

Risk factors for aggression in pre-adolescence: Risk domains, cumulative risk and gender differences – Results from a prospective longitudinal study in a multi-ethnic urban sample

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Abstract

This article reviews a range of risk factors for aggression at age 11 derived from a prospective longitudinal study on the social development of children in a large multi-ethnic sample in Switzerland. The study uses a multi-informant approach that permits reliance on combined measures of social behaviour and covers factors derived from a wide range of risk domains. Besides analysing the effects of individual risk factors, the study also investigates the effect size of cumulative risk within and across risk domains. It further analyses gender differences in risk vulnerability. Results suggest that proximal behavioural and psychological risk factors most strongly predict later aggression, whereas more distal external factors related to the family, to school and to peer relationships are less predictive. The most distal factors (perinatal risks and sociodemographic factors) are only marginally associated with later aggression. Analysis of cumulative risk suggests a strong relationship between the number of risk factors and later aggression. Finally, results support the notion of a higher risk vulnerability of boys compared with girls. Results are discussed in the context of extant research.

Keywords

aggression, cumulative risk, pre-adolescence, prospective longitudinal study, risk factors, violence

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Introduction

In recent decades a considerable amount of research has been carried out on risk factors associated with aggression and violence among children and youths. In particular, several large-scale prospective panel studies have identified long- and medium-term predictors of aggression and delinquency by measuring correlates *before* the outcome variable. Most of these studies have been carried out in North America (e.g. Hawkins et al., 2003; Huizinga et al., 2003; Loeber et al., 2003; Sampson and Laub, 1993; Thornberry et al., 2003; Tremblay et al., 2003) or in other anglophone countries (e.g. Farrington, 2003; Moffitt et al., 2001; Wikström and Butterworth, 2006). In contrast, similar studies on the development of aggressive and otherwise problematic behaviour are still scarce in continental Europe and mostly rather recent, with the notable exception of Magnusson and colleagues' pioneering study in Sweden (e.g. Magnusson et al., 1983). Most other studies typically started after the mid-1990s, all of them being located in North-West European countries such as the Netherlands (e.g. Veenstra et al., 2009), Germany (e.g. Boers et al., 2009; Lösel et al., 2009) or Switzerland (e.g. Eisner and Ribeaud, 2005). Among other things, such studies are important for assessing whether effect sizes of risk factors are stable across cultural and societal contexts.

Goals of the study

This essentially descriptive article reviews the predictive power of a wide range of childhood risk factors for aggression in pre-adolescence that were measured in the Zurich Project on the Social Development of Children (*z-proso*) and compares the findings with those of similar studies and with relevant meta-analyses. The single-sample approach allows reliable identification of relative differences in the effect size among the analysed risk factors. Another aim is to examine the effect of cumulative risk (Loeber et al., 1998; Stouthamer-Loeber et al., 2002) within and across risk domains to get a picture of the relative importance of each risk domain and of the impact of the *variety* of risk exposure. Finally, the article aims to investigate gender differences in risk vulnerability by comparing effect sizes across genders.

Key characteristics of the study

z-proso is a large-scale prospective, longitudinal and randomized-experimental study based in Zurich and started in 2004 with a cohort of roughly 1300 first-graders. Some of its key characteristics render it particularly appropriate for an overview on risk factors for aggressive behaviour in pre-adolescence. First, the use of a combined prospective and retrospective longitudinal design allows the inclusion of the subjects' whole lifespan and establishes a clear time order. Second, the sample is large enough to detect even small effect sizes. Third, multilingual interviews allowed the inclusion of all major minority groups. Consequently, the sample is ethnically highly heterogeneous. Along with an initial participation rate above 75 percent, this ensures its high representativeness and the inclusion of at-risk groups. Fourth, the use of a multi-informant approach to assess behavioural outcomes allows for robust measures. Fifth, the data collection among

parents, teachers and children covers almost all relevant risk domains. Finally, the class-based sampling method allowed the use of sociometric instruments.

Risk factor definition

The term 'risk factor' is used with different meanings and refers sometimes to correlates, sometimes to predictors and sometimes to causes (Farrington, 2000; Kraemer et al., 1997). To prevent such ambiguities, we rely on the risk-factor definition proposed by Murray and colleagues, which is based on Kraemer's definition (Kraemer et al., 1997): 'Risk factors are correlates that are shown to predict delinquency. To demonstrate that something is a risk factor, a study needs to demonstrate correlation, and the variable must be shown to precede the outcome' (Murray et al., 2009: 3). This definition of risk factors does not imply a notion of causation. However, by temporally preceding the outcome, they comply with a necessary condition for a correlate to be a potential cause. Accordingly, they might also be involved in the causation of aggressive behaviour, and many of them were theoretically derived as such. Nevertheless, given this risk-factor definition, the study results allow inferences only about prediction, not about causation.

Risk factors versus protective factors

In criminological and developmental research the term 'protective factors' as opposed to 'risk factors' is used in an inconsistent manner. Resilience research proposes the most complex conceptualization of protective factors. In this context, protective factors are conceived as factors that can counteract the influence of a risk factor (Rutter, 1985). Hence, their effect can be understood only in interaction with a risk factor. A more straightforward approach conceives protective and risk factors as the opposite poles of one variable (Stouthamer-Loeber, 1993). Technically, this is solved by defining each of the extreme quartiles of a continuously distributed variable as a risk and a protective factor respectively, the middle 50 percent of the distribution being conceived as neutral (Loeber et al., 2003: 118). In the present study we use a similar approach. For correlational analyses based on continuous variables, indicators are poled in such a way that the 'risk pole' always has the highest value. Analyses with categorical outcomes are based on median-split variables with the upper 50 percent defined as 'at risk', except for categorical variables.

Risk domains

Based on Bronfenbrenner's (1979) seminal work on the ecology of human development, and more specifically on the notion of human development as an interaction of the growing individual with distinct systems or settings of action and influence, we distinguish several risk domains, as listed below. Similar structurings of risk domains can be found in extant reviews of risk and protective factors (see, e.g., Farrington, 1998; Hawkins et al., 1998; Lipsey and Derzon, 1998; Lösel and Bender, 2006).

Individual risk factors. Individual risk factors encompass risk factors associated with the child's behaviour, biological and psychological makeup, and social skills, cognitions and

attitudes to surrounding systems (e.g. the school, the law) and persons. Perinatal circumstances that might have affected the child's biological and psychological makeup are also subsumed here. Moreover, (indoor) leisure activities, conceived as individual lifestyle indicators, are also listed under individual risk factors.

Family characteristics. During infancy and childhood the family represents the most important formative micro-system for the child's development. Accordingly, many external risk factors are related to this domain. We distinguish four sets of family characteristics: individual family member characteristics, inter-individual relationships, family structure and parenting characteristics. Among family member characteristics we further differentiate between psychological parent characteristics and sociodemographic parent characteristics, the latter representing the family's position in the societal macro-system. Moreover, family member characteristics also comprise sibling characteristics. Inter-individual relationships focus on the partnership between the parents as well as on conflict among family members, while family structure encompasses the number of family members and the possible absence of one parent. The parenting domain addresses several aspects of parenting behaviour and also includes external childcare.

School. During middle childhood the child enters school as a new formative micro-system. All risk factors that emerge from the school setting (e.g. school disorder, class cohesion) are subsumed here, except the child's individual school-related characteristics which are conceptualized as individual characteristics.

Peers and classmates. Entering the micro-system of school also implies new relationships with classmates and consequently an increasing importance of the peer group for behavioural development. During this formative stage, the role and popularity of the child in the class, as well as contacts with antisocial peers, are likely to influence the development of aggressive behaviour. Moreover, victimizations might also affect the likelihood of reactive forms of aggressive behaviour.

Method

Study, sample and data collections

The data for the following risk factor overview stem from the Zurich Project on the Social Development of Children (*z-proso*), an ongoing prospective, longitudinal study of a cohort of children who entered primary school in 2004 at an average age of 7 (see Eisner and Ribeaud, 2005, and Eisner et al., 2008, for details of the study design). The target population of the study consists of all 2520 children who entered Grade 1 of public primary school in the city of Zurich in 2004. The sampling frame was formed by all 90 public primary schools in the city of Zurich from which a random sample of 56 schools, stratified by school size and school district, was drawn. The target sample of the study encompasses all 1675 children who started primary school in one of the selected schools, as well as their parents and teachers. A total of 1235 parents participated in the initial

Table 1. Number of participants and median data collection date

	Parent interviews			Child assessments			Teacher surveys		
	N	Median date	ID	N	Median date	ID	N	Median date	ID
Wave 1 Risk factors	1235 (74%)	Oct-04	P1	1361 (81%)	Mar-05	C1	1350 (81%)	Mar-05	T1
Wave 2 Risk factors	1192 (71%)	Sep-05	P2	1335 (80%)	Nov-05	C2	1326 (79%)	Jan-06	T2
Wave 3 Risk factors	1181 (71%)	Sep-06	P3	1322 (79%)	Nov-06	C3	1294 (77%)	Dec-06	T3
Wave 4 Outcome	1074 (64%)	Oct-08	P4	1148 (69%)	Feb-09	C4	1269 (76%)	Jun-08	T4

Note: Percentages in brackets refer to participation rates compared with the initial target sample.

interview. Table 1 gives an overview of the number of participants, the participation rates and the median date of the different data collections.

The risk factors analysed in this study derive from the first three interview waves at ages 7, 8 and 9, whereas the criterion variable of aggressive behaviour was measured in wave 4 at age 11. At this age almost all children changed to 'intermediary' primary school, which involves a change in class and thus also in classmates and teachers. Each sweep comprised data collections from the primary caregiver, the child and the teacher.

Written parental consent was obtained for the first three project years¹ and needed to be renewed at wave 4.² Computer-assisted face-to-face parent interviews lasted an average of 1 hour and were usually conducted at the parents' home. The preferred interview partner was the primary caregiver, mostly the mother. Parents were offered an incentive of about €25 per interview.

Since 57 percent of the parents in the target sample had an immigrant background, several measures were taken to promote their participation. In particular, all contact letters and parent interviews were translated into the most important minority languages – i.e. Albanian, English, Italian, Portuguese, Serbian/Croatian/Bosnian, Spanish, Tamil and Turkish. Details of the translation procedure are described in Eisner and Ribeaud (2005), and language-specific participation rates may be found in Eisner et al. (2008: 78).

In the first three data collection waves, computer-assisted personal face-to-face child assessments were conducted at schools and lasted for 45 minutes. In the fourth wave, assessments were changed to classroom-based paper-and-pencil surveys that lasted 90 minutes.³ Participating children were guided through the questionnaire by project collaborators. Children who moved from the city or who were the only project participant in their school were surveyed at home. Teacher assessments consisted of paper-and-pencil questionnaires that included questions on child behaviour, the child's social role in the classroom and the academic achievement of the child. Another questionnaire focused on school problems and class cohesion.

Measures and scale statistics

Reliability and standard descriptive scale statistics are summarized in Table 2. The following instrument descriptions focus on the source and relevant particularities of each measure without systematically specifying the standard statistics listed in Table 2.

Criterion variable

The measurement of child behaviour is based on a multi-trait/multi-informant approach that combines parent, teacher and child information. Combining all three informants is generally believed to yield the most valid and reliable estimates of child behaviour problems (Bank et al., 1990; Perren et al., 2006; Verhulst et al., 1994). Child behaviour was assessed with the Social Behaviour Questionnaire (SBQ) developed by Tremblay et al. (1991). Teacher and parent response was elicited on five-point Likert scales. Children were shown drawings on a screen representing a given behaviour along with the recorded item wording, and responses were elicited in a yes/no format. The use of a self-administered CAPI (computer assisted personal interviewing) technique allowed the child to answer without the aid of an interviewer, thus ensuring a more anonymous and valid measurement of problem behaviour.

The aggressive behaviour scale comprises items referring to physically violent behaviour as well as to proactive and reactive aggression. Internal consistencies for the aggressive behaviour scale were .81 for the primary caregiver assessment, .94 for the teacher assessment and .75 for the child's self-assessment. Scales obtained from each informant were z-standardized and averaged across informants. Scores from all three informants were available for 986 children.⁴ As usual for multi-informant behavioural assessments (Achenbach et al., 1987), cross-informant correlations are moderate and yield low scale reliability (.53). For analyses based on dichotomous outcomes, the combined scores were dichotomized, giving the highest 25 percent of problem behaviour a score of 1 and the remaining 75 percent a score of 0 (Farrington and Loeber, 2000).

Antecedent behaviour

Antecedent behaviour was measured with the SBQ (see above) in the first assessment wave. All measures are derived from multi-informant measurements and include the five principal behavioural domains covered by the SBQ, namely *aggressive behaviour*, *non-aggressive externalizing behaviour* (i.e. opposition, defiance, stealing, lying, vandalizing), *internalizing problems* (i.e. anxiety and depression), *attention deficit hyperactivity disorder* (ADHD) and *prosocial behaviour* (i.e. helping and empathy). For all behavioural domains, within-informants reliabilities are satisfactory to good, whereas cross-informants reliabilities remain below .5.

Antecedent problem behaviour was also assessed on the basis of a *bullying* self-report scale derived from Olweus (1993) and Alsaker (e.g. Alsaker and Gutzwiller-Helfenfinger, 2010). This scale covers four types of bullying (teasing, stealing and destroying things, physical violence, rejection). The same instrument was used to assess bullying from the victim and the observer perspective.

Table 2. Scale descriptions by risk domain

Risk domain	Risk factor	Instrument/source (data collection wave)	Number of items	Cronbach's alpha	Mean ^a (SD)	N	Percent at risk (dichotomous variable)
<i>Criterion variable</i>							
<i>Individual</i>	Aggression at 11 (criterion variable)	Combined SBQ – aggression (PCT4)	35 (P: 12; C: 12; T: 11)	.528 ^b (P: .811; C: .750; T: .940)	–0.01 (0.70)	1184	25.0%
	Male gender	School department database	1	–	0.52 (0.50)	1675	51.9%
	Aggression	Combined SBQ – aggression (PCT1)	35 (P: 12; C: 12; T: 11)	.381 ^b (P: .789; C: .716; T: .934)	0.00 (0.65)	1361	50.0%
	ADHD	Combined SBQ – ADHD (PCT1)	25 (P: 9; C: 8; T: 8)	.438 ^b (P: .811; C: .750; T: .940)	0.00 (0.67)	1361	50.0%
	Non-aggressive externalizing problem behaviour	Combined SBQ – non-aggressive PB (PCT1)	24 (P: 9; C: 9; T: 6)	.386 ^b (P: .684; C: .596; T: .811)	0.00 (0.66)	1361	49.6%
	Internalizing problems	Combined SBQ – internalizing problems (PCT1)	25 (P: 9; C: 9; T: 7)	.224 ^b (P: .709; C: .624; T: .895)	0.00 (0.61)	1361	50.0%
	Low prosociality	Combined SBQ – prosociality, inverted (PCT1)	27 (P: 10; C: 10; T: 7)	.381 ^b (P: .766; C: .594; T: .922)	0.00 (0.66)	1361	50.0%
	Bullying actor	Bullying self-report (C2)	4	.633	0.39 (0.55)	1335	52.4%
	Perinatal circumstances	Perinatal risk checklist (PI)	1	–	0.13 (0.34)	1219	13.2%
	Tobacco during pregnancy	Perinatal risk checklist (PI)	1	–	0.38 (0.95)	1220	16.1%
Alcohol during pregnancy	Perinatal risk checklist (PI)	1	–	0.46 (0.92)	1220	24.8%	

(Continued)

Table 2. (Continued)

Risk domain	Risk factor	Instrument/source (data collection wave)	Number of items	Cronbach's alpha	Mean ^a (SD)	N	Percent at risk (dichotomous variable)
Personality	Low trustfulness	Trust game – trustfulness score, inverted (C2)	–	–	1.71 (0.40)	1030	50.0%
	Low self-control	Adapted Grasmick scale for children (C3)	4	.391	2.86 (0.58)	1322	48.7%
	Sensation-seeking	Travel game (C1)	9	.676	0.58 (0.25)	1361	46.6%
Cognitions, attitudes and social skills	Hostile attribution	Social problem- solving assessment tool (C3)	4	.506	0.15 (0.21)	1322	38.0%
	Aggressive conflict resolution	Social problem- solving assessment tool (C3)	4	.427	0.26 (0.17)	1322	25.6%
	Lack of competent conflict resolution	Social problem- solving assessment tool (C3)	4	.549	0.77 (0.10)	1322	54.2%
	Violence-permissive behavioural norms	Deviant norms self- report (C3)	1	–	3.24 (0.82)	1318	54.7%
School-related individual factors	Low school bonding	Child-reported school commitment, inverted (C2)	1	–	2.40 (0.71)	1332	48.4%
	Low school bonding	Teacher-reported school motivation, inverted (T2)	1	–	3.32 (0.84)	1251	11.2%
	Low school achievement	Teacher-reported maths and language achievement, inverted (T2)	2	.762	3.23 (0.93)	1255	46.0%

Table 2. (Continued)

Risk domain	Risk factor	Instrument/source (data collection wave)	Number of items	Cronbach's alpha	Mean ^a (SD)	N	Percent at risk (dichotomous variable)
Indoor leisure activities	Adult media content	Media use checklist (C3)	2	.449	0.27 (0.37)	1317	39.3%
	Extended TV exposure	Child-reported TV use (C3)	1	–	3.95 (1.34)	1296	34.4%
	Extended computer game exposure	Child-reported computer game use (C3)	1	–	2.50 (2.14)	1070	39.2%
	Lack of creative and intellectually demanding leisure activities	Routine activities checklist, inverted (PI)	4	.359	2.44 (1.04)	1234	47.2%
<i>Family and parenting</i>							
Family structure	Broken home	Household structure assessment (PI)	1	–	0.22 (0.42)	1237	22.4%
	Large family size	Household structure assessment (PI)	1	–	1.15 (0.92)	1240	27.9%
Sociodemographic parent characteristics	Low formal education level	Parent-reported education, both parents, inverted (PI)	1	–	6.39 (2.97)	1228	42.9%
	Low socioeconomic status	Parent-reported profession, ISEI-coded, inverted (PI/3)	1	–	48.42 (19.58)	1195	49.6%
	Parental unemployment	Parent-reported spells of unemployment, EHC (PI)	1	–	0.24 (0.43)	1225	24.5%

Table 2. (Continued)

Risk domain	Risk factor	Instrument/source (data collection wave)	Number of items	Cronbach's alpha	Mean ^a (SD)	N	Percent at risk (dichotomous variable)
Financial hardship	Parent-reported spells of financial difficulties, EHC (P1)	Parent-reported spells of financial difficulties, EHC (P1)	1	-	0.17 (0.37)	1225	16.6%
Migrant background	Parents' country of birth, both parents born abroad (P1)	Parents' country of birth, both parents born abroad (P1)	1	-	0.46 (0.50)	1229	46.1%
Psychological parent characteristics	Caregiver's depression	General Health Questionnaire 12 (P2)	12	.817	0.78 (0.38)	1184	50.1%
Caregiver's low self-control	Adapted Grasmick scale (P2)	Adapted Grasmick scale (P2)	12	.694	1.22 (0.54)	1187	49.1%
Caregiver's experience of corporal punishment	Caregiver's upbringing assessment (P3)	Caregiver's upbringing assessment (P3)	2	.510	1.84 (0.86)	1166	50.2%
Sibling behaviour	Aggressive siblings	Sibling aggression, SBQ (P2)	6*3	.770	1.62 (0.67)	883	46.8%
Inter-individual family relationships	Poor relationship to siblings	Sibling relationship scale, inverted (P2)	6*4	.605	3.63 (0.57)	884	49.5%
Poor partner relationship	Dyadic Adjustment Scale 7, inverted (P2)	Dyadic Adjustment Scale 7, inverted (P2)	7	.623	4.53 (0.70)	980	47.2%
Poor family climate	Family climate scale, inverted (P2)	Family climate scale, inverted (P2)	3	.546	4.39 (0.57)	1188	48.7%
Parenting and childcare	Parental discord in parenting matters	Parent Problem Checklist (P2)	16	.898	1.50 (0.48)	1040	51.3%
Lack of parental involvement	APQ – involvement, inverted (P2)	APQ – involvement, inverted (P2)	10	.678	3.10 (0.42)	1192	52.2%

(Continued)

Table 2. (Continued)

Risk domain	Risk factor	Instrument/source (data collection wave)	Number of items	Cronbach's alpha	Mean ^a (SD)	N	Percent at risk (dichotomous variable)
	Lack of positive parenting	APQ – positive parenting, inverted (P2)	5	.615	3.16 (0.52)	1192	44.0%
	Poor parental monitoring	APQ – poor monitoring (P2)	10	.659	0.35 (0.35)	1192	52.7%
	Erratic parenting	APQ – erratic (P2)	6	.576	1.21 (0.54)	1180	48.7%
	Corporal punishment	APQ – corporal (P2)	3	.543	0.38 (0.46)	1189	54.3%
	Group-based external childcare	Quarters of external childcare during preschool years, EHC (P1)	1	–	1.45 (3.30)	1225	32.2%
<i>Domain of school</i>							
Schoolhouse	Perceived violent school environment	Bullying observation (C2)	4	.676	1.83 (0.97)	1322	52.4%
	School disorder	School Problems Checklist (T2)	7	.894	2.29 (0.67)	1261 (123)	51.1%
	Low class cohesion	Class cohesion scale, inverted (T2)	5	.859	4.25 (0.56)	1317 (129)	47.0%
Class	Change of class	School Department database	1	–	0.25 (0.43)	1382	24.7%
	Poor teacher–child relationship	Child-reported relationship to teacher (C3)	1	–	1.49 (0.61)	1320	43.6%
<i>Peer relationships</i>							
Popularity/trust	Low popularity among classmates	Coach Game, positive nominations, inverted (C2)	–	–	0.3 (0.18)	1272	49.5%

Table 2. (Continued)

Risk domain	Risk factor	Instrument/source (data collection wave)	Number of items	Cronbach's alpha	Mean ^a (SD)	N	Percent at risk (dichotomous variable)
	Low popularity among classmates	Role in class, popular, inverted (T2)	1	–	3.87 (0.93)	1317	30.8%
	Low trustworthiness	Trust game – trustworthiness score, inverted (C2)	–	–	1.71 (0.38)	1030	50.0%
Bullying/rejection	Rejection by classmates	Coach Game, negative nominations (C2)	–	–	0.10 (0.11)	1272	48.9%
	Victim of bullying	Bullying victimization (C2)	4	.652	0.84 (0.75)	1335	51.5%
Peer domination	Victim of bullying	Teacher-assessed role in class, bullied (T2)	1	–	1.40 (0.70)	1317	29.6%
	Withdrawal	Teacher-assessed role in class, withdrawn (T2)	1	–	1.40 (0.77)	1317	26.6%
Peer domination	Peer domination	Teacher-assessed role in class, dominant (T2)	1	–	1.46 (0.84)	1317	28.1%
Antisocial/violent peers	Violent best friends	Best friend assessment (C3)	2	.417	0.29 (0.38)	1285	42.4%

Notes: P = parent; C = child; T = teacher; EHC = event-history calendar.

^a Where applicable: before inversion.

^b Cross-informant reliability (in parentheses: within-informant reliability).

Perinatal factors

Postnatal depression and substance use during pregnancy were assessed in the first parent interview on the basis of a perinatal risk checklist. *Postnatal depression* was measured with a dichotomous 'yes'/'no' item, and *alcohol and cigarette use* were each measured on a single five-point Likert scale.

Personality factors

The three personality-related factors of low trustfulness, low self-control and sensation-seeking were measured in the first, second and third child interview respectively. *Trustfulness* (trust beliefs) was measured with a sociometric instrument developed by Rotenberg et al. (2005).⁵ Participants were asked to rate each of their classmates on whether they would 'always', 'sometimes' or 'never' keep a promise. The average of given ratings is used as a measure of trustfulness, and the average of received ratings indicates the level of trustworthiness (see below).⁶

Self-control was measured with a child-adapted set of four items derived from Grasmick et al. (1993) measuring risk-seeking, preference for physical activity, short temper and self-centredness (Cronbach's $\alpha = .39$). *Sensation-seeking* was assessed by a board game developed by Alsaker and her collaborators (e.g. Alsaker and Gutzwiller-Helfenfinger, 2010) in which the child advances around the board and passes through several stops. At each stop the participant has to choose between a more thrilling/adventurous and a more secure option (9 items, $\alpha = .68$).⁷

Attitudes, cognitions and social skills

Three risk factors associated with social cognitions and attitudes – *hostile attribution of intent*, *aggressive conflict resolution* and *lack of socially competent conflict resolution* – were derived from the social problem-solving assessment tool. This instrument, initially developed by Dodge and colleagues (e.g. Dodge and Coie, 1987), was further refined for the purpose of the present study. It consists of four potentially conflictive situation vignettes of children's everyday life (e.g. 'ALTER doesn't want to share a swing with EGO'), each supported by a drawing adapted for boys and girls. For each vignette, the child was asked for the possible intent of the other child (attribution of intent), how s/he would feel in a similar situation (self-attribution of feeling) and how s/he would try to solve this conflict (conflict resolution strategy). Attribution of intent and problem-solving were recorded as plain text and then coded independently by two raters.

Inter-rater reliability for the coding of *hostile attribution of intent* (e.g. Dodge, 1986) varied considerably across the four situations, with a Krippendorff's α (Hayes and Krippendorff, 2007) of .91, .73, .78 and .62, respectively. The scores of both raters were averaged, and a mean score of hostile attribution across the four vignettes was computed (Cronbach's $\alpha = .51$).

The first *conflict solution* elicited for each vignette was coded into six mutually exclusive categories (aggressive, socially competent, punishment by an authority/adult, intervention of an authority/adult, passive/inappropriate, and irrelevant/other). Inter-rater

reliability (Krippendorff's α for two raters) across these six categories was .75, .90, .90 and .92, respectively. The proposed solutions were dichotomized into aggressive vs. other answers, and socially competent vs. other answers for both ratings. Each pair of variables was then averaged across raters and an average score of these inter-rater scores was computed across the four situations, both for *aggressive* (Cronbach's $\alpha = .43$) and for *socially competent* answers (.55). Using another instrument, *violence-permissive behavioural norms* were assessed by a single item asking participants 'how bad' they would find it to hit or kick another child depicted as being nasty towards the respondent.

School-related individual factors

Low bonding to school was measured with a single item from both the child's and teacher's perspective. The child was asked how much s/he likes going to school, and the teacher was asked on a five-point Likert scale whether the child was more or less motivated for school compared with the average of children of the same age. The same scale was also used to assess children's mathematical and language performance. Both items were averaged to a *school achievement* score ($\alpha = .76$).

Indoor leisure activities

Four constructs indicate the type and extent of the child's self-reported media use at wave 3: *use of adult media contents* (i.e. contents restricted to adults above 18 years) comprises two dichotomous variables, one indicating watching adult movies and the other playing adult computer games ($\alpha = .45$). *TV exposure* and *computer game exposure* are measured with one item each.

An index of *creative and intellectually demanding leisure activities* based on four items (reading, playing an instrument, painting/crafting, music/drama/dance lessons) was derived from the child's routine and leisure activities scale used in the first parent interview ($\alpha = .36^8$).

Family structure

The *adult caregiver structure* distinguishes between households with both biological parents present and all other types of household. The *number of siblings* living in the household is a mere count variable between zero and six. Children of step-parents and half-siblings are counted as well.

Sociodemographic parent characteristics

Both caregivers' sociodemographic characteristics were assessed in the first interview wave. Occupational status information was updated at wave 3. *Caregivers' formal education* was assessed on a scale ranging from 'compulsory school not completed' to 'university degree'. The resulting scale is based on the highest degree attained by either of both caregivers. The *caregivers' socio-professional status* score is based on a post hoc ISCO (International Standard Classification of Occupations) coding of the caregivers' current

profession (Elias and Birch, 1994), which was transformed to ISEI (International Socio-Economic Index) scores (Ganzeboom et al., 1992). The final scale is based on the highest ISEI score across both caregivers and both measurements at waves 1 and 3. *Caregivers' unemployment* and *financial difficulties* were measured at wave 1 and coded 1 if a caregiver had experienced at least a trimester of unemployment or, alternatively, if the household had experienced a trimester of financial hardship since the child's birth, and 0 in all other cases (Eisner et al., 2009). *Migration background* was assessed on the basis of the caregivers' country of birth. If both caregivers (or the single caregiver in single-parent households) were born abroad, the variable was coded 1, otherwise 0. Based on this definition, 46 percent of the sample's households have a migration background.

Psychological parent characteristics

Caregiver depression and anxiety was assessed with the 12-item version of the General Health Questionnaire (GHQ-12, Goldberg, 1978; Goldberg and Hillier, 1979). *Caregiver self-control* was measured with an adapted 12-item version of the Grasmick et al. (1993) scale ($\alpha = .69$).

Despite not being a psychological factor per se, but nonetheless likely to be formative of different psychological facets related to parenting, the *caregiver's recollected experience of corporal punishment* (approximately at age 9) was assessed based on recollected maternal and paternal corporal punishment ($\alpha = .51$).

Sibling characteristics

Caregivers were asked to rate the level of *physical aggression of each of the target child's siblings* living in the same household on the basis of three SBQ items (see above) on the physical aggression subscale ($\alpha = .77$). Scoring was based on the highest aggression score across all (up to 6) siblings.

Inter-individual family relationships

Three types of relationships in the family are distinguished, namely the relationship between the target child and each of his/her siblings, the partnership among the primary caregivers and general family climate. The quality of the *relationship among siblings* was rated by the primary caregiver on the basis of four items per sibling (e.g. 'Play with each other, 'Have an argument with each other) ($\alpha = .61$). *Partner relationship* was assessed by means of the shortened Dyadic Adjustment Scale (DAS-7, Sharpley and Rogers, 1984). Only caregivers living with a partner at the time of the interview completed this instrument. *Family climate* is based on a three-item measure (e.g. 'We are a happy family and we like each other a lot') developed by Wikström et al. (2006), which yields a reliability of $\alpha = .55$.

Parenting and childcare

Three measures are used to assess parenting and childcare. The Parent Problem Checklist (Dadds and Powell, 1991) measures *parental inconsistency and discord in parenting*

matters (16 items; $\alpha = .90$). This measure was completed only by caregivers who lived with a partner.

Parenting style was measured at wave 2 with the Alabama Parenting Questionnaire (APQ; Shelton et al., 1996). This instrument covers five main domains of *parenting style*: *parental involvement* (10 items, $\alpha = .68$), *positive parenting* (5 items; $\alpha = .62$), *poor monitoring* (10 items; $\alpha = .66$), *inconsistent discipline* (6 items; $\alpha = .58$), *corporal punishment* (3 items; $\alpha = .54$).

Professional external childcare was measured within the frame of the first wave Event History Calendar (Eisner et al., 2009). The derived measure indicates the number of trimesters during which a child was in centre-based professional childcare (i.e. nursery, crèche or after-school club) for at least two days per week during preschool and kindergarten years.⁹

School

Three measures are related to extra-individual school factors. The first risk factor relates to the level of *observed bullying at school* (teasing, stealing, and destroying things, physical violence, rejection; see ‘antecedent behaviour’ in this section for more details) as reported by participating children at wave 2 ($\alpha = .68$).¹⁰ The *level of disorder* at school was assessed by teachers on the basis of the seven-item School Problems Checklist ($N = 123$ teachers, $\alpha = .89$; e.g. ‘purposeful destruction of school materials/vandalism’). The third factor is a measure of *class cohesion*, reported by teachers on a five-item scale ($N = 129$ teachers, $\alpha = .89$; e.g. ‘Pupils in this class help each other’). *Change of class* during the first three years of school was measured as an indicator of contextual instability. The variable indicates whether or not a child changed his/her class during this period, regardless of the reasons for the change (e.g. relocation, class repetition). As a final indicator related to the domain of school, the *teacher–child relationship* was measured with a single item on a four-point Likert scale from the child’s perspective in the third assessment wave (‘How well do you get along with your teacher?’).¹¹

Peer relationships

Peer relationships among classmates and friends, as well as the children’s positions and roles in the class network, were assessed from both the teachers’ and the children’s perspectives. Teachers were asked to rate the *role of each child in the class*. They had to assess to what extent the child was ‘popular’, ‘bullied’, ‘withdrawn’ and ‘dominating others’ on a five-point Likert scale. For this study the second wave measurement is used. Child-level measures encompass both sociometric instruments, in which each child rates each of his/her classmates, and conventional questionnaire-based instruments. The ‘Coach Game’ (e.g. Alsaker and Gutzwiller-Helfenfinger, 2010) is a sociometric instrument aimed at measuring *popularity and rejection in class*. Each child was asked to nominate up to six classmates to join him/her on a trip on a public-transport coach (positive nominations/popularity). Children were further asked to indicate the classmates with whom they would not want to go on a trip (negative nominations/rejection).¹² Both measures consist of the number of nominations weighted by the number of raters. The second

sociometric instrument was developed by Rotenberg et al. (2005) and measures participants' *trustworthiness* (see 'psychological factors' in this section for more details). Both sociometric measures were administered during wave 2.

Conventional measures comprise an index of four types of *bullying victimization* ($\alpha = .65$), as well as an assessment of *best friends' acts of violence* (see 'antecedent behaviour' in this section for more details). For each of their two best friends, participants were asked if they had seriously hit or kicked other children in the current year. These ratings were then added up.

Dichotomization and cumulative risk indicators

To facilitate comparisons with studies based on odds ratios and to compute cumulative risk indices, all risk factors were dichotomized on a split-half basis, except those with innate thresholds or those that were already dichotomous.¹³ The last column in Table 2 shows the corresponding at-risk percentages after dichotomization. Based on these dichotomized risk factors, an *overall cumulative risk index* was computed along with nine *domain-specific cumulative risk indices*. Whereas domain-specific indices are based on the full set of underlying variables, the overall cumulative risk index does not include gender and is further limited to those 47 variables that significantly correlate with aggression (see Table 3). Similarly, the *cumulative external risk index* comprises all 29 significant external risk factors, i.e. all non-individual factors plus perinatal factors.

Cumulative risk scores were computed only for those cases for which the second wave of teacher interviews as well as a complete set of parent and child interviews across the first three waves were available, i.e. from all data sources from which risk factors were derived. Since different measures were missing, partly randomly and partly systematically (e.g. the partner relationship was assessed only in two-parent households), cumulative risk factors were computed in such a way that up to a quarter of the underlying variables were allowed to be missing. For the overall measure, a maximum of 7 missing measures were tolerated. To prevent artificially lowering the scores of cases with missing values, a mean score across valid factor values was computed and then multiplied by the total number of factors included in the corresponding scale.

Analysis

Continuous outcomes were analysed on the basis of Pearson correlations; dichotomous outcomes were analysed with bivariate logistic regressions. Effect-size differences between boys and girls were calculated using Fisher's z transformation (Rosenthal, 1991: 63f.). Pearson correlations are reported without ' $r =$ ' in two-digit format (e.g. '.26'). Levels of significance are reported with asterisks ($***p < .001$; $**p < .01$; $*p < .05$; $ns p \geq .05$).

Results

Table 3 summarizes the results. Risk factors are organized by domains. For each factor, the correlation with the level of aggression at age 11 is reported for boys, girls and the

Table 3. Risk-factor associations with overall aggression (Pearson correlations and odds ratios)

Risk domain	Risk factor	Group									
		Boys		Girls		All					
		<i>r</i>		<i>r</i>		<i>r</i>					
<i>Individual</i>											
Biological makeup Antecedent behaviour	Male gender	—		—		.262	***	3.389	***	1184	
	Aggression	.507	***a	.388	***a	.495	***	4.608	***	1168	
	ADHD	.337	***	.253	***	.342	***	2.997	***	1168	
	Non-aggressive externalizing problem behaviour	.414	***b	.325	***b	.433	***	4.109	***	1168	
	Internalizing problems	.210	***b	.116	***b	.155	***	1.386	*	1168	
Perinatal circumstances	Low prosociality	.087	*	.130	**	.173	***	1.609	***	1168	
	Bullying actor	.264	***	.183	***	.275	***	1.768	***	1173	
	Postnatal maternal depression	.116	***b	.004	ns ^b	.072	*	1.408	ns	1076	
	Tobacco during pregnancy	.086	*	.061	ns	.081	**	1.422	ns	1076	
	Alcohol during pregnancy	.051	ns	.046	ns	.046	ns	1.213	ns	1076	
Personality	Low trustfulness	.154	**	.072	ns	.116	***	1.260	ns	910	
	Sensation-seeking	.125	**	.067	ns	.196	***	2.175	***	1169	
	Low self-control	.293	***	.205	***	.289	***	2.677	***	1171	
	Hostile attribution	.100	*	.057	ns	.105	***	1.362	*	1171	
	Aggressive conflict resolution	.172	***	.126	**	.198	***	1.941	***	1171	
Cognitions, attitudes and social skills	Lack of competent conflict resolution	.127	**	.044	ns	.153	***	1.488	**	1171	
	Violence-permissive behavioural norms	.212	***	.175	***	.222	***	1.714	***	1168	
	Low school commitment (child perspective)	.154	***b	.044	ns ^b	.147	***	1.507	**	1170	
	Low school motivation (teacher perspective)	.118	***b	.002	ns ^b	.089	**	1.924	**	1101	

(Continued)

Table 3. (Continued)

Risk domain	Risk factor	Group				All	Odds Ratio	All	N	
		Boys		Girls						
		r	ns	r	ns					
Indoor leisure activities	Low school achievement	.027	ns	-.016	ns	.008	ns	0.803	ns	1105
	Adult media content	.142	***	.089	*	.182	***	2.489	***	1168
	Extended TV exposure	.038	ns	.011	ns	.043	ns	1.274	ns	1147
	Extended computer game exposure	.100	*	.089	ns	.144	***	1.815	***	950
Lack of creative and intellectually demanding leisure activities		.133	**	.040	ns	.167	***	1.471	**	1087
Family and parenting Family structure	Broken home (lacking biological parent)	.149	***	.173	***	.147	***	2.070	***	1090
	Large family size	-.006	ns	.032	ns	.008	ns	0.946	ns	1093
Sociodemographic parent characteristics	Low formal education level	-.014	ns	.064	ns	.014	ns	1.231	ns	1082
	Low socioeconomic status	.005	ns	.017	ns	.001	ns	0.975	ns	1060
	Parental unemployment (EHC)	.036	ns	.024	ns	.017	ns	1.253	ns	1083
	Financial hardship (EHC)	.092	*	.080	ns	.087	**	1.674	**	1083
Psychological parent characteristics	Migrant background	-.026	ns	.048	ns	.018	ns	1.099	ns	1083
	Caregiver's depression	.147	***	.068	ns	.103	***	1.277	ns	1071
	Caregiver's low self-control	.159	***	.108	*	.139	***	1.379	*	1074
	Caregiver's experience of corporal punishment	.140	***	.066	ns	.117	***	1.195	ns	1061
Sibling behaviour Inter-individual family relationships	Aggressive siblings	.188	***	.263	***	.204	***	1.552	**	802
	Poor relationship to siblings	.284	***	.220	***	.271	***	2.261	***	803
	Poor partner relationship	.211	*** ^a	.078	ns ^a	.145	***	1.494	*	889
	Poor family climate	.198	***	.159	***	.178	***	1.717	***	1074

Table 3. (Continued)

Risk domain	Risk factor	Group			All	Odds Ratio	All	N
		Boys	Girls	All				
		r	r	r				
Parenting and childcare	Parental discord in parenting matters	.203 ***	.185 ***	.182 ***	1.377 *	ns	949	
	Lack of parental involvement	.124 **	.090 *	.114 ***	1.525 **	ns	1077	
	Lack of positive parenting	.059 ns	.046 ns	.040 ns	1.185 ns	ns	1077	
	Poor parental monitoring	.258 ***	.163 ***	.243 ***	1.640 ***	ns	1077	
	Erratic parenting	.169 ***	.166 ***	.178 ***	1.433 *	ns	1067	
	Corporal punishment	.138 **	.113 **	.139 ***	1.316 ns	ns	1076	
	Group-based external childcare (EHC)	.129 **	.061 ns	.111 ***	1.569 **	ns	1083	
Domain of school	Violent school environment	.147 ***	.094 *	.134 ***	1.768 ***	ns	1173	
	Schoolhouse (observed bullying)	.066 ns	.008 ns	.038 ns	1.079 ns	ns	1105	
Class	School disorder	.141 *** ^b	.044 ns ^b	.120 ***	1.366 *	ns	1152	
	Low class cohesion	.140 *** ^a	.001 ns ^a	.087 **	1.376 *	ns	1183	
	Change of class	.244 *** ^a	.071 ns ^a	.195 ***	2.026 ***	ns	1169	
Teacher-child relationship								
Peer relationships	Poor teacher-child relationship							
	Popularity/trust	.016 ns	.029 ns	.006 ns	0.861 ns	ns	1126	
Bullying/rejection	Low popularity among classmates (sociometric measure)	.170 ***	.088 *	.144 ***	1.703 ***	ns	1160	
	Low popularity among classmates (teacher report)	.276 ***	.192 ***	.276 ***	2.980 ***	ns	910	
	Low trustworthiness	.172 ***	.127 **	.172 ***	1.928 ***	ns	1126	
	Rejection by classmates (sociometric measure)							
	Victim of bullying (child report)	.187 ***	.138 ***	.184 ***	1.912 ***	ns	1173	

(Continued)

Table 3. (Continued)

Risk domain	Risk factor	Group				All	Odds Ratio	All	N	
		Boys		Girls						
		r		r						
Peer domination	Victim of bullying (teacher report)	.115	**	.108	*	.109	***	1.488	**	1160
	Withdrawal (teacher report)	.093	*	.087	*	.093	**	1.333	ns	1160
	Peer domination (teacher report)	.247	***	.194	***	.199	***	2.019	***	1160
Antisocial/violent peers Cumulative risk factors	Violent best friends	.162	***	.137	**	.213	***	2.125	***	1136
	Antecedent behaviour (6 factors)	.418	***	.345	***	.423	***	3.906	***	1050
	Perinatal factors (3)	.107	*	.047	ns	.089	**	1.363	*	1057
Internal individual factors (7)	Internal individual factors (7)	.286	***	.202	***	.309	***	2.738	***	1045
	Indoor leisure activities (4)	.136	**	.089	*	.193	***	1.874	***	1059
	Sociodemographic parent characteristics (5)	.025	ns	.031	ns	.019	ns	1.268	ns	1037
Family structure, members and relationships (9)	Family structure, members and relationships (9)	.324	*** ^b	.221	*** ^b	.273	***	1.963	***	1077
	Parenting and childcare (7)	.249	***	.191	***	.230	***	1.643	***	1043
	School (5)	.256	*** ^a	.111	* ^a	.206	***	1.899	***	1052
Peer status (8)	Peer status (8)	.268	***	.239	***	.271	***	2.316	***	1010
	Cumulative external risk (29)	.464	*** ^b	.364	*** ^b	.435	***	3.452	***	1036
	Overall cumulative risk (47)	.523	*** ^a	.419	*** ^a	.516	***	4.551	***	1034

Note: EHC: event-history calendar.

^a Correlation for boys and for girls differs significantly (95% confidence interval).

^b Correlation for boys and girls differs near-significantly (90% confidence interval).

*** $p < .001$; ** $p < .01$; * $p < .05$; ns $p \geq .05$

entire sample, followed by the odds ratio of the dichotomized risk factor. The last column reports the number of cases on which the analysis is based.

Individual risk factors

As shown by numerous other studies (Archer, 2004), *male gender* is a highly significant risk factor for aggression, with a correlation of .26*** and an odds ratio of 3.4***. Further, all types of *antecedent social behaviour* at age 7 are significantly correlated with aggression in pre-adolescence. The strongest correlation (.50***) is observed with earlier aggression, followed by non-aggressive forms of externalizing behaviour (NAEX; .43***), ADHD (.34***) and bullying (.28***). The correlations with low prosociality (.17***) and internalizing problems (.16***) are noticeably lower. Odds ratios reflect the same order of association, with values ranging from 1.4* for internalizing problems to 4.6*** for aggression.

Correlations with antecedent behaviour are generally stronger among boys than among girls. However, this difference in effect size reaches significance only in relation to earlier aggression, and near-significance as regards NAEX and internalizing problems.

Perinatal risks such as substance use during pregnancy and postnatal depression are only weakly associated ($r < .10$) with aggression. Alcohol use during pregnancy is not significantly correlated with aggression, and postnatal depression is a gender-specific risk factor that is significantly associated with aggression only among boys.

The *personality factor* of low trustfulness is only weakly correlated with pre-adolescent aggression (.12***). In contrast, sensation-seeking (.20***) and low self-control (.29***) have substantially higher effect sizes. Correspondingly, children with below-average self-control and above-average levels of sensation-seeking are more than twice as likely as other children to be at risk of aggression (OR = 2.7*** and 2.2***). However, sensation-seeking seems to mediate a gender effect, since the gender-specific correlations for this factor are noticeably lower than for the entire sample. Moreover, gender-specific results show that all personality factors are predictive among boys, whereas only self-control is significantly associated with aggression among girls. Overall, self-control is the strongest non-behavioural individual risk factor in both genders.

Predictors associated with *cognitions, attitudes, and social skills* correlate in a similar range as personality factors. Hostile attribution has the lowest effect size (.11***), while aggressive conflict resolution strategies (.20***) and violence-permissive behavioural norms (.22***) have the strongest correlations. Lack of competent conflict resolution (.15***) takes an intermediate position. Whereas all these factors are significantly correlated with aggression among boys, this is not the case for hostile attribution and lack of competent conflict resolution among girls.

With regard to *individual school-related factors*, child-reported low school commitment (.15***) and teacher-reported low motivation for school (.09**) are both significantly correlated with aggression. Gender-specific analysis shows that both these factors are risk factors only for boys (.15***, .12**), but not for girls (.04^{ns}, .00^{ns}). Low school achievement is not correlated with aggression in either gender.

With regard to *media use*, time spent watching TV is not associated with aggression (.04^{ns}), but children who use *adult media content* are 2.5 times more at risk of aggression

than other children (.18***). In contrast to TV exposure time, time spent playing computer games is a significant risk factor (.14***). Lack of creative and intellectually demanding *leisure activities* also has a significant effect size (.17***).

Compared with the entire sample, the correlations of all indoor leisure indicators are systematically smaller within both gender groups, and fail to achieve significance for three indicators among girls. This general pattern suggests that these variables mediate gender effects.

Family and parenting

Among the indicators of *family structure*, only the lack of a biological parent is correlated with aggression (.15***); family size is not (.01^{ns}). All measures of *sociodemographic parent characteristics* – formal education, socioeconomic status (SES), unemployment, migrant background – are systematically uncorrelated with aggression. Only the more relative measure of spells of financial hardship presents a slight correlation (.09**) with pre-adolescent aggression.

Psychological parent characteristics are significantly correlated with aggression in a narrow range between .10*** for caregiver's depression and .14*** for caregiver's self-control. Caregiver's experience of corporal punishment takes an intermediate position (.12***). However, the corresponding odds ratios fail to achieve significance for both caregiver's depression (1.23^{ns}) and experience of corporal punishment (1.20^{ns}). Moreover, gender-specific correlations differ markedly, with values between .14*** and .16*** among boys and .07^{ns} and .11* among girls, suggesting that psychological caregiver characteristics are more closely related to aggression among boys than among girls.

With an overall correlation of .20***, *siblings' aggression* is one of the strongest external risk factors. It even turns out to be the strongest non-behavioural risk factor among girls (.26***).

All analysed risk factors related to *inter-individual family relationships* correlate highly with aggression. The strongest risk factor in this domain is a poor relationship among siblings (.27***), which also is the strongest external risk factor among boys (.28***). Family climate is a noticeably weaker risk factor (.18***), and the quality of the relationship between parents is the weakest relational family factor (.15***). This factor achieves significance only among boys (.21***), the gender-specific correlations differing significantly from each other.

All risk factors related to *parenting and childcare* are significantly correlated with aggression, except positive parenting (.04^{ns}). The strongest factor is lack of parental monitoring (.24***), followed by indicators of inconsistent parenting (erratic parenting, .18***; discord in parenting matters, .18***). Corporal punishment is also significantly correlated with aggression (.14***), but the corresponding odds ratio (1.32^{ns}) fails to achieve significance. Conversely, lacking parental involvement is less strongly correlated with aggression (.11***) but has a comparatively high odds ratio (1.53**). Group-based external childcare is also weakly but still significantly associated with aggression ($r = .11$ ***; OR = 1.57**).

Generally, boys' aggression is more affected than girls' aggression by parenting factors. However, these differences are comparatively low, with two noticeable exceptions. First, the correlation for parental monitoring is much (yet non-significantly) stronger

among boys (.26***) than among girls (.16***). Second, group-based external childcare is significantly correlated with aggression among boys (.13**) but not among girls (.06^{ns}).

School

All risk factors related to school significantly correlate with aggression except school disorder (.04^{ns}). The strongest correlation is observed for the teacher–child relationship (.20***), while the level of observed bullying at school (.13***), low class cohesion (.12***) and change of class (.09**) are less correlated. Similarly as for the *individual* school factors, boys' aggression is systematically more correlated with external school factors (.15***, .14***, .14***, .24***) than is girls' aggression (.09*, .04^{ns}, .00^{ns}, .07^{ns}), most of these differences being (near-)significant.

Peer relationships

Whereas the sociometric measure of *low popularity* among classmates is not associated with aggression ($r = .01^{\text{ns}}$), teacher-reported low popularity is (.14***). Explicit *rejection* by classmates (i.e. negative nominations) is also correlated with aggression (.17***). However, the strongest risk factor in this domain is a low level of *trustworthiness*. With a correlation of .28***, this factor presents the highest overall correlation among all external, non-individual risk factors analysed in this study. Untrustworthy individuals are three times more at risk of aggression (OR = 2.98***).

Bullying victimization is also a risk factor for later aggression according to both child (.18***) and teacher reports (.11***). Moreover, *withdrawal* is slightly correlated with aggression (.09**) but the associated odds ratio does not reach significance (1.33^{ns}).

With a correlation of .20*** and an odds ratio of 2.02***, *peer domination* at age 8 is a comparatively strong risk factor for aggression. This factor, along with teacher-reported low popularity, low trustworthiness and child-reported bullying victimization, is more strongly associated with aggression among boys than among girls.

Finally, violent best friends are also a risk factor for pre-adolescent aggression (.21***). Children with violent best friends at age 9 are twice as likely to be aggressive in pre-adolescence as other children (OR = 2.13***). However, this risk factor too seems to mediate a gender effect since correlations within both gender groups are weaker than in the overall sample.

Cumulative risk

Cumulative risk indicates to what extent *variety* of risk exposure in a given domain accounts for variation in aggression. Among domain-specific cumulative risk factors, *antecedent behaviour* is most strongly correlated with aggression (.42***). However, the single measure of antecedent aggression is even more correlated than the combined measure of antecedent behaviour, indicating that the composite measure does not add additional explanatory power compared with one of its components. Internal individual factors are the second-strongest set of risk factors (.31***), followed by family-related indicators (.27***), peer status (.27***), parenting characteristics (.23***), school

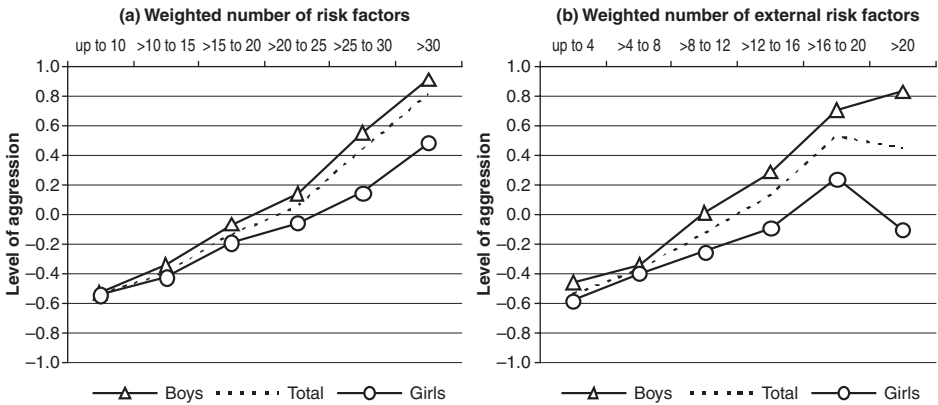


Figure 1. Level of aggression by number of risk factors: (a) by overall risk, (b) by external risk

factors (.21***), and indoor leisure activities (.19***). Cumulative perinatal risk is only marginally correlated with aggression (.09**), while cumulative sociodemographic risk is not correlated with aggression at all (.02^{ns}).

Cumulative risk factors are consistently more associated with aggression among boys than among girls. By and large, correlations in the total sample are similar to those found among boys. One exception concerns the *indoor leisure activities cumulative index*, which shows noticeably higher correlations in the total sample compared with each gender, suggesting that it mediates gender effects.

Both *overall cumulative risk* ($r = .52^{***}$; OR = 4.55***) and the overall *external risk* ($r = .44^{***}$; OR = 3.45***) are strongly correlated with aggression, with effect sizes among boys (.52***, .46***) once more being stronger than among girls (.42***, .36***). Figure 1 provides a more detailed picture of the association between cumulative risk, gender and aggression.

Figure 1(a) shows that the relationship between the number of risk factors and the level of aggression is steeper among boys than among girls. At the lower end of the cumulative risk index there are no gender differences in levels of aggression, but these differences increase as a function of risk exposure, thus suggesting that girls are more resilient to high-risk exposure than boys. Figure 1(b) shows that this general finding also applies to cumulative external risk. It thus seems that gender differences in aggression are not caused by innate gender-specific propensities toward aggressive behaviour. Rather, they are likely to be a consequence of the higher risk vulnerability of boys compared with girls. As a result, boys who are not or are only weakly exposed to risk are not more likely to act aggressively than girls. Gender differences appear, and increase, only with rising risk exposure. Boys' higher risk vulnerability is also reflected by boys' generally higher effect sizes among single risk factors.¹⁴

Moreover, Figure 1(b) shows that the level of aggression among girls decreases in the group with the highest external risk exposure. This somewhat surprising pattern is not very robust since it is based on only 11 cases. However, this might reflect the development of risk resilience when exposed to an extremely adverse environment.

Summary and discussion

A detailed discussion of the findings and of possible underlying causal processes would be beyond the scope of this article. Instead, selected results of each risk domain are related to recent research. Particular attention is given to findings from meta-analyses and from comparable longitudinal studies.

Antecedent behaviour

For the analysed period of approximately four years, our analyses confirm the well-established finding of a relative stability of aggression over time (e.g. Eron and Huesman, 1990; Moffitt et al., 2001; Olweus, 1979; Stanger et al., 1997; Tremblay and LeMarquand, 2001), antecedent aggression being the strongest predictor of later aggression identified in this study. Other forms of antecedent externalizing problem behaviour and, to a lesser extent, antecedent internalizing problems and low prosociality are also predictive of later aggression. These findings corroborate the large body of evidence on the versatility of offending and problem behaviour, or, alternatively, on findings on the co-occurrence of different types of problem behaviour and mental health problems in aggressive and more generally antisocial subjects over the life course (e.g. Hinshaw et al., 1993; Huizinga and Jakob-Chien, 1998; Tremblay et al., 1996).

Perinatal risk factors

Our results confirm earlier findings on the association between maternal smoking during pregnancy and later aggression (for reviews, see Huizink and Mulder, 2006; Knopik, 2009; Wakschlag et al., 2002). However, the causal nature of the relationship is still controversial and most recent results suggest that maternal smoking is not a causal factor for aggression but rather a marker for a series of other causal factors of aggression (Roza et al., 2009). Regarding the correlation between (mostly moderate) alcohol use during pregnancy and later aggression, our findings do not even confirm a raw, statistically uncontrolled correlation. Whereas a causal relationship between heavy maternal drinking and neurobehavioural, as well as many other outcomes, from birth to adolescence has been repeatedly found (e.g. Jacobson and Jacobson, 2002; Streissguth et al., 2004), evidence regarding the effects of *moderate* alcohol use is more ambiguous and the causal nature of the relationship remains controversial (e.g. D'Onofrio et al., 2007; Gray et al., 2009; Huizink and Mulder, 2006). Regarding postnatal maternal depression, our results confirm earlier findings of a moderate correlation with emotional and behavioural outcomes in childhood (Beck, 1998). Sinclair and Murray's (1998) finding of a gender-specific effect could also be replicated, postnatal depression being associated with later aggression only in males.

Psychological factors

Three psychological factors associated with aggression were analysed in this article. Low self-control was highly predictive in this relatively young sample and was the

strongest non-behavioural risk factor. This result is in line with the general finding that self-control is a strong predictor of a wide range of criminal and 'analogous' (Gottfredson and Hirschi, 1990: 42f.) behaviours (for an overview, see Pratt and Cullen, 2000). Recent results of a similar longitudinal study further confirmed the correlation between low self-control and offending in an adolescent sample (Wikström and Butterworth, 2006: 102ff). Sensation-seeking, a concept closely related to low self-control in general and to risk-seeking in particular, also had a significant effect size. However, the association was less pronounced than for low self-control and the construct appeared to substantially mediate a gender effect.

Low trustfulness, a psychological construct that, to our knowledge, has not yet been included in comparable large-scale studies, was also significantly correlated with later aggression, particularly among boys. Interestingly, this relationship was identified early in the tradition of Social Information Processing (Dodge, 1980) but then forgotten. Considering recent advances in the field of neurocognitive research on the 'trust hormone' oxytocin and its relationship to hostility and aggressive behaviour (e.g. Kirsch et al., 2005; Siever, 2008; Zak and Fakhar, 2006), reconsidering the role of trust in the development of aggression seems a promising and innovative direction for future research.

Attitudes, cognitions and social skills

Four measures derived from Crick and Dodge's Social Information Processing (SIP) Model (Crick and Dodge, 1994; Dodge, 1986) were analysed in the present study. Hostile attribution of intent was found to be weakly associated with later aggression (.11). This result is somewhat below the average correlation between hostile attribution and general aggression found in a broad meta-analysis (.19; De Castro et al., 2002). However, this meta-analysis also reports lower mean correlations for studies with open answer formats (.14) and studies including both genders (.14), as is presently the case.

Both measures related to readily accessible behavioural responses were more strongly correlated with aggression than hostile attribution, this finding being in line with a recent German study among adolescents (Lösel et al., 2007). Among these measures, aggression was more strongly linked to the accessibility of aggressive responses than to the inaccessibility of socially competent responses. This suggests that aggressive behaviour is due more to the salience of aggressive schemata in aggressive children than to the unavailability of competent conflict resolution schemata (see also Bliesener and Lösel, 2001; Rubin et al., 1991). However, the SIP factor most associated with aggression is related to behavioural norms that can be conceived as an element of the database that informs SIP (Crick and Dodge, 1994). More precisely, violence-permissive behavioural norms turned out to be particularly strong predictors of later aggression, among both boys and girls. This finding emphasizes the importance of moral rules in the development of aggressive and antisocial behaviour (e.g. Antonaccio and Tittle, 2008; Wikström and Butterworth, 2006).

Sociodemographic parent characteristics

The empirical status of the relationship between parents' socioeconomic status and aggression and delinquency has always been a point of controversy in criminology (for a recent

overview, see Wikström and Butterworth, 2006: 58ff). Depending on the measures used for both the criterion and the predictor variable, extant research shows widely differing correlations between these sets of constructs. For example, Hawkins et al. (1998) report odds ratios varying between 1.2 and 3.8 and correlations between $-.08$ and $.19$ with regard to violence, whereas recent results from the Peterborough study (Wikström and Butterworth, 2006) do not show significant associations between social class and assault as well as most other forms of delinquency. Similarly to this latter finding, in the present study three of the four socioeconomic indicators (formal education, SES, unemployment) did not significantly correlate with aggression. Only the number of spells of financial hardship was identified as a significant risk factor, this result suggesting that only economic strain perceived as such – likely as a parental stressor – is related to aggression,¹⁵ whereas the parents' position in the societal macro-system is not. Our results also failed to corroborate an association between the parents' migration status¹⁶ and aggression, a finding in line with Wikström and Butterworth (2006: 71ff). However, this finding contradicts both general research on crime and immigration (e.g. Tonry, 1997) and results from recent large-scale self-report studies among adolescents in Switzerland (Ribeaud and Eisner, 2009).¹⁷

Individual parent and sibling characteristics

In line with Gottfredson and Hirschi's (1990) general theory of crime, which assumes that parents with low self-control develop inappropriate parenting styles and thus impede the development of self-control in children (Gottfredson and Hirschi, 1990: 97ff), parental self-control was identified as a substantial risk factor for pre-adolescent aggression. Maternal depression, which is also conceived as a source of inappropriate child-rearing (e.g. Cummings and Davies, 1994), was also associated with child aggression, particularly among boys.

The correlation between the mother's experiences of physical punishment and her child's pre-adolescent aggression suggests an inter-generational transmission of aggression that can basically be explained either genetically or on the basis of social learning theory (Bandura, 1973). Similarly, the considerable correlation between sibling aggression and target-child aggression might be attributable to both these causes.

Inter-individual family relationships

The quality of inter-individual family relationships was consistently correlated with aggression, the strongest correlation being observed for the relationship among siblings, followed by general family climate and the quality of the relationship between the parents. However, the strong effect of the sibling relationship needs to be put into perspective, since the corresponding scale includes items on aggression and disputes among siblings. Accordingly, the correlation found might partially reflect the target child's aggressiveness across different settings.

Parenting and childcare

All dimensions of parenting at age 8 were significantly associated with pre-adolescent aggression, except positive parenting. The effect sizes found in this study precisely

corroborate those found in a recent large-scale meta-analysis on the association between parenting and delinquency (Hoeve et al., 2009). Moreover, our results showed a significant correlation between group-based external childcare and later aggression, this finding being in line with extant research (Belsky et al., 2007).¹⁸

Peer relationships

In line with previous research (e.g. Keenan et al., 1995; Warr, 2002), a substantial correlation between violent peers and later aggression could be found. In addition, the link between victimization and offending and aggression identified in a wide range of populations (e.g. Baron, 1997; Camodeca et al., 2002; Mayhew and Elliott, 1990) was also found in our sample. Moreover, the correlations between sociometric status and aggression corroborate the general findings of Newcomb et al.'s (1993) meta-analysis on children's sociometric status and various behavioural, emotional and cognitive outcomes. Similarly to our results, this study showed that aggression was more strongly correlated with rejection than with lacking popularity.

One of our most intriguing findings is the strong correlation between trustworthiness and aggression. To our knowledge, extant research has not yet yielded comparable results, and the question of possible causal linkages needs further examination. Additional multiple regression analyses indicate that, even controlling for aggression at the time of the trust measurement, this effect remains highly significant, suggesting that trustworthiness might have a truly causal effect on later aggression. This finding is partly supported by recent experimental neuro-economic research that shows that experiences of distrust tend to increase levels of aggression in males (Zak et al., 2005). From another perspective, two recent studies (Betts and Rotenberg, 2007; Rotenberg et al., 2008) suggest that trustworthiness is substantially predicted by self-control and might thus be a social mediator of its effects on later aggression and delinquency.

Cumulative risk and cross-domain differences

Domain-specific measures of cumulative risk were used to evaluate the impact of variety of risk exposure and to assess the relative importance of each risk domain. The broader picture that emerges from these analyses is that proximal individual risk factors related to antecedent behaviour and to psychological characteristics, as well as social skills, are the strongest correlates of aggression ($.3 < r < .5$). External factors related to the micro- and meso-systems of family, peers and school take an intermediate position ($.2 < r < .3$), and distal factors related to perinatal risks and to the societal macro-system (i.e. sociodemographic factors) are only marginally related to aggression ($r < .1$).

Similarly to Loeber and colleagues' studies on cumulative risk (Loeber et al., 1998; Stouthamer-Loeber et al., 2002), our results show a strong relationship between risk exposure across all domains and pre-adolescent aggression. With roughly 27 percent of explained variance in aggression, the predictive power of our cumulative risk measure is somewhat superior to the range of 16–25 percent described by Lösel and Bender (2006) as the upper threshold in the early prediction of antisocial behaviour. However, even this exceptionally broad measure of risk exposure was not substantially more correlated with

aggression at age 11 than aggression at age 7. This result suggests that a proper multi-informant assessment of early aggression is a simple and highly reliable indicator of later aggression and thus also questions the value of more complex instruments such as the EARL-20B (Augimeri et al., 2001) for mere screening purposes.

Gender differences

As known from a large body of research (e.g. Archer, 2004), gender is a strong predictor of aggression. In their comprehensive attempt to explain the nature of gender differences in aggression and antisocial behaviour, Moffitt et al. conclude that these differences are rooted in a higher *exposure* of boys to risk factors (2001: 109ff) but not in higher *vulnerability* of boys (2001: 90ff), higher vulnerability being indicated by higher correlations between risk factors and a given outcome. These results clearly contrast with our findings. Although we also found a higher risk exposure of boys, our results further suggest higher risk vulnerability among boys with regard to both cumulative risk and many single risk factors. At the lowest levels of the overall and of the external cumulative risk measures, boys' levels of aggression did not differ from those of girls, but gender differences grew with increasing risk exposure (Figure 1). This pattern precisely reflects the vulnerability hypothesis, whereas it would have been refuted in the event of overlying or parallel gender curves of aggression. A (near-)significant higher vulnerability of boys was also found for the family and the school cumulative risk indices (Table 3). Moreover, most single risk factors were more strongly correlated with aggression among boys than among girls, and these differences reached (near-) significance in 10 out of 47 significant risk factors. In particular, boys were found to be consistently over-vulnerable with regard to all school factors. In contrast, girls were not found to be significantly more vulnerable to any single risk factor. The causes of the obvious inconsistency between the Dunedin and the present study need closer scrutiny in future research.

Conclusions

Results from the *z-proso* study on risk factors for pre-adolescent aggression broadly confirm findings from comparable longitudinal studies and related meta-analyses. In particular, we did not find substantial differences from similar studies from North America and other anglophone countries. The most striking difference relates to the almost nonexistent effects of sociodemographic variables in our study. However, we also found that these null effects likely reflect methodological artefacts. The second deviant finding relates to gender-specific effects of risk factors. Our results corroborate the hypothesis of a higher risk vulnerability of boys compared with girls.

Overall, our results confirm Lösel and Bender's observation (2006) that correlations between early risk factors and later aggression typically range between .1 and .2, except for antecedent externalizing behaviour, which is noticeably more strongly associated with aggression. They further confirmed that the maximally predictable share of variance in aggression by risk factors cannot be expected to exceed 20–25 percent. However, Lipsey and Derzon (1998: 98ff) have shown that this share is in no way trivial or

negligible. It allows correct prediction of a high percentage of cases and is thus helpful in finding avenues for early interventions.

The present study allowed comparisons across many different risk factors and domains within the same sample. These comparisons showed that proximal behavioural and psychological risk factors are stronger predictors of aggression than more distal external factors related to surrounding formative systems, such as the family, school or peers. Another, more implicit advantage of such large overviews is their tolerance of null results. Whereas risk-factor-specific publications are likely to be subject to the 'file drawer problem' (Rosenthal, 1979), general overviews will more likely report non-significant or other unexpected results. Accordingly, they help to provide meta-analyses – and consequently the whole field of developmental risk-factor research – with less biased estimates.

As to future research, efforts toward systematic reports of *causal* risk factors – in contrast to mere risk factors, as is the case here – are highly desirable. As suggested by Murray et al. (2009: 12ff), the identification of causal risk factors would imply controlling for confounds measured *prior to the risk factor*. Since in many instances the direction of the causal relationship between a risk factor and aggression or antisocial behaviour is unclear and/or thought to be mutually reinforcing (e.g. Thornberry et al., 1991), a straightforward control variable to be systematically included in reviews of time-varying, malleable risk factors would be antecedent measurements of the outcome variable before or together with the assessment of the risk factor. Accordingly, such models would assess the association between risk factors and *changes* in the outcome variable.

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Notes

1. Parents could also consent to only their child's and their teacher's participation without participating themselves. This measure allowed the inclusion of 140 additional participants.
2. This renewal is the main reason for the significant drop in participation between waves 3 and 4.
3. With regard to the key outcomes of problem behaviour, preliminary analyses suggest that children reported higher rates with the paper-and-pencil method. However, comparisons with other informants and earlier measurements show that the shift was similar across participants. Correspondingly, the correlational analyses presented here remain widely unaffected by the method change.
4. In 98 additional cases scores were missing from one informant. These missing scores were imputed using the expectation maximization method (SPSS Inc., 2009).
5. Given the sociometric design, trust beliefs were measured only in classes with at least five participating children.
6. For a precise description of the scoring based on round-robin social relations analyses, see Betts and Rotenberg (2008).

7. For example, the child is asked whether s/he wants to start the trip with a fast motorbike (thrilling option) or with a funny locomotive (secure option).
8. The low reliability may be explained by the mutual exclusion of such activities (for example, a child who intensively practises an instrument and goes to music lessons cannot, at the same time, read or paint a lot).
9. Only group-based professional childcare arrangements were included in this measure because recent research suggests that only this type of care is associated with an increase in externalizing problems (Belsky et al., 2007; Eisner et al., 2009).
10. Given that this measure is assessed on the individual child level, it is likely influenced by each child's perception and thus needs to be conceived as an individually biased contextual measure. More accurate analyses on that issue would require hierarchical modelling.
11. This factor is also likely influenced by the child's perception. However, analyses with the corresponding measure from the teacher's perspective yield very similar results.
12. In order to obtain stable measures, scores were computed only for classes with at least 10 pupils of whom at least 5 had to be study participants.
13. Dichotomization has the advantage of generating robust, less distribution-sensitive measures than correlations. Using both continuous and dichotomous indicators facilitates appreciation of the consistency of effects independently of methodological artefacts (for a rationale on dichotomization, see Farrington, 1998).
14. Note that the generally higher level of aggression among boys is not only due to boys' higher risk vulnerability but also a consequence of boys' higher risk exposure. In the present study, girls were exposed to $M = 11.0$ external risk factors and to a total of $M = 17.8$ risk factors; these figures rise to $M = 12.1$ and $M = 21.3$ among boys ($p < .001$ for both gender comparisons).
15. Considering that periods of economic hardship are likely perceived as such when negative changes in the economic situation occur, this finding is in line with results from the Montreal Longitudinal and Experimental Study, which indicate that 'extreme delinquency' at age 16 is substantially associated with transitory poverty but not with continuous poverty (Tremblay et al., 2003: 218).
16. Migration status is strongly negatively correlated both with parents' education ($-.29^{***}$) and with parents' SES/ISEI ($-.45^{***}$).
17. Given the incongruence of our results with those of general research on violence and both SES and immigration, data were scrutinized for possible artefacts by analysing the correlation between these variables and indicators of aggression for each informant type separately. Regarding parents' education, SES and migration status, teacher reports of aggression were significantly correlated in the expected way ($-.11^{***}$, $-.08^{**}$ and $+.14^{***}$ respectively), whereas parents' reports were correlated in the opposite direction ($+.06^*$, $+.04^{ns}$ and $+.14^{***}$). Child reports were consistently uncorrelated with all three sociodemographic indicators. The comparatively high correlation between a measure of socially desired answers and sociodemographic variables in the parent interview data indicates that answers of low-SES and immigrant parents are likely biased with regard to sensitive domains such as aggression and delinquency. Thus, it seems likely that the correlation between sociodemographic variables and aggression is underestimated when relying on parent reports or on composite measures that include parent ratings. However, even when relying on teacher reports, results suggest comparatively weak correlations between sociodemographic variables and aggression.
18. More detailed analyses based on the present data set can be found in Eisner et al. (2009) and Averdijk et al. (2009).

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