Joint Trajectories of Reactive and Proactive Aggression from Mid-childhood to Early Adolescence: Relations to Sensation Seeking, Risk Taking, and Moral Reasoning

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Abstract

We examined the roles of sensation seeking, risk taking, and moral reasoning in the development of reactive and proactive aggression. Data were drawn from a multiethnic, longitudinal study of children from Switzerland (N = 1,571; assessed annually over 6 years; 7-years-old at Time 1). At all six time points, teachers reported children's reactive and proactive aggression via questionnaire. Children's sensation seeking (at Time 1) and risk taking (at Time 2) were assessed with two interactive computer tasks and their moral reasoning was assessed at Time 2 in response to four hypothetical vignettes depicting moral transgressions. Latent Class Growth Modeling revealed four developmental trajectories of reactive aggression and three of proactive aggression. Six joint trajectories of reactive and proactive aggression were then identified. Children with high sensation seeking and risk taking were very likely to develop both types of aggression during childhood. Children with high moral reasoning skills were very likely to develop reactive aggression during adolescence, whereas those with low moral reasoning were likely to show proactive aggression during childhood. These findings highlight the shared and differential roles of sensation seeking, risk taking, and moral reasoning in the development of reactive and proactive aggression from mid-childhood to early adolescence. We discuss implications for common and tailored strategies to combat these aggression subtypes.

Keywords: reactive aggression, proactive aggression, sensation seeking, risk taking, moral reasoning, longitudinal study

Joint Trajectories of Reactive and Proactive Aggression from Mid-childhood to Early Adolescence: Relations to Sensation Seeking, Risk Taking, and Moral Reasoning

Reactive (i.e., hot-headed or emotional) and proactive (i.e., cold-blooded or unemotional) forms of aggression have been associated with distinct, adverse outcomes across development (see Hubbard, McAuliffe, Morrow, & Romano, 2010 for a review). For example, reactive aggression has been linked to internalizing symptoms, such as anxiety and depression (Fite, Rubens, Preddy, Raine, & Pardini, 2014), whereas proactive aggression has been associated with subsequent externalizing symptoms, such as violence and vandalism (Vitaro, & Brendgen, 2005; Vitaro, Brendgen, & Barker, 2006). The most effective reduction of these aggression subtypes and their respective consequences will likely require knowledge of their shared and unique sources, and early developmental antecedents. However, little is known about the shared and differential developmental antecedents that trigger the emergence of reactive and/or proactive aggression.

In the present investigation, we aimed to clarify the regulatory and moral antecedents of reactive versus proactive aggression. Specifically, we examined relations of sensation seeking, risk taking, and moral reasoning to joint developmental trajectories of reactive and proactive aggression. Given the dearth of longitudinal studies on reactive and proactive aggression spanning childhood and adolescence, we focused on the period of mid-childhood to early adolescence (i.e., from age 7 to 12). This allowed us to assess the antecedents and correlates of childhood-onset/-limited and adolescent-onset aggression, which have been shown to vary in their severity and persistence across the lifetime (e.g., Moffitt, 1993, 2003; Xie, Drabick, & Chen, 2011).

The Development of Reactive and Proactive Aggression

Both reactive and proactive aggression involve an intention to physically and/or mentally harm others (Arsenio, Adams, & Gold, 2009). However, reactive aggression is characterized by emotional, defensive harm in response to goal blocking or provocation (Dodge, Coie, & Lynam, 2006), whereas proactive aggression is characterized by unemotional, goal-oriented harm in anticipation of self-serving outcomes (Arsenio et al., 2009). A person-centered approach can help to better understand how aggression unfolds within children across development and to outline differential patterns of within-child change (Nagin, 2005). A number of studies adopting this approach have found the following groups of generalized aggression trajectories from childhood to adolescence: a small High-Stable/High group with childhood onset, a Low-Increasing group with adolescence onset, a High-/Moderate-Decreasing childhood-limited group, a large Low-Stable group, and other groups stemming from unique sample characteristics (e.g., Bongers, Koot, van der Ende, & Verhulst, 2004; Nagin & Tremblay, 1999).

Reactive and proactive aggression appear to follow similar trajectories, at least in adolescence (Barker, Tremblay, Nagin, Vitaro, & Lacourse, 2006; Fite, Colder, Lochman, & Wells, 2008). For example, Barker et al. (2006) identified three trajectories of both reactive and proactive aggression among adolescent boys from 13- to 17-years-of-age: a High-Stable group (that peaked at age 15; approximately 7% of the sample), a Moderate-Decreasing group, and a Low-Stable group (approximately 50% of the sample). The present study was among the first to assess reactive and proactive aggression across childhood and adolescence, which allowed us to explore the distinction between childhood- and adolescent-onset/limited groups. Childhood-onset aggression (excluding childhood-limited) tends to persist across the lifetime and predicts long-

term maladjustment. Adolescent-onset aggression typically desists into adulthood and more often relates to concurrent adjustment issues (Moffitt, 1993, 2003; Xie et al., 2011).

In addition, there is evidence that both forms of aggression tend to co-occur within the same person (see Card & Little, 2006). Developmental researchers have therefore begun to study the comorbidity or overlap of different trajectory classes. Various empirical studies have demonstrated that children and adolescents who display both types of aggression may be at particularly high risk for poor developmental outcomes, including both internalizing and externalizing problems (e.g., Barker et al., 2006; Pang, Ang, Kom, Tan, & Chiang, 2013; Salmivalli & Nieminen, 2002). However, relatively few studies have investigated the comorbidity of reactive and proactive aggression over time. To fill this research gap, we aimed at identifying joint trajectories of both reactive and proactive aggression from mid-childhood to early adolescence.

Sensation Seeking, Risk Taking, and the Development of Reactive and Proactive Aggression

Sensation seeking and risk taking have been strongly implicated in the development of aggressive behavioral disorders (Roberti, 2004; Swaim, Henry, & Baez, 2004; Wilson & Scarpa, 2011). *Sensation seeking* is the tendency to pursue exciting experiences with the end goal of increasing arousal and high levels thereof reflect strong, arousal-related impulses (Zuckerman, 1994). A recent meta-analysis of 43 independent effect sizes and 32, 217 participants from late childhood to early adulthood found a significant, positive association between sensation seeking and aggression (d = .19, $p < .001$; Wilson & Scarpa, 2011). *Risk taking* implies a propensity to act on impulses for reward despite the potential for undesirable consequences (Lejuez et al.,

2002). Behaviors endemic to early risk taking include aggression and delinquency (e.g., Romer, 2010; Swaim et al., 2004).

Relatively few studies have considered sensation seeking and risk taking in relation to reactive and proactive aggression. However, it is reasonable to argue that sensation seeking and risk taking are more apparent in children with reactive aggression because they have the impulses to seek excitement and act on these impulses in the heat of the moment, whereas children with proactive aggression are able to channel their misconduct in a calculated manner (see Dodge et al., 2006). Empirically, researchers have found that low levels of behavioral inhibition (including high sensation seeking) have been associated with both reactive and proactive aggression in 2- to 5-year-olds (Kimonis et al., 2006), and16-year-olds (Raine et al., 2006). Collectively, these findings suggest that both reactive and proactive aggression are associated with impulsive tendencies, although proactively aggressive children may be more apt at regulating immediate, aggressive impulses and translating them into planned aggressive acts. Nonetheless, these studies were cross-sectional and mostly relied on questionnaire measures of temperamental impulsivity rather than direct measures of sensation seeking and risk taking. The present study was the first to utilize behavioral measures of both constructs and to account for relations of both to reactive and proactive aggression in a longitudinal framework.

Moral Reasoning and the Development of Reactive and Proactive Aggression

Developmental scientists have argued that both moral emotions and moral reasoning (i.e., the use of moral logic, norms, and self-reflection to guide and justify behavior) can highlight the negative consequences of aggressive conduct, reduce the likelihood of its occurrence, and motivate moral behavior in children and adolescents (e.g., Arsenio, 2014; Malti & Krettenauer, 2013). There has been some empirical support for the link between moral reasoning and

aggression. For example, Murray-Close, Crick, and Galotti (2006) found that children who endorsed physical aggression were more aggressive than children who perceived such conduct as morally wrong.

Limited evidence also suggests that moral reasoning may be differentially related to reactive and proactive aggression. Arsenio et al. (2009) found that moral emotion attributions and moral reasoning in response to vignettes depicting deliberate harm were collectively and negatively related to proactive but not reactive aggression in a sample of low-SES adolescents. There is also evidence that both reactively and non-aggressive children, but not proactively aggressive children, tend to share the belief that harming others is morally wrong and unfair (see Arsenio, 2010). Together, these findings suggest that factors unrelated to morality (e.g., deficient regulatory abilities and foresight) may prevent reactively aggressive children from capitalizing on their moral reasoning skills in provoking situations. Proactively aggressive children, on the other hand, may favor the positive emotional and material incentives of aggressive acts at the expense of lacking moral judgment and moral reasoning skills (Arsenio et al., 2009; Blair, 2011). Building on this limited, cross-sectional evidence, the present study was the first to examine whether mid-childhood deficits in moral reasoning trigger proactive, but not reactive aggression trajectories into early adolescence.

The Present Study

Our major research questions were two fold: First, what are the joint developmental trajectories of reactive and proactive aggression from mid-childhood to early adolescence? Second, how do sensation seeking, risk taking, and moral reasoning in mid-childhood relate to these trajectories? Similar to longitudinal studies in adolescence (e.g., Barker et al., 2006; Fite et al., 2008), we expected to uncover the following groups of both reactive and proactive

aggression trajectories: a small High-Stable/High group, a High-/Moderate-Decreasing group, and a large Low-Stable group. Based on past longitudinal studies of generalized aggression (e.g., Bongers et al., 2004; Nagin & Tremblay, 1999), we also expected a Low-Increasing group from childhood to adolescence. Previous longitudinal studies on aggression subtypes, being restricted to adolescence, have been unable to investigate the latter.

In line with cross-sectional findings (e.g., Kimonis et al., 2006), we expected high sensation seeking and risk taking to predict problematic pathways of reactive and proactive aggression. Finally, we hypothesized that deficient moral reasoning would relate to high-stable trajectories of proactive, but not reactive, aggression because past findings and theorizing suggest that deficits in the moral domain are unique to proactively aggressive children (Blair, 2011). We controlled for socioeconomic status (SES) and sex in light of previous studies linking SES to aggression (Dodge, Pettit, & Bates, 1994) and moral development (Malti & Ongley, 2014), and sex to aggression (Archer, 2004).

Method

Participants

Data were drawn from an ongoing combined longitudinal and intervention study in Switzerland, the Zurich Project on the Social Development of Children and Youths, which includes 56 elementary schools (stratified by enrollment size and SES). At Time 1, the target sample consisted of all first grade students from these schools (N = 1,675; 52% male; Mage = 7.5 years). The present analysis included annual data from teachers between 2004/5 and 2009/10 (i.e., Times 1-6; ages 7-12) and data from children at Times 1 and 2 (i.e., ages 7 and 8). The same teachers completed assessments from Times 1-3 and 4-6, respectively. The final sample consisted of 1,571 children who had aggression data for at least one time point (97.6% of

children had at least two waves of data; 85.9% had at least three, 83.1% had at least four, 74.1% had at least five, and 55.3% had all six; *N*s = 1,349, 1325, 1294, 1269, 1266, 1288 at each respective time point for teacher reports). The present analysis focused on the longitudinal component of the study, for which there was an intervention component with treatment and control groups. There were no statistically significant baseline differences on any of the teacher outcome measures across treatment conditions and there were also no statistically significant intervention effects observed for most child development outcomes (see Malti, Ribeaud, & Eisner, 2011).

The city of Zurich has one of the highest populations of immigrants in Europe, which contributed to the sample's representativeness (see Eisner, Malti, & Ribeaud, 2011). Eleven percent of children were born outside of Switzerland and both parents were born outside of Switzerland in 46% of cases. Of these cases, parents hailed from ex-Yugoslavia (16%), Germany (5%), Portugal (5%), Sri Lanka (5%), Turkey (4%), EU-15 countries (4%), Rest of Asia (4%), Italy (3%), Sub-Saharan Africa (3%), rest of Latin America (3%), Spain (2%), South/East Europe (2%), North Africa (1%), Brazil (1%), Middle East (2%), USA/CAN/NZ/AUS (1%), and unknown origins (0.1%). In terms of educational attainment, 24% of parents had little or no secondary education, 32% had vocational training, 29% had a baccalaureate degree or advanced vocational diploma, and 16% had a university degree.

Procedure

Institutional Review Board (IRB) approval was obtained prior to recruitment and data collection. Parents provided written informed consent at Time 1 (valid until Time 3) and Time 4 (valid until Time 6). At Times 1 and 2, children partook in computer-assisted interviews that lasted approximately 45 minutes. Forty-four intensively trained research assistants administered

the interviews at the schools and recorded children's responses in computers. Children also completed interactive, computer-based tasks as part of the interviews. To accommodate immigrant participants, special care was taken to recruit native speaking research assistants and ensure cross-cultural competence. At all time points, teachers completed a questionnaire.

Measures

Aggression subtypes. We chose to analyze teacher reports of children's reactive and proactive aggression because they were collected across all six time points of the study and evidence suggests that teachers provide valid assessments of aggressive behavior in middle childhood (Henry & Metropolitan Area Child Study Research Group, 2006), whereas children often have difficulty providing consistent reports of their own externalizing behavior (Loeber, Green, Lahey, & Stouthamer-Loeber, 1991).

Reactive aggression. Teachers reported children's reactive aggression using the reactive aggression subscale of the Social Behavior Questionnaire (SBQ; Tremblay et al., 1991), a comprehensive assessment of children's problem and prosocial behaviors. They rated three items (e.g., "The child responds in an aggressive manner when teased" and "…is aggressive when contradicted") on a 5-point Likert scale ranging from 0 = never to 4 = very often. Cronbach's αs ranged from .92 to .94. Mean scores were calculated and higher scores indicated higher levels of reactive aggression.

Proactive aggression. Teachers reported children's proactive aggression using the proactive aggression subscale of the Social Behavior Questionnaire (SBQ; Tremblay et al., 1991). They rated four items (e.g., "The child scares other children to get what he/she wants" and "…tries to dominate other children") on a 5-point Likert scale ranging from 0 = never to 4 = very

often. Cronbach's αs ranged from .87 to .90. Mean scores were calculated and higher scores indicated higher levels of proactive aggression.

Sensation seeking. At Time 1, children's sensation seeking was assessed with the "Travel Game", which was developed by Alsaker and Gutzwiller-Helfenfinger (2010) and adapted as a computer-based task for the current study. The Travel Game involves the child taking a hypothetical "trip". As they move their token along the trip (i.e., a line), the child is required to make a series of choices between two alternative situations, one sensational and one less sensational (e.g., choose to travel with a fast motorbike vs. a funny steam locomotive; choose to watch a horror film or kids' animated cartoon). A proportional score for each child was calculated by dividing their number of sensational choices by the total number of choices. Higher scores indicated higher levels of sensation seeking.

Risk taking. At Time 2, children's risk taking was assessed with the Balloon Analogue Risk Task (BART; Lejuez et al., 2002), a computer-based, behavioral assessment of risk taking propensity. During this task, children are told to earn as many coins as possible by clicking a "pump" button several times to inflate a balloon. The more the balloon is inflated, the more coins are earned. However, the balloon is programmed to burst after a certain number of pumps and all coins of that trial are lost. Children played a total of 20 trials. As recommended by Lejuez et al. (2002), we quantified risk taking by calculating the average number of pumps across all trials (excluding those in which the balloon burst) for each child, which ranged from 0.67 to 91.25, and standardized these scores for further analyses. Higher scores indicated higher levels of risk taking.

Moral reasoning. At Time 2, children's moral reasoning was assessed in response to four vignettes depicting moral transgressions (e.g., pushing another child, teasing or bullying).

For each vignette, children were asked if the hypothetical character's actions were right or wrong (i.e., to provide their judgment). They were then asked to provide their reasoning as to why the actions in question were right or wrong. Reasons were coded as 1 = golden rule, 2 = moral norms, 3 = empathy, 4 = hedonistic, 5 = sanction-oriented, 6 = repetition, and 7 = undifferentiated. In line with related research on children's moral reasoning (citation withheld for blind review), responses coded as 1, 2, and 3 were combined and coded as 1 = moral, whereas all other responses were recoded as 0 = non-moral. Resulting binary scores were aggregated across the four vignettes to create a composite score for each child. Higher scores indicated higher levels of moral reasoning.

Socioeconomic status. As a proxy of socioeconomic status (SES), caregivers' professions were coded according to Elias and Birch (1994) and transformed into International Socio-Economic Index (ISEI) of occupational status scores ranging from 16 to 90 (Ganzeboom, Degraaf, Treiman, & Deleeuw, 1992). Final ISEI scores (based on the caregiver with the highest score) were standardized for further analyses.

Missing Data and Data Analysis Strategy

Retention rates were higher than 80% for teacher assessments across all time points and the retention rate for Time 2 child assessments was 95%. Little's Test (1988) in SPSS 22 revealed that data were not Missing Completely at Random (MCAR), χ^2 (571) = 679.81, p = .001. Since SES predicted missingness, we controlled for this variable in all further analyses. To account for missing data, we employed maximum likelihood with robust standard errors (MLR) for parameter estimation in Mplus 7.11 (Muthén & Muthén, 2012).

The following data analysis strategy was utilized to investigate our research questions: First, we used Latent Growth Curve Modeling (LGCM) to identify overall changes in reactive

and proactive aggression, respectively, based on a comparative fit index (CFI) near .95, a root mean square error of approximation (RMSEA) near .06, and a maximum likelihood-based standardized root mean squared residual (SRMR) near .08 (Hu & Bentler, 1999). We then used Latent Class Growth Modeling (LCGM; Jung & Wickrama, 2008; Nagin, 2005) to identify distinct developmental trajectories within reactive and proactive aggression, respectively. Evaluation of the best fitting models was based on the following criteria: (1) Low Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) scores; (2) high entropy; (3) significant Vuong-Lo-Mendel-Rubin Likelihood Ratio Test (LMR-LRT); (4) a parsimonious and conceptually clear model; and (5) sufficient number of members in each trajectory group (Haltigan & Vaillancourt, 2014; Jung & Wickrama, 2008). Next, a joint trajectory model was run to estimate joint probabilities (i.e., the proportion of children within each dual trajectory combination) and conditional probabilities (i.e., the probability of belonging to a certain reactive aggression trajectory conditional on the probability of belonging to a certain proactive aggression trajectory and vice versa) of following differential combinations of reactive *and* proactive aggression trajectories (Haltigan & Vaillancourt, 2014; Nantel-Vivier, Pihl, Côte, & Tremblay, 2014). Last, multinomial logistic regression was used to predict joint trajectory membership from children's levels of sensation seeking, risk taking, and moral reasoning (controlling for sex and family SES).

Results

Descriptive Statistics

Descriptive statistics and zero-order correlations are shown in Table 1. At all time points, high levels of sensation seeking and risk taking were associated with high levels of reactive and proactive aggression. At Time 2, high levels of moral reasoning were associated with low levels

of reactive aggression. Boys had higher levels of reactive aggression, proactive aggression, and sensation seeking, whereas girls had higher levels of moral reasoning. Higher SES was associated with lower levels of reactive aggression, proactive aggression, and risk taking, and higher levels of moral reasoning. Children showed stability in both reactive and proactive aggression across time. Reactive and proactive aggression were positively associated with each other at all time points.

Developmental Trajectories of Reactive and Proactive Aggression

LGCM indicated that a cubic model fit the data for reactive aggression, χ^2 (11) = 100.69, $p < .001$, CFI = 0.95, RMSEA = 0.07, SRMR = 0.04, better than a quadratic model, $\Delta\chi^2$ (1) = 6.41, $p < .03$. Overall, children's reactive aggression started stable, decreased at a high rate, and then decreased at a lower rate into early adolescence. From this overall LGC model, we estimated one-, two-, three-, four-, and five-class models of reactive aggression using LCGM (see Table 2 for fit indices). A four-class model fit the data best.

Figure 1A depicts the four identified classes or groups of reactive aggression trajectories from Time 1 to 6. Class 1 (7.6%, *n* = 119) showed high initial levels of reactive aggression that remained stable across childhood and slightly decreased into early adolescence but still remained high relative to all other groups, which we labeled a High-Stable trajectory. Class 2 (8.3%, *n* = 130) showed low initial levels of reactive aggression that significantly increased into early adolescence, which we labeled a Low-Increasing trajectory. Class 3 (25%, *n* = 390) showed moderate initial levels of reactive aggression that significantly decreased into early adolescence, which we labeled a Moderate-Decreasing trajectory. Class 4 (59%, *n* = 932) showed relatively low levels of reactive aggression across time, which we labeled a Low-Stable trajectory.

For proactive aggression, LGCM indicated that a quadratic model fit the data, χ^2 (12) = 128.09, $p < .001$, CFI = 0.93, RMSEA = 0.08, SRMR = 0.05, and a cubic model was not better than a quadratic model, $\Delta\chi^2$ (1) = 1.75, $p > .05$. Overall, children's proactive aggression started stable and gradually decreased into early adolescence. From this overall LGC model, we estimated one-, two-, three-, four-, and five-class models of proactive aggression using LCGM (see Table 2 for fit indices). A three-class model fit the data best.

Figure 1B depicts the three identified groups of proactive aggression trajectories from Time 1 to 6. Class 1 (11%, *n* = 176) showed high initial levels of proactive aggression that remained relatively stable across middle childhood and decreased into early adolescence, which we labeled a High-Decreasing trajectory. Class 2 (8%, *n* = 130) showed low initial levels of proactive aggression that significantly increased into early adolescence, which we labeled a Low-Increasing trajectory. Class 3 (81%, *n* = 1265) showed relatively low levels of reactive aggression across time, which we labeled a Low-Stable trajectory.

Joint Developmental Trajectories of Reactive and Proactive Aggression

Based on the best-fitting 4-class model of reactive aggression and the best-fitting 3-class model of proactive aggression, we identified six joint developmental trajectories of reactive and proactive aggression (groups with sizes of or lower than 1% children were discarded). As shown in Table 3, the largest joint trajectory group consisted of children exhibiting both low levels of reactive and proactive aggression across time (i.e., dual Low-Stable trajectory; 54%). Twenty percent of children jointly followed a reactive Moderate-Decreasing and proactive Low-Stable trajectory. Another 8% of children jointly followed a reactive High-Stable/proactive High-Decreasing trajectory, while 7% of children jointly followed a Low-Increasing reactive and proactive aggression trajectory (i.e., dual Low-Increasing trajectory). Five percent of children

belonged to a reactive Moderate-Decreasing/proactive High-Decreasing trajectory and another 5% of children followed a reactive Low-Increasing/proactive Low-Stable trajectory. Table 3 also presented conditional probabilities of belonging to proactive aggression subgroups given reactive membership and those of belonging to reactive aggression subgroups given proactive membership.

Predicting the Joint Development of Reactive and Proactive Aggression

We conducted a multinomial logistic regression predicting the probabilities of belonging to each of the six joint trajectory groups using the dual Low-Stable trajectory as reference. As shown in Table 4, relative to the dual Low-Stable reference group, boys were more than two times more likely to follow the reactive High-Stable/proactive High-Decreasing trajectory. Low SES increased the likelihood of following all other five joint trajectories with any moderate or high levels of aggression, particularly the dual Low-Increasing trajectory. Children with high levels of sensation seeking were almost six times more likely to follow the reactive High-Stable/proactive High-Decreasing trajectory and five times more likely to follow the reactive Moderate-Decreasing/proactive High-Decreasing trajectory. High risk taking increased the likelihood of following the reactive High-Stable/proactive High-Decreasing trajectory. Children with high moral reasoning were more than ten times more likely to belong to the reactive Low-Increasing/proactive Low-Stable trajectory, whereas children in the dual Low-Increasing group did not necessarily show low levels of moral reasoning. Finally, children with low moral reasoning were marginally more likely to follow the reactive Moderate-Decreasing/proactive High-Decreasing trajectory but not the reactive High-Stable/proactive High-Decreasing trajectory.

Discussion

The reactive-proactive aggression distinction has garnered considerable empirical support in terms of differential outcomes across childhood and adolescence (Hubbard et al., 2010). The sources of reactive and/or proactive aggression, however, have received much less attention. Addressing the short- and long-term consequences of these distinct subtypes requires a better understanding of their shared and differential antecedents in a longitudinal framework. Here, we assessed the regulatory and moral developmental antecedents of reactive and proactive aggression from mid-childhood to early adolescence. Overall, both aggression subtypes followed similar trajectories. Importantly, levels of sensation seeking, risk taking, and moral reasoning in mid-childhood predicted distinct joint trajectories of reactive and proactive aggression into adolescence.

We identified four trajectory groups of reactive aggression from mid-childhood to early adolescence: a High-Stable group, a Moderate-Decreasing group, a Low-Increasing group, and a Low-Stable group, and three trajectory groups of proactive aggression: a High-Decreasing group, a Low-Increasing group, and a Low-Stable group. These groups largely align with those identified by other longitudinal studies of generalized aggression spanning childhood and adolescence (e.g., Bongers et al., 2004; Nagin & Tremblay, 1999; Xie et al., 2011), and longitudinal studies on reactive-proactive aggression trajectories spanning adolescence (Barker et al., 2006, 2010). Overall, both aggression subtypes appear to follow similar developmental trajectories from mid-childhood to adolescence and reactively aggressive children outnumbered proactively aggressive children (showing moderate to high levels of aggression at any time point; see Figure 1), which is consistent with Barker and colleagues' findings with adolescent males (Barker et al., 2006, 2010; see also Tremblay, 2000).

Although aggression levels of the High-Stable reactive group tapered into adolescence, they were still comparatively high at all time points (in relation to other groups). Aggression levels of the High proactive group, however, decreased into adolescence. Decreases in both reactive and proactive aggression into adolescence may reflect a normative, overall decreasing trend for aggression (see Bongers et al., 2004; Xie et al., 2011). They may also reflect fluctuations or temporary changes during this particular period (e.g., changes in peer groups), and may increase again into mid-adolescence (Barker et al., 2010; Nagin & Tremblay, 1999). Finally, these two trajectories may represent childhood-limited aggression subtypes (i.e., that high levels of reactive and proactive aggression are limited to childhood; Xie et al., 2011). The Low-Increasing groups of both aggression subtypes showed significant increases from late childhood to the cusp of adolescence. These increases may continue until mid-adolescence since previous longitudinal studies indicate that reactive and proactive aggression peak at mid-adolescence (e.g., Barker et al., 2006, 2010). Further, these trajectories may reflect the early stages of adolescent-onset reactive and proactive aggression (Xie et al., 2011), although future waves of data are needed to corroborate this claim.

Given the overlap of reactive and proactive aggression, we focused on joint trajectories. There was not a reactive Low-Stable/proactive Low-Increasing group empirically, neither was there a reactive Low-Stable/proactive High-Decreasing group. On the contrary, Low-Stable proactive group children were also classified in the reactive Low-Increasing and Moderate-Decreasing trajectories. Taken together, our findings suggest that proactive aggression seems to always be comorbid with certain levels of reactive aggression, whereas reactive aggression is not always comorbid with proactive aggression (i.e., asymmetry of overlap; Pang et al., 2013; Vitaro & Brendgen, 2005). Moreover, there was no reactive Low-Increasing/proactive High-Decreasing

group, nor were there reactive High-Stable or Moderate-Decreasing/proactive Low-Increasing groups in our data. These findings suggest that children showed childhood-limited proactive aggression may not suddenly start to show reactive aggression from early adolescence and vice versa, which further indicate the comorbidity of the two subtypes of aggression. Overall, educators and practitioners in designing intervention and/or prevention programs targeting subtypes of aggression should note the comorbidity of these two subtypes and particularly the asymmetry of the overlap (i.e., many children may show reactive aggression without proactive aggression but most children who show proactive aggression usually also show reactive aggression).

Children high in both sensation seeking and risk taking were more likely to follow a reactive High-Stable/proactive High-Decreasing trajectory. Showing high levels of both sensation seeking and risk taking appears to put children at risk of developing high levels of both reactive and proactive aggression from an early age. Children high in sensation seeking were also more likely to follow a reactive Moderate-Decreasing/proactive High-Decreasing trajectory. Thus, in relation to sensation seeking, early risk taking seems to particularly predict elevated reactive aggression from childhood to adolescence above and beyond sensation seeking. Risk takers, and not necessarily sensation seekers, are naïve to undesirable consequences (Lejuez et al., 2002). Given the negative consequences of reactive aggression, this difference may explain why risk taking appears to add risk of developing reactive aggression on top of seeking exciting experiences. Collectively, these findings suggest that sensation seeking and risk taking are related to high levels of both reactive and proactive aggression, particularly in mid-childhood. This largely aligns with previous, concurrent studies relating sensation seeking and risk raking to aggression (e.g., Kimonis et al., 2006; Romer, 2010; Wilson & Scarpa, 2011). Thus, both

constructs appear to be part of the constellation of factors that contribute to both aggression subtypes. Nonetheless, it should be noted that our indices of sensation seeking and risk taking were not assessed longitudinally. Continued, high levels of sensation seeking and risk taking may have contributed to elevated levels of reactive and proactive aggression into adolescence, whereas decreases in risk taking after childhood may have resulted in a moderate-decreasing trend of reactive aggression. On the other end of the spectrum, children low in risk taking and sensation seeking were more likely to follow Low-Stable trajectories of both aggression subtypes, which may have stemmed from their enhanced regulatory skills and related impulse control (see Eisenberg, Smith, & Spinrad, 2011).

In addition, we also found evidence for the differential role of moral reasoning in the development of proactive versus reactive aggression. Children with high levels of moral reasoning at age 8 were more likely to follow a reactive Low-Increasing/proactive Low-Stable trajectory. While high levels of moral reasoning alone are unlikely to exacerbate reactive aggression, it is possible that a combination of high moral reasoning and other factors may. In determining the intentionality of others' behavior, reactively aggressive children are prone to making hostile attributions (Arsenio et al., 2009). If such children also have high levels of moral reasoning, they may be more inclined to misattribute the behavior of others as moral misconduct worthy of aggressive retaliation. This tendency may be particularly strengthened as this group of children develops more distorted cognitive thinking, resulting in adolescence-onset reactive aggression subtype. Such findings suggest and that moral reasoning may even be a risk factor for children with reactive aggressive only, particularly adolescence-onset types. However, our findings cannot rule out the possibility that high moral reasoning may relate low levels of reactive aggression. Future research should tap into these differences by assessing moral

reasoning longitudinally. In any case, these results suggest that acts of reactive aggression are not devoid of moral concern (also see Arsenio, 2006; Arsenio et al., 2009), whereas acts of proactive aggression from childhood to adolescence may be heightened by low levels of moral reasoning and consistently blunted by high levels of moral reasoning.

However, we did not find that children with low moral reasoning skills were more likely to follow a dual Low-Increasing trajectory of both reactive and proactive aggression. Given the link between high moral reasoning and the Low-Increasing reactive trajectory, it is possible that deficits in moral reasoning at mid-childhood relating to increasing proactive aggression might have cancelled out high moral reasoning relating to increasing reactive aggression. Moreover, children following the reactive Moderate-Decreasing/proactive High-Decreasing trajectory showed marginally low moral reasoning, whereas the reactive High-Stable/proactive High-Decreasing trajectory children did not show deficits in moral reasoning. Such findings suggest that children following high levels of proactive aggression from mid- to late-childhood (i.e., childhood-limited) may have deficits in moral development. More research is needed to investigate the role of morality in relation to these two subtypes of aggression.

Despite its novel focus on the associations of early sensation seeking, risk taking, and moral reasoning to developmental trajectories of reactive and proactive aggression, our study had several limitations. First, we only assessed sensation seeking, risk taking, and moral reasoning at one assessment point. Without longitudinal measures thereof, we were unable to determine if developmental shifts in these constructs were related to our observed shifts in reactive and proactive aggression into adolescence. Furthermore, beyond risk taking, sensation seeking, and moral reasoning, other regulatory and moral development variables, such as effortful control, emotion regulation, and moral emotions, may be differentially associated with reactive and

proactive aggression (see Eisner & Malti, 2015). Future research that includes these dimensions is warranted to further delineate which aspects of regulatory and moral development most strongly predict differential pathways of aggression subtypes. Second, our "Travel Game" for assessing sensation seeking is not widely used yet. However in the current study, sensation seeking was positively linked to reactive and proactive aggression both concurrently and across time. We also found that boys scored much higher in sensation seeking than girls did. These findings are in line with previous studies using distinct measures of sensation seeking (see Wilson & Scarpa, 2011). Our study demonstrated its good predictive validity but future studies are needed to further validate this measure. Also, sensation seeking was not correlated with risk taking in the current study. They may be different constructs as sensation seekers may accept risk as a possible outcome for obtaining arousal, but they do not necessarily seek out risk for its own sake (Roberti, 2004; Zuckerman, 1994). Both measures were also behavioral measures administered at different time points. The situation-based and occasion-specific nature of behavioral measures may have contributed to the lack of correspondence in the current study (De Los Reyes & Kazin, 2005). These reasons may explain the fact that we did not find significant correlations between sensation seeking, risk taking, and moral reasoning. Also, moral reasoning concerns the moral domain and is more cognitively infused as children need to weigh the complexity of social situations, while sensation seeking and risk taking concern the regulatory domain and may reflect reward sensitivity. However, some regulation is needed for individuals to conduct moral thinking and experience moral emotions without personal distress (Eisenberg, 2000), such that sensation seeking, risk taking, and moral reasoning may not be totally independent. Third, since risk taking and moral reasoning were assessed at T2, it is possible that

early aggression trajectories may have influenced these measures. The current study was unable to determine the direction of influence and future research should examine causality.

In sum, our findings suggest that sensation seeking, risk taking, and moral reasoning are differentially related to reactive versus proactive aggression. These findings deepen our understanding of the antecedents of reactive and proactive aggression and are useful for the design of differential assessments and developmentally tailored intervention strategies for these aggression subtypes. Specifically, reducing high levels of sensation seeking and risk taking by teaching children self-regulating strategies may be critical in curbing both reactive and proactive aggression, particularly during childhood.

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Table 1

Descriptive Statistics and Correlations between Study Variables

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*
1. Sex[a]	--																
2. SES	-.04	--															
3. SS	-.41***	-.02	--														
4. RT	-.05	-.06*	.05	--													
5. MR	.08**	.08**	-.03	.03	--												
6. RA T1	-.17***	-.10***	.17***	.06*	-.04	--											
7. RA T2	-.13***	-.12***	.12***	.10**	-.06*	.63***	--										
8. RA T3	-.17***	-.09**	.16***	.06*	.02	.48***	.58***	--									
9. RA T4	-.20***	-.05	.14***	.06*	-.01	.30***	.25***	.32***	--								
10. RA T5	-.18***	-.10**	.11***	.06*	-.00	.28***	.27***	.25***	.32***	--							
11. RA T6	-.16***	-.14***	.12***	.07*	-.03	.21***	.18***	.19***	.23***	.45***	--						
12. PA T1	-.03	-.09**	.12***	.12***	-.04	.60***	.45***	.36***	.25***	.20***	.15***	--					
13. PA T2	.01	-.11***	.11***	.12***	-.02	.41***	.62***	.45***	.18***	.22***	.13***	.61***	--				
14. PA T3	-.01	-.13***	.10***	.08**	.02	.33***	.40***	.61***	.23***	.19***	.16***	.45***	.61***	--			
15. PA T4	-.13***	-.05	.13***	.10***	.00	.26***	.22***	.32***	.65***	.23***	.20***	.31***	.26***	.31***	--		
16. PA T5	-.13***	-.11***	.09**	.09**	-.05	.23***	.21***	.19***	.27***	.63***	.39***	.24***	.25***	.20***	.25***	--	
17. PA T6	-.11***	-.13***	.10**	.08**	-.05	.11***	.09**	.13***	.19***	.32***	.61***	.13***	.14***	.16***	.19***	.40***	--
Mean	1.48	45.64	0.58	23.48	0.80	0.94	0.87	0.95	0.86	0.68	0.71	0.41	0.41	0.43	0.43	0.27	0.25
SD	0.50	19.32	0.25	11.31	0.23	0.96	0.93	0.93	1.00	0.87	0.87	0.64	0.63	0.64	0.68	0.56	0.53

Note. [a]Sex was coded as 1 = boy and 2 = girl. SES = Socioeconomic Status; SS = Sensation Seeking; RT = Risk Taking; MR = Moral Reasoning; RA = Reactive Aggression; PA = Proactive Aggression; T1-T6 = Time 1 to Time 6; SD = Standard Deviation.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2

Comparison of Models with Different Classes

		1-class	2-class	3-class	4-class	5-class
RA	Log-likelihood	-10459.41	-9730.81	-9533.00	-9333.47	-9333.47
	# of parameters	10	15	20	25	30
	BIC	20992.41	19572.01	19213.19	18850.93	18887.73
	AIC	20938.82	19491.61	19106.00	18716.94	18726.94
	Entropy	NA	0.77	0.76	0.78	0.58
	LMR-LRT *p*-value	NA	< .001	< .001	.03	.50
PA	Log-likelihood	-7247.22	-6356.77	-5942.39	-5762.32	-5590.34
	# of parameters	9	13	17	21	25
	BIC	14560.67	12809.22	12009.88	11679.19	11364.66
	AIC	14512.43	12739.54	11918.77	11566.64	11230.68
	Entropy	NA	0.89	0.90	0.88	0.89
	LMR-LRT *p*-value	NA	< .001	.02	.26	.27

Note. RA=Reactive Aggression; PA=Proactive Aggression.

Table 3

Joint and Conditional Trajectory Membership Probabilities

	Joint probabilities			RA trajectory conditional on PA trajectory			PA trajectory conditional on RA trajectory		
	PA trajectory			PA trajectory			PA trajectory		
RA trajectory	HD	LI	LS	HD	LI	LS	HD	LI	LS
HS	.08	.01	.01	.57	.11	.02	.78	.09	.14
MD	.05	.00	.20	.42	.02	.28	.21	.00	.79
LI	.00	.07	.05	.01	.86	.07	.02	.55	.44
LS	.00	.00	.54	.00	.02	.63	.00	.00	1.00

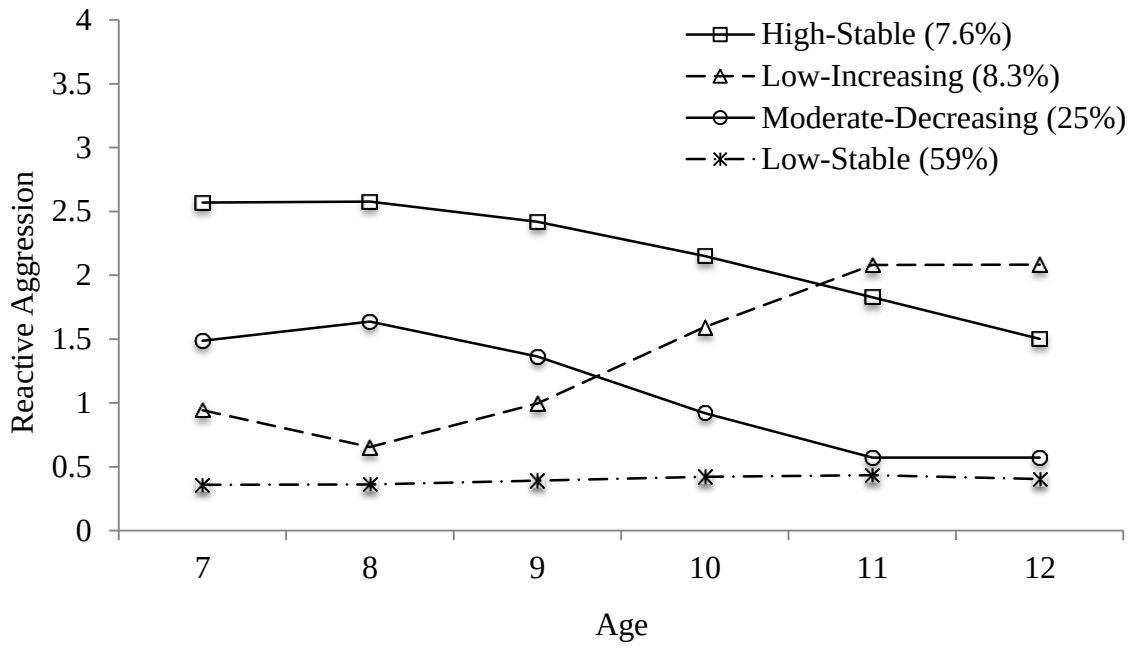
Note. RA = Reactive Aggression; PA = Proactive Aggression; HS = High-Stable; MD = Moderate-Decreasing; LI = Low-Increasing, LS = Low-Stable; HD = High-Decreasing.

Table 4

Prediction of Joint Reactive Aggression (*RA*) *and Proactive Aggression* (*PA*) *Trajectories*

	Joint trajectory groups (OR [95% CI])				
Predictors	RA HS/PA HD	RA MD/PA HD	RA MD/PA LS	RA LI/PA LI	RA LI/PA LS
Boy	2.09** [1.23, 3.55]	.61 [.34, 1.10]	1.34† [.99, 1.87]	1.50 [.90, 2.51]	1.78† [.98, 3.24]
SES	.60*** [.45, .76]	.72* [.55, .95]	.76*** [.66, .89]	.57*** [.44, .73]	.73* [.56, .97]
SS	5.92** [1.98, 17.69]	5.06** [1.50, 17.08]	1.68 [.88, 3.18]	2.34 [.82, 6.90]	2.30 [.68, 7.77]
RT	1.45*** [1.19, 1.78]	1.16 [.90, 1.49]	1.01 [.87, 1.18]	1.16 [.92, 1.45]	.83 [.62, 1.11]
MR	.63 [.23, 1.70]	.38† [.12, 1.13]	.98 [.51, 1.88]	.91 [.32, 2.59]	10.20** [2.11, 49.34]

Note. Reference group: RA LS/PA LS group (i.e., dual Low-Stable group). OR = Odds Ratio; SS = Sensation Seeking; RT = Risk Taking; MR = Moral Reasoning; RA = Reactive Aggression; PA = Proactive Aggression; HS = High-Stable; HD = High-Decreasing; MD = Moderate-Decreasing; LI = Low-Increasing; LS = Low-Stable.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.



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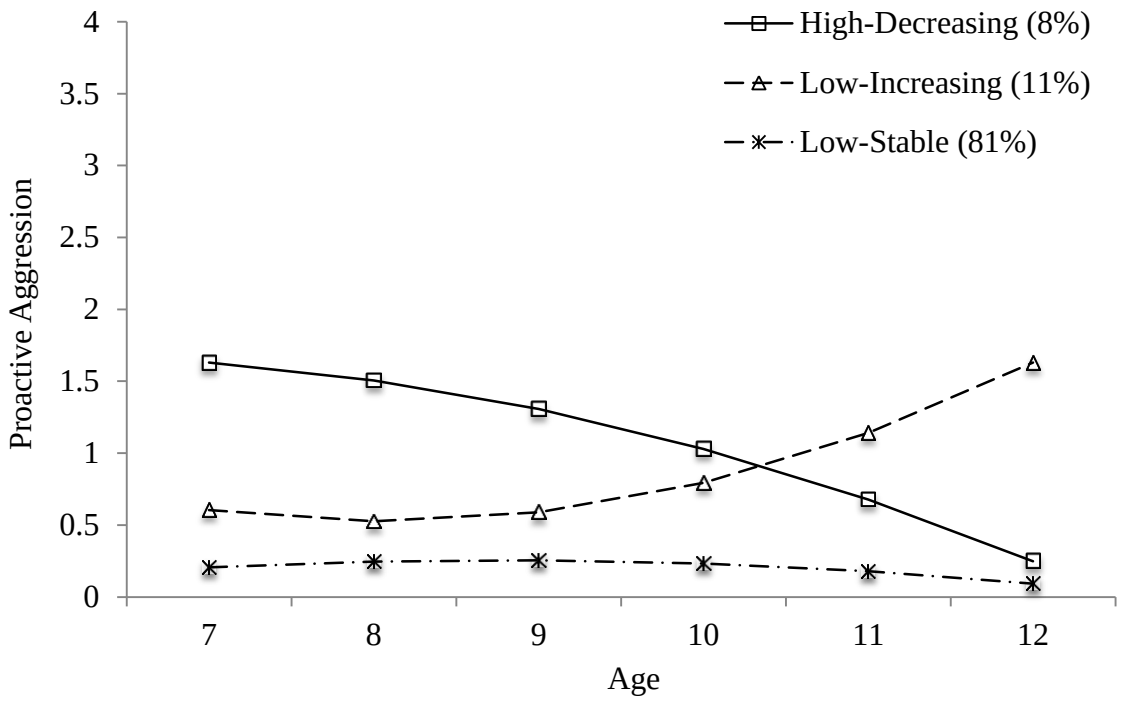

B

Figure 1. Developmental trajectories of reactive and proactive aggression from mid-childhood to early adolescence.