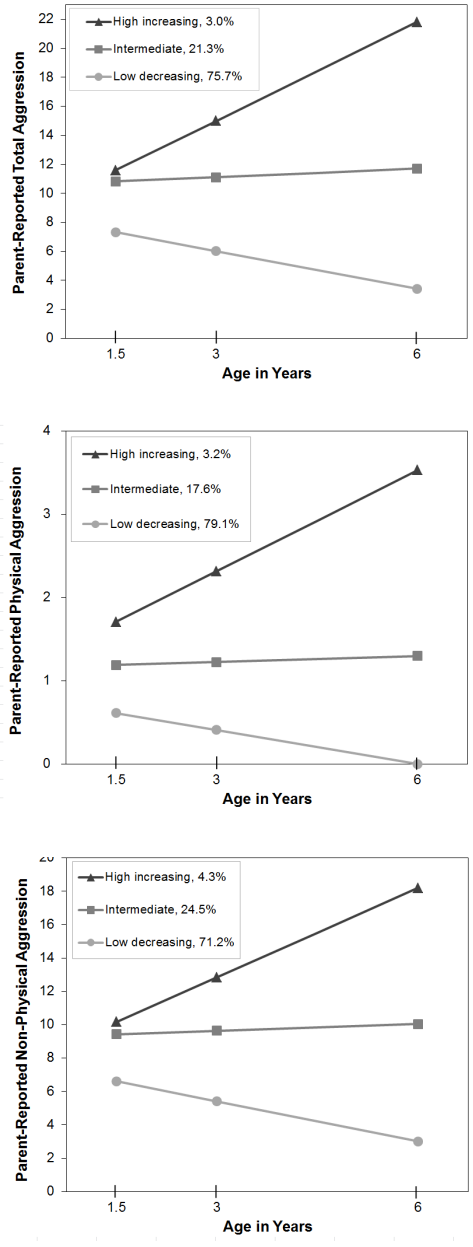

FIGURE 2.1
Trajectories of total aggression (n = 4,781), physical aggression (n = 4,778), and non-physical aggression (n = 4,771) from 1.5 to 6 years of age.

Marital status of the mother differed between classes in two out of five imputed datasets $\chi^2(2, n = 2{,}756) = 5.09\text{-}7.53$, $p = .023\text{-}.078$, $\varphi = .04\text{-}.05$. In the datasets in which the classes differed on marital status, the intermediate class included more children of mothers without a partner ($res_{adj} = 2.5\text{-}2.7$), whereas the low decreasing class contained more mothers who were married/living together as compared to the other classes ($res_{adj} = 2.5\text{-}2.7$). Maternal education differed between classes in two out of five imputed datasets $\chi^2(2, n = 2{,}756) = 8.18\text{-}9.86$, $p = .043\text{-}.085$, $\varphi = .05\text{-}.06$. In the datasets in which the classes differed on maternal education level, the intermediate class included more children of mothers with secondary education ($res_{adj} = 2.4\text{-}2.5$) and fewer children of mothers with higher education ($res_{adj} = -2.9 - -3.0$), whereas the low decreasing class contained more mothers who had higher educational levels ($res_{adj} = 2.7\text{-}2.8$) and fewer who had secondary education ($res_{adj} = -2.2 - -2.4$) as compared to the other classes. In addition, classes differed on hostility of the mother in all datasets, $F(2, 2{,}753) = 42.08$, $p < .001$, partial $\eta^2 = .03$ (the range of the five imputed datasets is reported in **TABLE S2.4**). Children in the high increasing class had more hostile mothers ($M = 0.49$, $SE = .04$, 95% CI 0.41-0.56) than the intermediate class ($M = 0.36$, $SE = .01$, 95% CI 0.34-0.39, $p < .001$, Cohen's $d = 0.41$) and low decreasing class ($M = 0.25$, $SE = .01$, 95% CI 0.24-0.26, $p < .001$, Cohen's $d = 0.77$,). The children in the intermediate class had on average more hostile mothers than the low decreasing class, $p < .001$, Cohen's $d = 0.36$. Although a trend suggested that more children in the low decreasing class had a TRF filled out by the teacher, $\chi^2(2, n = 4781) = 6.00$, $p = .050$ (the same values in all imputed datasets), the difference was not significant.

Relating trajectories of total aggression to teacher-reported problem behavior

We tested whether class membership was related to different levels of total aggressive behavior, attention problems and rule breaking behavior as reported by the teacher, adjusting for several covariates. Correlations between all variables included in the models are reported in **TABLE 2.3**. Unadjusted and untransformed means of the TRF scales per class can be found in **FIGURE 2.2**, transformed means will be used in the analyses and are reported in text.Univariate follow-up tests from the MAN(C)OVA's are reported in **TABLE 2.4**.

TABLE 2.3

Correlations Between Outcomes, Predictors and Covariates in the Total Aggression Model

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. TRF aggression[d]	-												
2. TRF attention[d]	.68***												
3. TRF rule breaking[d]	.68***	.56***											
4. Class total aggression (intermediate)[1]	.12***	.10***	.08***										
5. Class total aggression (high decreasing)[1]	.16***	.14***	.12***	-.08***									
6. Total aggression age 6	.23***	.20***	.17***	.62***	.50***								
7. Gender[2,a]	-.20***	-.29***	-.19***	-.08***	-.06**	-.12***							
8. Age TRF[d]	.11***	.18***	.09***	.05**	.01	.03	-.01						
9. Time interval CBCL and TRF[c,d]	.10***	.15***	.07***	.06**	.01	.04*	-.01	.97***					
10. Education mother (low)[3,c]	.05*	.09***	.06**	.03	.00	.03	-.00	.04	.02				
11. Education mother (secondary)[3,c]	.09***	.10***	.09***	.04*	-.01	.05**	.01	.04*	.01	-.15***			
12. Marital status[4,c]	.12***	.12***	.13***	.05*	.00	.07***	-.03	.00	-.02	.06**	.11***		
13. Hostility[b]	.04	.03	.05*	.13***	.11***	.21***	-.01	.03	.01	.04	-.01	.09***	
14. Probability of class assignment	-.12***	-.10***	-.11***	-.34***	-.05*	-.38***	.06**	-.03	-.02	-.03	-.06**	-.05**	-.10***

n = 2,756

Note. Pooled Pearson and point-biseral correlations were used in case of two continuous or one continuous and one dichotomous variable respectively. Pooled phi-coefficients were used for correlations between two dichotomous variables.

[1]Low decreasing class is reference category. [2]Gender is coded as 0 (boy) and 1 (girl). [3]Higher education is reference category. [4]Marital status is coded as 0 (married / living together) and 1 (no partner).

[a]Data collected prior to or at birth. [b]Data collected at age 3. [c]Data collected at age 6. [d]Data collected at age 6.5

*$p < .05$, ** $p < .01$, *** $p < .001$.

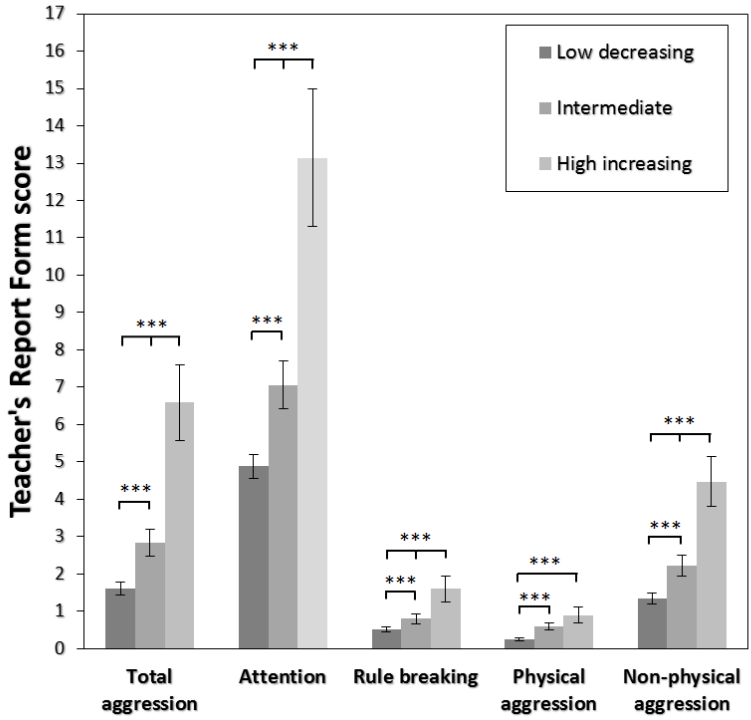

FIGURE 2.2
Unadjusted and untransformed mean levels of total aggression, attention problems, rule breaking behavior, physical aggression, and non-physical aggression. Error bars represent confidence intervals. Significant differences in unadjusted and untransformed mean levels between classes are indicated as: $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$. *n = 2,756 for total aggression, attention, and rule breaking. n = 2,753 for physical aggression.*
n = 2,749 for non-physical aggression.

The unadjusted, adjusted for probability and fully adjusted multivariate tests all showed an effect of class membership on teacher-reported problems, respectively $F(6, 5504) = 21.56$, $p < .001$, partial $\eta^2 = .02$, $F(6, 5502) = 17.20$, $p < .001$, partial $\eta^2 = .02$, and $F(6, 5490) = 14.33$, $p < .001$, partial $\eta^2 = .02$. The range of statistics over the five imputed datasets for the multivariate analyses is reported in **TABLE S2.5**. The fully adjusted univariate analyses showed an effect of class membership on teacher-reported total aggression ($p < .001$, partial $\eta^2 = .03$, Cohen's $d = 0.34$, 85% CI 0.28-0.39).

TABLE 2.4

Univariate Analysis of Covariance Relating Class Membership to Problem Behavior at School

	Aggression[a]		Attention[b]		Rule breaking[c]		Physical aggr.[d]		Non-physical aggr.[e]	
Model	*F*	partial η^2	*F*	partial η^2	*F*	partial η^2	*F*	partial η^2	*F*	partial η^2
Model 1										
Classes[1]	60.49***	.04	48.17***	.03	28.98***	.02	49.70***	.04	50.91***	.04
Model 2										
Classes[1]	47.41***	.03	38.35***	.03	21.53***	.02	49.17***	.04	42.21***	.03
Probability	16.61***	.01	11.00**	.00	15.48***	.01	6.26***	.00	10.83**	.00
Model 3										
Classes[1]	39.04***	.03	29.16***	.02	15.65***	.01	31.02***	.02	32.58***	.02
Gender	96.15***	.03	231.64***	.08	85.03***	.03	87.35***	.03	83.08***	.03
Age TRF	29.12***	.01	82.40***	.03	16.94***	.01	13.73***	.01	30.63***	.01
Education mother	10.45**	.01	21.87***	.02	12.14***	.01			10.43**	.01
Marital status	31.42***	.01	30.33***	.01	37.25***	.01	12.22***	.01	21.46***	.01
Hostility mother	0.08	.00	0.21	.00	1.02	.00			0.05	.00
Probability	12.02**	.00	6.48*	.00	10.45**	.00	5.82*	.00	7.87**	.00
Parity									2.31	.00

n = 2,756 for model [a,b,] and [c]. n = 2,753 for model [d]. n = 2,749 for model [e].

Note. The results of the first imputed dataset are reported in this table. The range of statistics over the imputed datasets of the fully adjusted analyses are reported in the Supplementary **TABLE S2.6**. The range of the model R^2_{adj} is reported below. [1]Classes = total aggression in model [a, b,] and [c]. Classes = physical aggression in model [d]. Classes = non-physical aggression in model [e].

Aggression: Model 1 all R^2_{adj} = .04; Model 2 all R^2_{adj} = .05; Model 3 all R^2_{adj} = .11. Attention: Model 1 all R^2_{adj} = .03; Model 2 all R^2_{adj} = .04; Model 3 all R^2_{adj} = .16.

Rule breaking: Model 1 all R^2_{adj} = .02; Model 2 all R^2_{adj} = .03; Model 3 all R^2_{adj} = .08. Physical aggression: Model 1 R^2_{adj} = .03; Model 2 R^2_{adj} = ..04; Model 3 R^2_{adj} = .08

Non-physical aggression: Model 1 all R^2_{adj} = .04; Model 2 all R^2_{adj} = .04; Model 3 R^2_{adj} = .09-.10

* $p < .05$, ** $p < .01$, *** $p < .001$.

Bonferroni corrected post-hoc tests revealed that the high increasing class had higher levels of teacher-reported total aggressive behavior (M = 0.67, SE = .05, 95% CI 0.58-0.76) as compared to the intermediate (M = 0.37, SE = 0.02, 95% CI 0.34-0.42, $p < .001$, Cohen's d = 0.85) and low decreasing class (M = 0.30, SE = .02, 95% CI 0.28-0.33, $p < .001$, Cohen's d = 1.05). The intermediate class had higher levels of total aggressive behavior as compared to the low decreasing class, $p < .001$, Cohen's d = 0.21.

Second, we tested whether class membership was related to attention problems reported by the teacher. The fully adjusted univariate analysis showed an effect of class membership on teacher-reported attention problems ($p < .001$, partial η^2 = .02, Cohen's d = 0.29, 85% CI 0.24-0.35). Bonferroni corrected post-hoc tests revealed that the high increasing class had higher levels of attention problems (M = 1.05, SE = 0.06, 95% CI 0.94-1.16) as compared to the intermediate (M = 0.71, SE = 0.03, 95% CI 0.66-0.76, $p < .001$, Cohen's d = 0.75) and low decreasing classes (M = 0.64, SE = .02, 95% CI 0.61-0.68, $p < .001$, Cohen's d = 0.94). Further, the intermediate class had significantly higher levels of attention problems as compared to the low decreasing class, p = .007, Cohen's d = 0.19.

Third, we tested whether class membership was related to rule breaking behavior. The fully adjusted analysis showed an effect of class membership on teacher-reported rule breaking behavior ($p < .001$, partial η^2 = .01, Cohen's d = 0.21, 85% CI 0.16-0.27). Bonferroni corrected post-hoc tests indicated that the high increasing class had higher levels of rule breaking behavior (M = 0.32, SE = 0.03, 95% CI 0.26-0.38) as compared to the intermediate (M = 0.19, SE = 0.01, 95% CI 0.16-0.21, $p < .001$, Cohen's d = 0.61) and low decreasing classes (M = 0.17, SE = 0.01, 95% CI 0.15-0.18, $p < .001$, Cohen's d = 0.70). Mean levels of rule breaking behavior did not differ significantly between the intermediate and low decreasing classes, p = .296. The range of statistics for the fully adjusted analyses of total aggression, attention problems and rule breaking behavior over the five imputed datasets are reported in the Supplementary **table s2.6**.

For each class, we computed the percentages of children in the borderline, clinical and combined ranges of the three TRF scales separately, results are presented in **table 2.5**. The percentages of children scoring in the borderline, clinical, or combined range were, in general, higher in the high increasing class as compared to one or both other classes. The intermediate class contained a larger percentage of children in the borderline and

combined range of total aggressive behavior and attention problems as compared to the low decreasing class. The percentage of children scoring in the clinical range of rule breaking behavior did not differ between classes. However, they did differ for the borderline and combined range of rule breaking behavior, with more children in the higher classes.

We reran the analyses, including the time interval between administering the CBCL (age 6) and the TRF as a covariate, but excluding the age of the child at the TRF assessment as a covariate. For all three models (total aggressive behavior, attention problems and rule breaking behavior), effect sizes of class membership remained similar for all three scales. The effects of the covariates and the Bonferroni corrected post-hoc tests for the class differences were also comparable to the previous models.

TABLE 2.5
Untransformed Means of TRF Scales and Percentages of Children in the Borderline and the Clinical Range

TRF scales	Classes		
	Low decreasing	Intermediate	High increasing
Aggression			
M (*SD*)	1.62 (3.77)	2.84 (5.03)	6.59 (7.53)
% Borderline[1]	2.5[a]	5.7[b]	18.5[c]
% Clinical[1]	0.8[a]	1.5 [a]	4.6 [b]
% Borderline & clinical	3.2[a]	7.2[b]	23.1[c]
Attention			
M (*SD*)	4.89 (7.18)	7.06 (8.66)	13.14 (10.79)
% Borderline[1]	1.5[a]	3.0[b]	6.2[b]
% Clinical[1]	0.6[a]	0.8[ab]	3.1[b]
% Borderline & clinical	2.0[a]	3.8 [b]	9.2[c]
Rule breaking			
M (*SD*)	0.53 (1.40)	0.80 (1.56)	1.60 (2.13)
% Borderline[1]	1.8[a]	2.3[a]	7.7[b]
% Clinical[1]	0.5[a]	0.9[a]	1.5[a]
% Borderline & clinical	2.3[a]	3.2[a]	9.2[b]

n = 2,756
[1]Percentages in the borderline and clinical cells do not overlap. Percentages within a TRF scale and within a row sharing a different superscript differ significantly at
$p < .05$.

Aggression at age 6 as predictor of teacher-reported total aggression

Next, we tested whether the use of total aggression trajectories was indeed more informative, in terms of explained variance, as compared to a single measure of aggression. All models were similar to the adjusted models reported in **TABLE 2.4**, except that we included parent-reported aggressive behavior at age 6 instead of class membership. Multivariate tests showed a significant effect of total aggression age 6 on the levels of teacher-reported problems, $F(3, 2745) = 30.76$, $p < .001$, partial $\eta^2 = .03$. In the univariate analyses, parent-reported total aggressive behavior at age 6 was related to teacher-reported total aggressive behavior, $F(1, 2747) = 88.33$, $p < .001$, partial $\eta^2 = .03$, Cohen's $d = 0.36$, 85% CI 0.30-0.41. Total aggressive behavior at age 6 was also related to teacher-reported attention problems and rule breaking behavior, respectively $F(1, 2747) = 54.71$, $p < .001$, partial $\eta^2 = .02$, Cohen's $d = 0.29$, 85% CI 0.23-0.34 and $F(1, 2747) = 33.38$, $p < .001$, partial $\eta^2 = .01$, Cohen's $d = 0.22$, 85% CI 0.17-0.28. These 85% confidence intervals of Cohen's *d* overlap with the confidence intervals of Cohen's *d* of the class membership analyses for total aggression, attention problems and rule breaking behavior respectively, indicating that the effect sizes are of comparable size. The range of statistics for these analyses are reported in the Supplementary **TABLE S2.6**. In Supplementary Material **TABLE S2.1** we also report on univariate analyses with total aggressive behavior at age 1.5 and 3 as predictors of teacher-reported problem behavior, including the same covariates as the former models. The partial η^2 of the models ranged between .00 and .01.

Trajectories of physical and non-physical aggression

Growth mixture models (GMM) with one to seven classes were tested for all children who had at least two measures of the physical or non-physical aggression scales available (respectively $n = 4{,}778$ and $n = 4{,}771$). Class solutions of physical and non-physical aggression are reported in **TABLE 2.2.** For similar reasons as mentioned before in case of total aggression, a three trajectory model was selected as the most optimal solution for both aggression types (**FIGURE 1**). The trajectories had comparable shapes and class sizes as the total aggression trajectories; for both physical and non-physical aggression the trajectories consisted of a low decreasing class with low levels at the start and decreasing levels of physical / non-physical

aggression over time ($p < .001$ for both models), an intermediate class with intermediate levels at the start and increasing levels of physical / non-physical aggression over time ($p = .020$ and $p = 0.30$ respectively) and a high increasing class with intermediate physical / non-physical aggression levels at the start that increased over time ($p < .001$ for both models).

Data on teacher-reported physical and non-physical aggression was available for 2,753 and 2,749 children respectively, subdivided into 2,229 and 2,053 children in the low decreasing class, 450 and 598 in the intermediate class and 74 and 98 in the high decreasing class for physical and non-physical aggression respectively. There was no different attrition rate per class based on the TRF selection for either physical or non-physical aggression: χ^2 (2, n = 4,778) = 4.48, $p = .106$ and χ^2 (2, n = 4,771) = 5.24, $p = .073$ (same values in all datasets). Differences between the low decreasing, intermediate and high increasing trajectories of physical and non-physical aggression on background variables are reported in text in Supplementary Material.

Relating trajectories of physical and non-physical aggression to teacher-reported aggression

We tested whether trajectories of physical and non-physical aggression were related to teacher-reported physical and non-physical aggression. Correlations between all variables included in the physical and non-physical aggression models are reported in Supplementary Material **TABLE S2.2** and **S2.3** respectively. Unadjusted and untransformed means of the TRF physical and non-physical aggression scales per class can be found in ***FIGURE* 2.2**, transformed means will be used in the analyses and are reported in text. Univariate results are reported in **TABLE 2.4**.

First, we tested the relation between physical aggression trajectories and teacher reports of physical aggression. The fully adjusted analysis showed an effect of class membership on teacher-reported physical aggression ($p < .001$, partial $\eta^2 = .02$, Cohen's $d = 0.30$, 85% CI 0.24-0.36). Bonferroni corrected post hoc test revealed that the high increasing class had higher levels of physical aggression ($M = 0.54$, $SE = .06$, 95% CI 0.42-0.65) than the intermediate ($M = 0.37$, $SE = .03$, 95% CI 0.32-0.42, $p = .022$, Cohen's $d = 0.34$) and low decreasing classes ($M = 0.21$, $SE = .02$, 95% CI 0.18-0.24, $p < .001$, Cohen's $d = 0.66$). The intermediate class had higher levels of physical aggression than the low decreasing class, $p < .001$, Cohen's $d = 0.32$.

Second, we tested whether trajectories of non-physical aggression were related to teacher-reported non-physical aggression. The fully adjusted analysis showed an effect of class membership on teacher-reported non-physical aggression ($p < .001$, partial $\eta^2 = .02$, Cohen's $d = 0.31$, 85% CI 0.25-0.36). Bonferroni corrected post hoc tests showed that the high increasing class had higher levels of non-physical aggression ($M = 0.53$, $SE = .04$, 95% CI 0.46-0.60) as compared to the intermediate ($M = 0.35$, $SE = .02$, 95% CI 0.31-0.39, $p < .001$, Cohen's $d = 0.56$) and low decreasing class ($M = 0.28$, $SE = .02$, 95% CI 0.25-0.31, $p < .001$, Cohen's $d = 0.77$). The intermediate class had higher levels of non-physical aggression than low decreasing class TRF, $p < .001$, Cohen's $d = 0.21$. The range of statistics for the fully adjusted analyses of physical and non-physical aggression over the five imputed datasets are reported in the Supplementary **TABLE S2.6**.

We reran the physical and non-physical aggression analyses, including the time interval between administering the CBCL (age 6) and the TRF as a covariate, but excluding the age of the child at the TRF assessment as a covariate. For both models (physical and non-physical aggression), effect sizes of class membership remained similar. The effects of the covariates and the Bonferroni corrected post-hoc tests for the class differences were also comparable to the previous models.

Aggression at age 6 as predictor of teacher-reported physical and non-physical aggression

Next, we tested whether the use of physical / non-physical aggression trajectories was indeed more informative, in terms of explained variance, as compared to a single measure of physical / non-physical aggression. All models were similar to the adjusted models reported in **TABLE 2.4**, except that we included parent-reported physical / non-physical aggressive behavior at age 6 instead of class membership. Parent-reported physical aggressive behavior at age 6 was related to teacher-reported physical aggressive behavior, $F(1, 2{,}747) = 72.40$, $p < .001$, partial $\eta^2 = .03$, Cohen's $d = 0.33$, 85% CI 0.27-0.38. Furthermore, parent-reported non-physical aggressive behavior at age 6 was related to teacher-reported non-physical aggressive behavior, $F(1, 2{,}739) = 84.19$, $p < .001$, partial $\eta^2 = .03$, Cohen's $d = 0.35$, 85% CI 0.30-0.41. For these models the 85% confidence intervals of Cohen's d overlap with the confidence intervals of Cohen's d of the class membership analyses for physical and non-physical aggression respec-

tively, indicating that the effect sizes are of comparable size. The range of statistics for these analyses are reported in the Supplementary **TABLE S2.6**.

In Supplementary Material **TABLE S2.1** we also report on univariate analyses with physical and non-physical aggressive behavior at age 1.5 and 3 as predictors of teacher-reported physical and non-physical aggression, including the same covariates as the former models. The partial η^2 of the models ranged between .00 and .02.

Discussion

In the current cohort study, we tested whether trajectories of parent-reported aggression at age 1.5 to 6 were related to teacher-reported problem behavior. Using growth mixture modeling (GMM; Muthén & Shedden, 1999), we found three trajectories of total aggression in our sample of 4,781 children. Analyses on the smaller sample with teacher-reported data (n = 2,756) showed that trajectories of parent-reported total aggression were related to teacher-reported total aggressive behavior, attention problems, and rule breaking behavior. However, a single time point measure of total aggression at age 6 was an equally accurate indicator of teacher-reported problem behavior as were the trajectories, since effect sizes between models were comparable. Similar trajectories were found for physical and non-physical aggression and their relations to teacher-reported physical and non-physical aggression were comparable. Furthermore, single time point measures of the subtypes of aggression at age 6 were equally accurate indicators of teacher-reported physical and non-physical aggression as the trajectories.

We identified a group children that showed high increasing levels of aggression over the first six years of life, confirming findings from other studies (for a review see Jennings & Reingle, 2012). The patterns and levels of the three trajectories correspond to the early childhood aggression trajectories reported by Tremblay et al. (2004), Côté et al. (2006) and Côté, Boivin et al. (2007). However, in these studies the trajectory with the highest aggression levels consisted of higher percentages of children (13.9% - 17.0%) than we found in our study (3.0%). In addition, the intermediate class in our study was also smaller (21.3%) compared to those studies (50.5 % - 58.0%).

The convergence among trajectories of different types of aggression might indicate that aggression is a relatively homogeneous developmental phe-

nomenon in early childhood. Whereas different types of aggression are present at a young age and have been suggested to show different patterns across childhood (e.g. Côté, Vaillancourt et al., 2007), we did not find evidence for such differences. Differentiation in developmental trajectories of physical and non-physical aggression might occur at a later age.

The current study showed that the high increasing trajectory was associated with more teacher-reported problem behavior, with substantial effect sizes for the mean differences with the intermediate and low decreasing class. Moreover, this high increasing total aggression trajectory contained in general a larger percentage of children scoring in the borderline and clinical range of teacher-reported problems as compared to the other classes. Children with the highest parent-reported levels of aggression over time thus have the largest risk of exhibiting problematic behaviors according to the teacher, suggesting that these children show problem behavior in multiple settings. Loeber and Hay (1997) argue that aggressive behavior occurring in multiple settings could often be considered maladaptive and pathological. Moreover, such pervasiveness across settings of aggression and related problems is considered to be a risk factor for the continuation of problem behavior and the development of other problems (Campbell, Shaw, & Gilliom, 2000; Loeber, 1990). Van Dulmen & Egeland (2011) report that when predicting externalizing problem behavior at later ages, the use of both parent- and teacher-reports is found to be more accurate than the reports of a single informant. However, this holds only when the different scores are weighted and variance sources, including informant sources of bias, in both scores are taken into account. When these are not taken into account, single informant scores are as informative as scores from multiple informants.

It should be noted that children in the intermediate class may also be at risk of higher levels of teacher-reported problem behavior. Although they did not have as high parent-reported aggression levels as the high increasing class, the intermediate class showed elevated, relatively stable levels of aggression over time. Furthermore, this class showed on average higher levels of teacher-reported problems and comprised more children scoring in the borderline range of the total aggression and attention problems scales as compared to the low decreasing class. Comparable results were found by Campbell et al. (2006) and Campbell et al. (2010) in an older age group (middle childhood). Children in the high and intermediate aggression trajectories showed increased levels of the broader construct exter-

nalizing problem behavior in a different setting. Campbell et al. (2006) also reported on the higher occurrence of ADHD and ODD symptoms in children in the higher trajectories during middle childhood.

The overall effect sizes for the associations between parent-reported aggression and teacher-reported problems in our study were small. It should however be noted that the high increasing total aggression class showed substantial effect sizes in predicting teacher-reported total aggressive behavior as compared to the intermediate (Cohen's d = 0.85) and low decreasing class (Cohen's d = 1.05). But the percentages of children in the high increasing trajectory scoring in the borderline and clinical range of teacher-reported problem behavior were low. Trajectories might, at least in our study on a rather homogeneous, non-risk sample, lack sensitivity and specificity; a large percentage of children in the higher classes did not show maladaptive levels of problem behavior at school and there was a group children in the lower classes with high ratings of teacher-reported problems. This lack of sensitivity and specificity might also point to a low agreement between informants (De Los Reyes et al., 2013), as in the Gross, Fogg, Garvey and Julion (2004) study where only a small percentage of the children had problem behavior scores in the clinical range from both parents and teachers. Other studies also found low agreement among parents and teachers in the occurrence of problem behavior (e.g. Miner & Clarke-Stewart, 2008; Winsler & Wallace, 2002; Youngstrom, Loeber, & Stouthamer-Loeber, 2000).

Disagreement among informants might be informative instead of reflecting mere measurement error. Parents and teachers may differ in their view on the severity of problem behavior. For example, Van der Ende and Verhulst (2005) and Youngstrom et al. (2000) found that teachers tend to report lower levels of problem behavior. Further, the CBCL and TRF have several unique items, which may account for lower agreement between parents and teachers. Lastly, children in our sample may have shown problem behavior mainly in one setting instead of multiple contexts (Kraemer et al., 2003; De Los Reyes, et al., 2013). Whereas pervasiveness across settings is considered the most worrisome and we identified such a group, Fergusson et al. (2009) highlight that even children with conduct problems in one setting are at risk for adverse developmental outcomes. Therefore the authors suggest that the use of both parent's and teacher's reports is important as to also include children with situational problems that could develop into serious problems later in life.

When comparing trajectories to a single assessment of aggression, our results indicate that the developmental patterns of aggression were not more informative than a concurrent level of aggression when testing its association with teacher-reported problem behavior. This is surprising, because repeated measures are thought to increase the precision of the measurements used. However in the current study, the last trajectory time point was measured approximately at the same moment as teacher-reported problem behavior, which may have diminished the additional precision that could be gained by using repeated measures. Moreover, the trajectories did not intersect. As the trajectories had the same relative position at all ages, this might also explain why the aggression score at age 6 was equally informative as the aggression trajectories. Furthermore, the supplementary analyses suggest that parent-reported measures of aggressive behavior closer in time (age 6) to teacher-reported problem behavior are more accurate indicators of teacher-reported problem behavior, as compared to measures at earlier ages (1.5 and 3 years of age). Despite the fact that the trajectories did not intersect, they showed changing levels of aggression over time. These changing levels might explain the weaker relation between earlier measures of aggressive behavior as compared to the age 6 measure. Parent-reported physical and non-physical aggression showed similar developmental trajectories as total aggression, with high increasing, intermediate and low decreasing trajectories. Further, effect sizes for the association of total, physical and non-physical trajectory class membership with respectively teacher-reported total, physical, and non-physical aggression were comparable. This makes it unlikely that replacement of physical aggression by non-physical aggression as children get older accounts for a stronger relation of the parent-reported age 6 measure with teacher-reported aggression than the trajectory.

Most studies using trajectories (e.g. Campbell et al., 2006; Campbell et al., 2010; Harachi et al., 2006;. Huijbregts, et al., 2009; Shaw, Hyde, & Brennan, 2012) did not test for the additional value of their trajectory approach. The results reported above might be specific to the current study because we measured aggression at only three occasions in a relatively short period of time and the time interval between the trajectories and teacher-reported problems was relatively small. Yet, future studies using aggression trajectories may take our finding into account and test for the incremental value of trajectory modelling, as to prevent the interpretation of findings in terms of longitudinal patterns of aggression whereas the relation between

aggressive behavior and either the predictor or the outcome could have been established equally effective by a single time point measure of aggression.

Several limitations must be mentioned. First, we did not have earlier measurements of teacher-reported aggression. Moreover, parent-reported aggression at age 6 and teacher-reported problem behavior were concurrent measures. Therefore it was not possible to test whether aggression as reported by one informant preceded the manifestation of aggression as reported by a different informant in another setting, or whether it developed jointly. Second, the fact that the CBCL and TRF questionnaires were directed towards different age ranges made them potentially less comparable, and may have resulted in a lower agreement between parents and teachers. Nevertheless, the use of different informants in different settings should be considered a strength, since it diminishes shared method variance bias. According to Doctoroff and Arnold (2004) the use of multiple sources and methods yields a more accurate representation of the child's behavior.

In sum, we identified a group of children with pervasive problem behavior in early childhood, which places these children at a heightened risk to develop problems later in life. The advantages of trajectories in the identification of young children with problem behavior according to both parent and teacher were, however, limited. In our study trajectories of total, physical and non-physical aggression did not show incremental predictive validity over the latest time point measurement. Whereas in other studies trajectories might be of additional value as compared to a single assessment of aggression, our results should be taken as a warning that the value of trajectories is not always self-evident and should be empirically demonstrated.

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