

Elementary school children's associations of antisocial behaviour with risk-taking across 7–11 years

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Background: The impact of childhood antisocial behaviour on future maladaptation has been acknowledged. Risk-taking has been associated with antisocial behaviour in adolescents and adults, but its association with childhood antisocial behaviour is understudied. In this study, we explored the association of children's risk-taking with antisocial behaviour in mainstream elementary schoolchildren studied longitudinally across 7–11 years. **Methods:** One thousand and eighty-six children (51% boys) were assessed in three annual waves. Antisocial behaviours (aggressive, covert antisocial and oppositional defiant behaviour) were assessed using teacher- and peer-reports. Risk-taking was measured using the Balloon Analogue Risk Task (BART). The association of antisocial behaviour with risk-taking was analysed using parallel growth models. **Results:** Children with higher levels of risk-taking at age 7 showed increased growth in peer-reported aggression from age 7 to 11. Risk-taking, that is increased levels at age 7 in boys and increased growth in girls, predicted increased growth in peer-reported oppositional defiant behaviour. Associations of risk-taking with teacher-reported aggression and covert antisocial behaviour were at trend level. **Conclusions:** Results indicated that already in childhood, among typically developing children, risk-taking is associated with the development of antisocial behaviour. Future research focused on antisocial behaviour, but also school mental health workers and clinicians should take into account that already in childhood, risk-taking might affect antisocial behaviour development. **Keywords:** Aggression; oppositional defiant behaviour; covert antisocial behaviour; risk-taking; children.

Introduction

Children who engage in antisocial behaviour are at risk for various adverse developmental outcomes, including school drop-out, criminal behaviour, psychopathology and substance dependence (Fergusson, Boden, & Horwood, 2009; Kim-Cohen et al., 2003). In this study, we will use the broad term 'antisocial behaviour' referring to aggressive, covert antisocial and oppositional defiant behaviour (Frick et al., 1993). Although the negative consequences of childhood antisocial behaviour are known, knowledge about factors that are associated with the development of childhood antisocial behaviour is still a topic of investigation (Hinshaw, 2002). In adolescents and adults, one factor that has been linked with both covert and overt forms of antisocial behaviour is risk-taking behaviour (Aklin, Lejuez, Zvolensky, Kahler, & Gwadz, 2005; Crowley, Raymond, Mikulich-Gilbertson, Thompson, & Lejuez, 2006; Fairchild et al., 2009; Leather, 2009). However, in childhood, studies into risk-taking behaviour are scarce. The objective of this study was to explore the association of risk-taking behaviour development with antisocial behaviour in a sample of elementary schoolchildren, followed across ages 7–11.

Childhood antisocial behaviours are thought to stem from – among others – deficits in impulse

control and self-regulation, and thwarted punishment and reward sensitivity (DeWall, Baumeister, Stillman, & Gailliot, 2007; Moffitt & Caspi, 2001; Nigg, Quamma, Greenberg, & Kusche, 1999; Vervoort et al., 2015). Interestingly, factors that are thought to underlie risk-taking are shared with antisocial behaviour. Risk-taking behaviour is defined as voluntary behaviour that involves a certain chance on negative outcomes, such as danger, harm or loss of resources, but also provides the opportunity to obtain a reward (Aklin et al., 2005; Leigh, 1999). According to theoretical and empirical work, risk-taking follows from the interplay between youth's socioemotional tendencies (i.e. reward-seeking, sensation-seeking, sensitivity to punishment and reward) and youth's cognitive control (i.e. impulse control, self-regulation) (Braams, van Duijvenvoorde, Peper, & Crone, 2015; Steinberg, 2004, 2010). Risk-taking behaviour is mainly studied in adolescence (Galvan, Hare, Voss, Glover, & Casey, 2007; Meyer, 2003), a period in which risk-taking is known to peak and where it has been linked to negative outcomes such as aggression, rule-breaking behaviour and delinquency (Crowley et al., 2006; Fairchild et al., 2009; Leather, 2009). Only few studies focused on childhood risk-taking. Despite their importance, our ability to draw conclusions based on these studies is still limited. Some studies used items such as 'takes part in gang fights' or 'stealing something', to operationalize risk-taking (Campbell, Spieker, Burchinal, & Poe, 2006; Fanti & Henrich, 2010), which overlaps with antisocial behaviours.

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This might have resulted in spurious, inflated associations between risk-taking and antisocial behaviour. Other studies, using observations of physical risk-taking at the school playground (Morrongiello & Lasenby-Lessard, 2007; Morrongiello, Ondejko, & Littlejohn, 2004; Morrongiello & Rennie, 1998), did not study its association with antisocial behaviours. Other researchers used a computerized task, such as the Balloon Analogue Risk Task (BART; Lejuez et al. (2002)), to measure risk-taking (Humphreys & Lee, 2011; MacPherson, Magidson, Reynolds, Kahler, & Lejuez, 2010). MacPherson et al. (2010) showed that among typically developing children followed across 9–13 years, earlier initiation of alcohol use was linked to increased risk-taking scores. In a cross-sectional study among mostly boys, Humphreys and Lee (2011) found that BART risk-taking scores were elevated among children with diagnoses of Oppositional Defiant Disorder (ODD) alone or combined with Attention Deficit Hyperactivity Disorder (ADHD), compared to normal controls.

When studying the link between childhood risk-taking and antisocial behaviour, it is important to consider potential sex-differences. It is well known that boys exhibit more antisocial behaviours than girls (Moffitt, 2001; Van Lier, Van Der Ende, Koot, & Verhulst, 2007). In addition, boys engage in more risk-taking behaviour on the playground than girls (Morrongiello & Rennie, 1998), although such sex-differences were not found in risk-taking assessed with the BART (MacPherson et al., 2010). Differential socialization of boys and girls may lead to sex-differences in the associations between risk-taking and antisocial behaviour. Boys, compared to same-age girls, are allowed by their parents to be more exploratory, to roam further from home and are given more opportunities to play in unsupervised environments (Morrongiello, Zdzieborski, & Normand, 2010). Being more often in unsupervised settings, might tempt boys to engage in antisocial behaviours that may arise from risk-taking behaviour such as starting fights and stealing. Yet, the limited research into childhood risk-taking makes it difficult to formulate a clear a priori hypothesis regarding sex-differences in the link between antisocial behaviours and risk-taking.

In sum, our knowledge on the link between risk-taking and antisocial behaviour in children is far from complete as previous studies used clinical samples, cross-sectional designs, did not include antisocial behaviour outcomes or used methods of assessing risk-taking that may actually reflect antisocial behaviour. Therefore, the objective of this study is to investigate the links between the development of risk-taking and the development of aggression, covert antisocial and oppositional defiant behaviour. To this end, a sample of 1,086 mainstream elementary schoolchildren was followed across ages 7–11. We expected to find a positive developmental association between risk-taking and

antisocial behaviour. Although we expected that boys would score higher on antisocial behaviour than girls, we cannot, based on prior work, make a hypothesis on potential sex-specific associations in this link.

Methods

Participants

The study was part of a longitudinal project – ‘Happy Children, Happy Adolescents?’ – among elementary schoolchildren on their behavioural, social-emotional, cognitive and bio-psychological development during elementary school. Participating schools were mainstream Dutch elementary schools situated in an urban area in the central part of the Netherlands and a rural area in the eastern part of the Netherlands. Parents were informed about the project and were asked for their written consent for their child to participate. For a more detailed description of the inclusion of schools, see (de Wilde, Koot, & van Lier, 2016). This study was approved by the Medical Ethical Committee of de Vrije Universiteit Medical Centre (protocol number NL37788.029.11).

Data used in the present study were collected in three consecutive age cohorts of children, who were assessed across three annual waves, in the spring of 2014 (T1), 2015 (T2) and 2016 (T3). Only those children who had at least two assessments of risk-taking were included in the analyses. By virtue of this criterion, 296 children were excluded from the analyses. The remaining 1,086 children (554 males, 51%), came from 62 classrooms, within 13 schools. There were on average 23 children in a classroom (range 8–31; modus = 25). The average number of classrooms within one school was five (range = 1–13). The grand majority of these children, 92.5%, had data on all three waves. Excluded children did not differ from included children with regard to sex ($\chi^2(1) = 0.02$, $p = .89$), age ($F(1) = 0.88$, $p = .35$), socioeconomic status ($F(1) = 1.47$, $p = .23$), risk-taking scores ($F(1) = 0.61$, $p = .44$), teacher-reported aggressive behaviour ($F(1) = 0.19$, $p = .66$), covert antisocial behaviour ($F(1) = 0.08$, $p = .78$) or oppositional defiant behaviour ($F(1) = 2.66$, $p = .11$). However, excluded children had higher scores on peer-reported aggressive behaviour ($F(1) = 12.60$, $p < .01$, $\eta^2 = .01$) and oppositional defiant behaviour ($F(1) = 17.18$, $p < .01$, $\eta^2 = .02$).

Of the 1,086 children, 297 children (cohort 1) were assessed at baseline in grade 1; *Mage* at baseline = 6.96 years ($SD = 0.39$; follow-up across age 7–9). Children in cohort 2 ($n = 384$) were first assessed in grade 2; *Mage* = 8.01 years ($SD = 0.41$; follow-up across age 8–10). Children from cohort 3 ($n = 405$) were first assessed in grade 3, *Mage* at baseline = 9.07 years ($SD = 0.41$; follow-up across age 9–11). See Table 1 for an overview of the sample sizes at each age and gender breakdown. Twenty percent of the children had a non-Dutch ethnical background. This percentage is comparable to the Dutch population, with 22.6% (Statistics Netherlands, 2017a). The percentage of children that came from low socioeconomic status (SES) households was 11.3%. This percentage is lower compared to the overall Dutch population, 21.1% (Statistics Netherlands, 2017b).

Procedure

Data were collected annually in school. Children completed the peer-nominations on tablets (Apple iPad 2, Cupertino, CA) in their classrooms in the morning, supervised by trained research assistants. Children were placed in an exam setting to avoid having contact with peers during the assessment. The computerized risk-taking task was also administered on the

Table 1 Sample size per age and gender for each cohort

	Cohort	Age 7		Cohort	Age 8		Cohort	Age 9		Cohort	Age 10		Cohort	Age 11	
		Boys	Girls		Boys	Girls		Boys	Girls		Boys	Girls		Boys	Girls
Wave 1	1	130	161	2	188	188	3	224	173		–	–		–	–
Wave 2		–	–	1	133	163	2	192	190	3	225	179		–	–
Wave 3		–	–		–	–	1	127	149	2	184	182	3	214	174
Total		130	161		321	351		543	512		409	361		214	174

tablet, after the lunch-break. All children were tested individually by trained research assistants in a room outside the classroom, in school. The teachers filled in questionnaires on children's behaviour online, in the same month the child assessments were completed.

Measures

Peer-reports of aggression and oppositional defiant behaviour. The Peer-reports were assessed using peer-nominations. Each child in the classroom was presented with a list of participating children in the classroom. Children were asked to nominate classmates who they felt fitted the descriptions 'Who in your classroom hits other children?' (Aggression) and 'Who in your classroom does not listen?' (Opposition). Children could not nominate themselves. The total number of aggression and opposition nominations for each child within each classroom were summed into a total aggression and opposition score, and standardized within classroom (Coie, Dodge, & Coppotelli, 1982).

Teacher-ratings of aggression, covert antisocial and oppositional defiant behaviour. The teacher-ratings were assessed using the Problem Behaviour at School Interview - short version (PBSI; Erasmus, 2000). Teachers rated problem behaviours at a 5-point Likert scale ranging from 0 (never applicable) to 4 (often applicable). Aggression was assessed using 5 items ('starts fights', 'pushes other children or puts them in danger', 'attacks other children physically', 'threatens other people', 'bullies or is mean to others'). Cronbach's alphas (α) ranged from .92 to .94 over the three assessments. Covert antisocial behaviour was assessed using four items ('disobeys teachers' instructions', 'lies', 'destroys properties belonging to others', 'swears'; range $\alpha = .83-.85$). Oppositional defiant behaviour was assessed through five items ('stubborn', 'talks back to staff', 'defiant', 'easily frustrated', 'argues a lot'; range $\alpha = .91-.92$). The scores were summed into a total aggression, covert antisocial and an opposition score and standardized within classrooms.

Risk-taking. Risk-taking was assessed using the Balloon Analogue Risk Task (BART; Lejuez et al., 2002). Children were instructed that they had to inflate the balloon shown on the screen, and that with every inflation the size of the balloon increased and a coin was added in their 'money-box'. This money-box was visible on the screen. Children had to inflate 15 balloons. Each balloon was programmed to explode at random between 1 and 128 pumps. If this happened, children were informed that they would lose the coins earned for that specific balloon. Children were further instructed that they could decide to stop inflating the balloon and to cash the coins at every moment. If the child stopped inflating before a balloon exploded, the coins would be saved in the 'money-box' and a new balloon would appear. The money-box thus displayed the coins earned up to that point. Note that the reward was nonmonetary and consisted of the total amount of points earned. A child's risk-taking propensity score was computed

by averaging the amount of pumps of nonexploded balloons (Lejuez et al., 2002).

Children's sex. The sex was dummy coded as 0 = girls and 1 = boys.

Household socioeconomic status (SES). Parents were asked to report on their current or most recent job. Job descriptions were classified according to the working population classifications of occupations scheme (Statistics Netherlands, 2010) which is based on the International Standard Classification of Occupations (ISCO-08; International Labour Organization (2012)). The highest SES score of the two parents was taken as household SES. SES was dummy coded (0 = low, 1 = medium or high SES), with low SES defined as being unemployed or holding a lower or elementary level job.

Statistical analysis

Parallel-process, sequential-cohort latent growth models were used to address our research questions. In the latent growth models, the development of antisocial behaviour and risk-taking was conceptualized using continuous latent growth factors. The intercept represents the initial levels (centred at age 7), and the slope term represents increases or decreases from the intercept with age. Individual differences in level and change across time are captured by the variance of the growth parameters.

We first fitted growth models for all constructs separately to assess the number of growth parameters needed. To test for associations of risk-taking with antisocial behaviour outcomes, parallel-process latent growth models (one per outcome and per informant) were fitted. In these models, the growth parameters of the outcome were regressed on growth parameters of risk-taking (see Figure 1). Testing for sex-differences was done using a multiple group model (boys vs. girls). A model in which the regression paths between risk-taking and the outcome were freely estimated across the sexes was compared to a model in which path estimates were held equal between boys and girls. Path estimates were controlled for SES.

Models were fitted in Mplus version 7.0, Los Angeles, CA (Muthén & Muthén, 2012). Models were estimated using the robust maximum likelihood estimator (MLR) to account for non-normal distributions of study variables. Standard errors of estimates were adjusted to account for clustering of data within schools using a sandwich estimator (Williams, 2000). Model fit was determined using the Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) with critical values $\geq .90$ (Bentler & Bonett, 1980) and the Root Mean Square Error of Approximation (RMSEA, critical value $\leq .06$) (Marsh, Hau, & Wen, 2004). Comparisons of the nested models were done using the Satorra-Bentler chi-square difference test (Satorra & Bentler, 2001).

Results

Descriptive statistics

Table 2 provides means and standard deviations of all study variables for boys and girls. Boys had

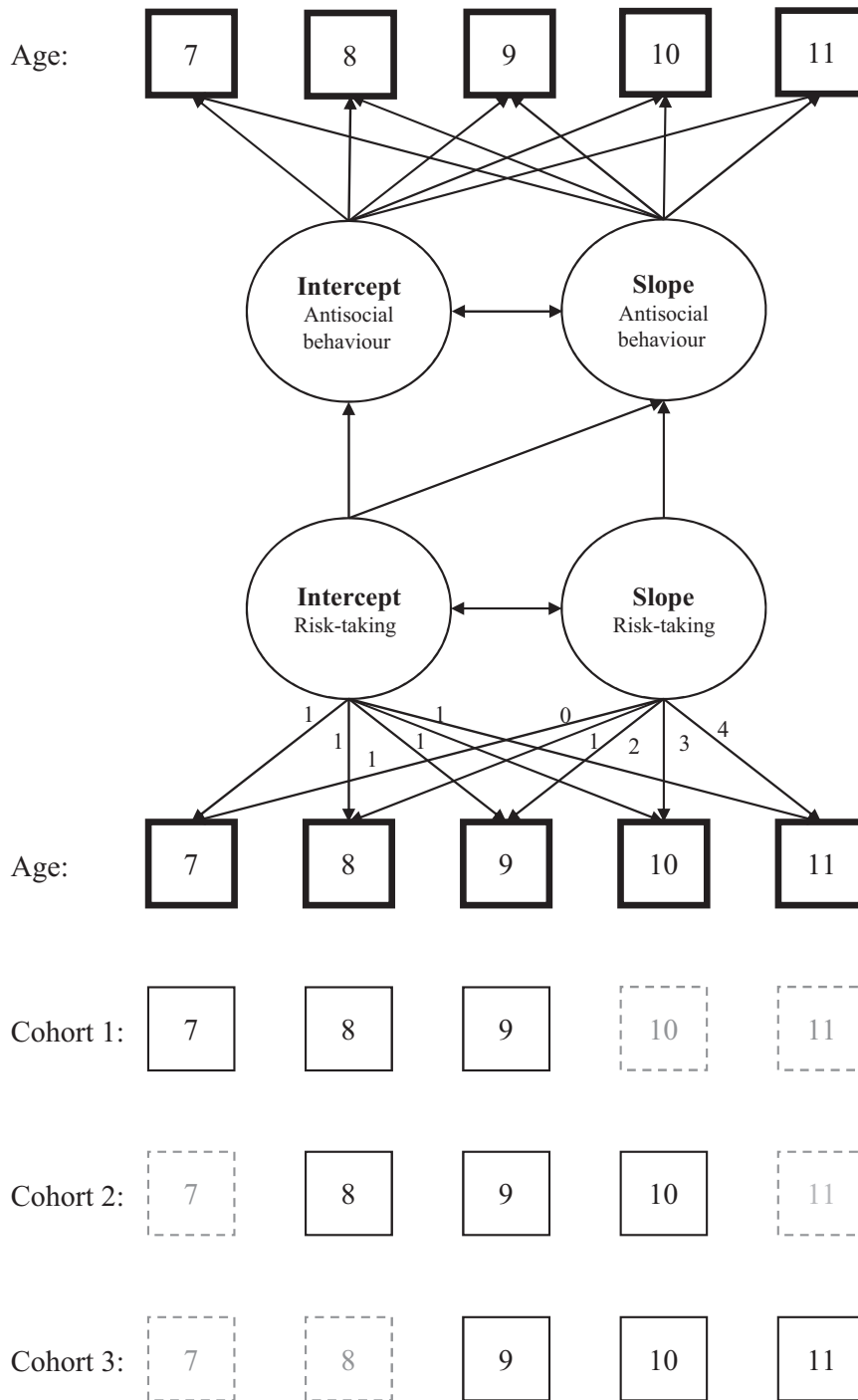


Figure 1 Graphical representation of data structure and parallel latent growth model of risk-taking and antisocial behaviours

higher antisocial behaviour than girls at all ages across informants. Mean levels of risk-taking were similar for boys and girls. See Tables S1–S3 from the online supporting information section for correlations between study variables. Correlations between risk-taking and both peer- and teacher-reports of antisocial behaviour were inconsistent and, if significant, of low magnitude (Cohen, 1988). Correlations between teacher- and peer-reports of antisocial behaviours were significant and in the expected direction.

Unconditional models of the outcome variables – with an intercept and linear slope (all with and

acceptable fit to the data; $RMSEA \geq .05$; $CFI \geq .93$; $TLI \geq .96$) – fitted better than models containing a quadratic term. The growth models showed that boys had higher initial levels and increased growth compared to girls on all antisocial behaviour outcomes. The development of risk-taking ($RMSEA = .06$, $CFI = .91$, $TLI = .95$), plotted in Figure 2, showed that at age 7, children pumped on average 9.28 times per balloon (Mean Intercept: $B = 9.28$, $SE = 0.33$, $p < .001$) and had an average annual increase in the number of pumps of 1.67 pumps per balloon (Mean Slope: $B = 1.67$, $SE = 0.20$, $p < .001$). With a total of 15 balloons per

Table 2 Means and standard deviations of study variables for boys and girls

	Age 7			Age 8			Age 9			Age 10			Age 11								
	M	SD	Range	F (df)	M	SD	Range	F (df)	M	SD	Range	F (df)	M	SD	Range	F (df)					
Risk-Taking																					
Boys	10.37	8.87	1.53–51.00	0.66	10.26	7.65	1.43–43.00	2.54	12.35	9.58	1.33–71.20	0.74	13.87	8.91	1.20–52.29	0.95	15.69	9.61	2.15–56.14	0.37	
Girls	11.48	11.92	1.07–94.80	(248)	11.42	9.39	1.13–59.89	(561)	12.86	8.39	1.92–57.45	(920)	14.53	9.70	1.93–60.36	(749)	16.29	9.53	1.07–54.40	(380)	
Peer-Reports																					
Aggressive Behaviour																					
Boys	0.16	0.20	0.00–0.81	61.46**	0.21	0.22	0.00–0.93	134.18**	0.24	0.24	0.00–1.00	216.08**	0.23	0.24	0.00–0.95	165.64**	0.22	0.25	0.00–0.95	61.03**	
Girls	0.02	0.06	0.00–0.47	(268)	0.05	0.09	.00–0.57	(585)	0.06	0.11	0.00–0.77	(974)	0.06	0.11	0.00–1.00	(766)	0.06	0.11	0.00–0.55	(387)	
Oppositional Defiant Behaviour																					
Boys	0.19	0.22	0.00–0.96	48.23**	0.21	0.24	0.00–0.96	87.42**	0.21	0.25	0.00–1.00	146.63**	0.21	0.25	0.00–1.00	119.82**	0.19	0.24	0.00–0.95	44.70**	
Girls	0.05	0.10	0.00–0.58	(268)	0.06	0.12	0.00–0.67	(585)	0.06	0.11	0.00–0.75	(974)	0.05	0.11	0.00–0.63	(766)	0.06	0.12	0.00–0.64	(387)	
Teacher-Reports																					
Aggressive Behaviour																					
Boys	0.60	0.78	0.00–3.20	20.14**	0.70	0.82	0.00–3.40	41.94**	0.63	0.75	0.00–3.60	72.73**	0.57	0.75	0.00–3.60	55.72**	0.42	0.64	0.00–2.60	20.24**	
Girls	0.26	0.44	0.00–2.00	(262)	0.33	0.55	0.00–2.40	(598)	0.27	0.51	0.00–3.80	(953)	0.23	0.46	0.00–3.40	(744)	0.16	0.33	0.00–2.00	(342)	
Oppositional Defiant Behaviour																					
Boys	0.87	0.85	0.00–3.60	6.73*	0.96	0.85	0.00–3.80	21.72**	0.95	0.86	0.00–3.80	52.85**	0.84	0.89	0.00–3.60	28.47**	0.72	0.84	0.00–3.40	5.33*	
Girls	0.63	0.65	0.00–3.20	(262)	0.66	0.74	0.00–3.60	(598)	0.58	0.72	0.00–3.60	(953)	0.53	0.69	0.00–3.80	(744)	0.53	0.65	0.00–2.60	(342)	
Covert Antisocial Behaviour																					
Boys	0.65	0.71	0.00–3.25	8.18*	0.65	0.71	0.00–2.75	28.01**	0.64	0.69	0.00–3.25	73.91**	0.51	0.64	0.00–3.00	37.55**	0.44	0.62	0.00–2.75	12.57**	
Girls	0.36	0.52	0.00–3.25	(262)	0.38	0.54	0.00–2.75	(598)	0.31	0.50	0.00–3.25	(953)	0.26	0.46	0.00–3.25	(744)	0.24	0.41	0.00–2.50	(342)	

Raw mean and standard deviations, not classroom Z standardized values are reported to simplify interpretation. F values regard tests of sex-differences. **p* < .05; ***p* < .001.

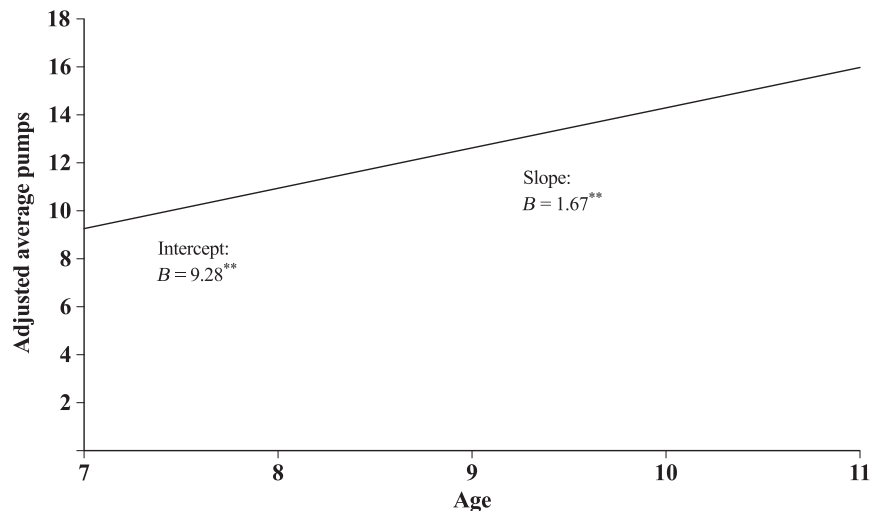


Figure 2 Estimated development of risk-taking from age 7 till 11. Scores represent the average pumps per nonexploded balloons. ** $p < .001$

assessment, this indicated an increase of – on average – 25.1 pumps per year. No gender differences were found in the development of risk-taking.

Association of antisocial behaviour with risk-taking

The associations between risk-taking and antisocial outcomes are depicted in Table 3. Results show a positive link between the intercept of risk-taking and the slope of peer-reported aggression ($B = .005$, $SE = 0.002$, $p = .012$) (RMSEA = .05, CFI = .94, TLI = .95). This effect was similar for boys and girls ($\Delta\chi^2 = 3.37$, $\Delta df = 3$, $p = .34$). This indicates that children who had higher levels of risk-taking at age 7, showed an increased growth of peer-reported aggression across ages 7–11, compared to children with lower levels of initial risk-taking.

The association of risk-taking with peer-reported oppositional defiant behaviour (RMSEA = .05, CFI = .95, TLI = .96) differed for boys and girls ($\Delta\chi^2 = 8.08$, $\Delta df = 3$, $p < .05$). For girls, a significant association between the slope of risk-taking and the slope of peer-reported oppositional defiant behaviour was found ($B = .009$, $SE = .004$, $p = .037$). This indicates that, in girls, increased growth in risk-taking predicted increased growth of oppositional defiant behaviours. For boys, there was a trend-level association between the intercept of risk-taking and the slope of oppositional defiant behaviours ($B = .010$, $SE = 0.005$, $p = .057$). This indicates that, in boys, higher initial levels of risk-taking predicted potentially increased growth of oppositional defiant behaviours.

Results of the associations of risk-taking with teacher-reported antisocial behaviours showed a trend-level positive link between the intercept of risk-taking and the intercept of both aggression ($B = .012$, $SE = 0.006$, $p = .061$) and covert antisocial behaviour ($B = .014$, $SE = 0.008$, $p = .057$), which was similar for boys and girls. Model fit was RMSEA = .05, CFI = .92, TLI = .94 and RMSEA = .06, CFI = .90, TLI = .92, respectively.

There was no significant link between risk-taking and teacher-reported oppositional defiant behaviour.

Discussion

This study examined the developmental links of risk-taking with antisocial behaviour across ages 7–11 in mainstream elementary schoolchildren. It was found that children's risk-taking behaviour, on average, increased over ages 7–11. We also found positive associations between risk-taking and the development of peer-reported aggressive and oppositional defiant behaviour. Links between levels of risk-taking and teacher-reported aggression and covert antisocial behaviour were found at trend level. The sex-difference seen in the association between risk-taking and peer-reported oppositional defiant behaviour reflected, by our interpretations, a nuance difference rather than a meaningful difference between boys and girls. That is, for both boys and girls, risk-taking was positively linked to the development of oppositional defiant behaviour. However, for boys, initial *level* of risk-taking was associated with the development of oppositional defiant behaviours (trend level), while for girls, *growth* in risk-taking was associated with growth in oppositional defiant behaviour. Thus, this sex-difference needs replication first before a conclusive interpretation is warranted.

Our finding that childhood risk-taking is associated with maladaptive outcomes is in line with previous research on this association in adolescents (Crowley et al., 2006; Fairchild et al., 2009; Leather, 2009). It also concurs with findings that children who had a clinical diagnosis of ODD and/or ADHD had higher levels of risk-taking than normal controls (Humphreys & Lee, 2011). We extended these findings by showing such associations in a normative sample of elementary school children followed across ages 7–11. Also, previous studies on the link between risk-taking and antisocial behaviour in adolescence included mainly or solely boys. We

Table 3 Associations between initial levels and changes of risk-taking with aggression, covert antisocial and oppositional defiant behaviour for peer- and teacher-reports

Risk-Taking Slope	Peer-reports						Teacher-reports									
	Aggressive Behaviour			Oppositional Defiant Behaviour			Aggressive Behaviour			Oppositional Defiant Behaviour			Covert Antisocial Behaviour			
	Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls	
	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope
	B	SE	B	SE	B	SE	B	SE	B	SE	B	SE	B	SE	B	SE
Intercept	.000	0.004	.005*	0.002	-.014	0.009	.010†	0.005	.009	0.007	-.001	0.002	.012†	0.007	-.003	0.004
Slope	–	–	.003	0.004	–	–	-.002	0.011	–	–	.009*	0.004	–	–	-.002	0.005

* $p < .05$; † $p < .06$

extended these findings by showing that the association of risk-taking with antisocial behaviours might be present among both sexes during childhood. Collectively, ours and the previous studies suggest that already in children, risk-taking behaviour is linked to maladaptive developmental outcomes such as antisocial behaviours.

It is important to note that in the present study, the link between teacher-reported antisocial behaviour and risk-taking just failed to reach conventional levels of significance (p 's $< .06$). A possible explanation may be the difference in scope of observations between teachers and classroom peers. Teachers observe children's behaviour primarily in a structured school setting: the classroom. Peers may have a broader scope as they frequently interact with classmates in more unstructured, less supervised settings such as during free play in the schoolyard, or even outside school settings (Hazler, Miller, Carney, & Green, 2001; Nabuzoka & Smith, 1999). We speculate that antisocial behaviours that may arise from increased risk-taking behaviour, such as starting fights, or breaking classroom rules, are more likely to occur in unstructured, unsupervised situations rather than in the structured classroom environment.

Although not the main objective of this study, it is noteworthy that we found that risk-taking increased over ages 7 till 11, which was in line with the study of MacPherson et al. (2010). We found no sex-difference in risk-taking development, which contrasted the observational study of Morrongiello and Rennie (1998) but concurred with other studies using the BART to assess risk-taking (Aklin et al., 2005; Lejuez et al., 2002; MacPherson et al., 2010).

This study has limitations. First, our sample consisted of primarily Caucasian children from relatively high SES households, attending mainstream elementary schools. Also, children excluded from this study had somewhat higher scores on peer-reported antisocial behaviour. It is therefore unknown whether our results extend to more diverse populations. Second, antisocial behaviours were rated in the school context. Although we are not certain about the scope that teachers and peers used when rating antisocial behaviours, the interpretations of our results may be mostly limited to the school context. Also, our study had no data on peer-reports of covert antisocial behaviour and relational forms of antisocial behaviour. Finally, it is not fully known how risk-taking measured with the BART is related to other risk-taking observations or measures in children. Morrongiello, Kane, McArthur, and Bell (2012) showed that BART scores were related to risk-taking scores on the Risk Propensity Scale (Meertens & Lion, 2008), but not to physical risk-taking.

Conclusions

Our findings have implications for future research and practice. Our study showed normative increases

in risk-taking across ages 7–11 among typically developing children and provided first evidence for a potential role of risk-taking in these children's antisocial behaviour development. Future studies on antisocial behaviour, but also school mental health workers and clinicians should take into account that risk-taking might affect symptoms of antisocial behaviour not only in adolescence, but already in childhood. Furthermore, researchers on antisocial behaviour development, but also school mental health workers should be aware of the possible differences between teacher and peer-reports of antisocial behaviours. In fact, this study urges to, next to teacher-reports, use classroom peers already at young ages as informants to provide a complete picture of children's antisocial behaviours.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Table S1. Correlations between all study variables for children in cohort 1, separately for boys and girls.

Table S2. Correlations between all study variables for children in cohort 2, separately for boys and girls.

Table S3. Correlations between all study variables for children in cohort 3, separately for boys and girls.

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Key points

- Risk-taking behaviour increases across the ages of 7–11 in children attending mainstream elementary schools.
- Boys and girls show similar levels of risk-taking behaviour over the ages of 7–11.
- Higher levels of risk-taking relate to increases in peer-reported aggressive and oppositional defiant behaviour.
- Despite minor sex-differences, the association between risk-taking and antisocial behaviour is mostly similar across boys and girls.
- The link between risk-taking and teacher-reported antisocial behaviour failed to reach significant levels and was therefore less conclusive than for peer-reported antisocial behaviour.

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