Development of male proactive and reactive physical aggression during adolescence

Edward D. Barker, Richard E. Tremblay, Daniel S. Nagin, Frank Vitaro, and Eric Lacourse

University of Montreal, Canada; Carnegie Mellon University, USA

Background: Different developmental courses have been postulated for proactive and reactive aggression. Objective: Investigated the developmental course of proactive and reactive aggression in a large sample of adolescent boys from low socioeconomic areas. Method: A dual group-based joint trajectory method was used to identify distinct trajectories as well as similarities and differences in intra-individual changes. Results: The trajectories for proactive and reactive aggression were similar: the majority of individuals followed infrequent and desisting trajectories. Contrary to expectations, very few adolescents followed trajectories of increasing proactive aggression. Reactive aggression was more common than proactive aggression. The overlap in trajectory group membership of individuals following trajectories of high peaking proactive and reactive aggression was nearly 100%. Across a period of 5 years, the boys on the high peaking trajectories were twice as likely to have affiliated with gangs. Conclusions: The developmental courses of proactive and reactive aggression are similar during adolescence. Males who tend to frequently use one form of aggression throughout adolescence also tend to frequently use the other and are at an increased risk for contemporaneous delinquent lifestyles. Keywords: Proactive, reactive, gang membership, dual trajectories. Abbreviations: BIC: Bayesian information criteria; PA: proactive aggression; RA: reactive aggression.

The World Health Organization reports that assaults involving adolescents and young adults are a leading cause of deaths, injuries, and physical disability (Krug, Dahlberg, Mercy, Zwi, & Lozano, 2002). The report also described physical aggression as a behavior that was learned during adolescence from exposure to social influences such as deviant peers. In contrast, recent longitudinal studies conducted in Canada, New Zealand and the United States indicate that almost all children resort to physical aggression less often as they grow older (e.g., Brame, Nagin, & Tremblay, 2001; Brody et al., 2003; Côté, Tremblay, Nagin, Zoccolillo, & Vitaro, 2002; Lacourse, Nagin, Tremblay, Vitaro, & Claes, 2003; Nagin & Tremblay, 1999).

Physical aggression, however, is a complex phenomenon: it is comprised of a variety of actions that have different functions, each of which could follow different developmental trajectories. For example, the division of aggressions into emotional reactions and instrumental acts has been made in a number of studies with children and adolescents (e.g., Berkowitz, 1993; Dodge & Coie, 1987; Hartup & de Witt, 1974). Angry and impulsive outbursts in response to a stressor or other provocation are labeled ‘reactive aggression’ (RA). ‘Proactive aggression’ (PA) is used to describe goal-oriented, predatory aggression, requiring neither provocation nor anger.

The majority of studies on RA and PA have operationalized these two types of aggression with teacher-reports developed by Dodge and Coie (1987). Although the two types of aggression are highly related (~.70) (see Vitaro & Brendgen, 2005), variable-centered studies have achieved reliable and valid measurement and construct validity (Dodge & Coie, 1987; Poulin & Boivin, 2000a). Likewise, person-centered studies show that RA in pre-adolescence is associated with early temperament problems (Vitaro, Brendgen, & Tremblay, 2002) and concurrent social adjustment problems such as classroom disruptiveness, negative social expectations and problematic peer-relations (Crick & Dodge, 1996; Dodge & Coie, 1987; Waschbusch, Willoughby, & Pelham, 1998). Preadolescent-to-early-adolescent PA, conversely, has been associated to positive expectancies for aggression and subsequent violent and non-violent conduct problems (Dodge, Lochman, Harnish, Bates, & Pettit, 1997; Vitaro, Gendreau, Tremblay, & Oligny, 1998). However, these person-centered studies have typically assessed the distinctiveness of PA and RA by using cross-sectional or pooled data to create heterogeneous groups using thresholds of, for example, 1 SD above the group mean. This strategy typically results in a majority of children discriminated as non-aggressive, followed by PA and RA mixed, RA only and PA only (for a review, see Vitaro & Brendgen, 2005). Although these studies have yielded important information about the prevalence of risk for aggression, they have not elucidated the stability and correlates of the PA and RA subtypes.

To our knowledge, no person-centered studies have assessed the developmental distinctiveness of PA and RA. The purpose of this study is to describe the intra-individual differences in the joint development of PA and RA in a sample of at-risk male ado-
lescents. We suggest that the observed decrease in the frequency of physical aggression from childhood to adulthood is largely driven by a decrease in RA. With brain maturation, children experience greater control over their negative emotional reactions, including anger (Kochanska, Murray, & Harlan, 2000). Emotional regulation may also contribute to goal-oriented aggression (e.g., Dodge et al., 1997). Thus, as they grow older, children would not only learn to control their emotionally based physical aggression, but also learn to use aggression for instrumental purposes (e.g., Lansford, Dodge, Pettit, & Bates, 2002). This would be the case especially during adolescence – changes in parental practices and parental monitoring (Menaghan, 2003) and an increase in affiliation with delinquent peers (Elliot & Menard, 1996; Warr, 1993) augment opportunities to engage in delinquent behaviors (Gottfredson & Hirschi, 1990). Males may be at particular risk for greater PA in adolescence, hence be more likely to affiliate with PA peers (Poulin & Boivin, 2000b; Vitaro et al., 2002). Thus, the developmental trajectories of PA and affiliation with deviant peers should be positively related.

From the available data and theoretical considerations three trajectories for each type of aggression can be expected: 1) a never group, 2) a group that increases in PA and a group that decreases in RA, and 3) a small proportion that have high levels of PA or RA. The differences in the frequency of PA and RA should lead to the following joint trajectories: a) the majority are non-aggressive, b) a sizable proportion follow a moderate trajectories of decreasing RA and increasing PA, c) a minority follow a decreasing trajectory in RA but never engage in PA, and d) a minority of adolescents follow an increasing chronic trajectory for PA while never engaging in RA. We also expected that boys in joint trajectory groups characterized by increasing PA would be more likely to affiliate with deviant peers via involvement in gangs.

This paper tested these hypotheses with a sample of male adolescents from low socioeconomic areas in a large North American city. Because of the higher rates of violence and greater prevalence of gangs in poor neighborhoods, this sample was expected to increase the likelihood of identifying some of the smaller high-risk joint trajectory groups, such as the chronic PA and RA and PA-only groups, and yield sufficient variance on the deviant peer affiliation outcome.

Method

Subjects

This sample was restricted to inner-city boys from the ages of 13 to 17. The rationale for the exclusion of females in the original sampling design was that males are at greater risk for delinquent behavior. The 1037 boys in the present study were part of an ongoing longitudinal study of children from low socioeconomic areas in Montréal, Québec, Canada. All were born to French-speaking Canadian parents. Their parents’ average score on the Blishen, Carroll, and Moore (1987) scale for occupational prestige was 38.29 (SD = 12.10) for the mothers and 39.44 (SD = 12.86) for the fathers. These scores represent low to average socioeconomic levels.

Because the analyses were conducted using maximum likelihood estimation, all boys were included in the present analyses (see Jones, Nagin, & Roeder, 2001). The sample sizes for PA and RA, respectively, by year, were as follows: 13 years n = 887 and 886; 14 years n = 886 and 865; 15 years n = 844 and 844; 16 years n = 826 and 826; and 17 years n = 790 and 791. Patterns of missing data were similar for the trajectories of PA and RA. The majority of the boys with three or more missing data points were in the low trajectories (proactive: 22.92%; reactive: 26.46%), followed by the medium trajectories (proactive: 7.58%; reactive 12.35%) and the high trajectories (proactive: 7.35%; reactive: 7.73%). To confirm that the missing data did not bias the trajectory parameter estimates the joint trajectories were also estimated with a reduced sample (N = 854) in which boys with three or more missing data points on each subscale were excluded. Because the results of the reduced sample analysis were equivalent to those of the full sample analysis, all analyses presented below used the full sample.

Measures

Self-reported PA and RA. In keeping with existing studies on PA and RA, the boys completed three RA and three PA items used by Dodge and Coie (1987). These items were translated to French. Following Little, Jones, Heinrich, and Hawley (2003) self-reports were used instead of teacher ratings. Self-reports in adolescence are often preferred to teacher-ratings for two reasons. First, self-reports show significant association to official court records of aggressive acts (see Loeber & Farrington, 2000). Second, adolescents are unsupervised by teachers and parents during the times in which they are most likely to be involved in aggressive and delinquent behaviors (U.S. Department of Education, 2000). In the current sample, self-reports of PA and RA (ages 13 to 17) were associated \( r_{mean} = .62, \) Range = .54–.65 at a lower rate than teacher-ratings (ages 13 to 15) \( r_{mean} = .20; \)

1 This sample has been utilized in other publications focusing on the development of physical aggression (e.g., Brame, Nagin, & Tremblay, 2001; Nagin & Tremblay, 2001). An intervention was embedded in the study for 46 of the boys and positive effects were found (see Lacourse et al., 2002). To confirm that intervention did not bias the trajectory parameter estimates the joint trajectories were also estimated with the 46 boys. Because the results of the reduced sample analysis were equivalent to those of the full sample analysis, all analyses used the full sample.

2 To assess the validity self-reports versus teacher-reports, we estimated correlations between self- and teacher-reports. RA \( r_{mean} = .20; \) Range = .17–.24 and PA \( r_{mean} = .14; \) Range = .13–.15 functioned similar to a ten-year comparison of teacher- and self-reports of externalizing behaviors \( r = .20 \) (Achenbach, Dumenci, & Rescorla, 2002).
Delinquent group membership. As part of the annual assessments from ages 13 to 17 years, participants were asked, ‘During the past 12 months, were you a member of a gang that did reprehensible acts?’ Use of a single dichotomous item has a long tradition in criminological studies of gangs and delinquent effects (Howell, Egley, & Gleason, 2000; Lacourse et al., 2003; Thornberry, Krohn, Lizotte, & Chard-Wierschem, 1993; Warr, 1993). We used this item to test whether the state of following an increasing trajectory for PA would increase the likelihood of concurrent engagement in a delinquent lifestyle. Criterion validity of this item, with the current sample (i.e., Lacourse et al., 2003) and other studies, includes significant relationships between gang membership/delinquent peer association, property offences, drug sales, drug use and physical aggression (Thornberry, 1998; Lacourse et al., 2003; Warr, 1993). We found participation in a delinquent group between the ages of 13 to 17 was significantly correlated (p < .001) with measures of PA ($r_{mean} = .28$; Range .24–.31) and RA ($r_{mean} = .33$; Range .28–.36) in each year.

Data analysis

The analysis proceeded in three steps. First, distinctive clusters of developmental trajectories were identified for PA and RA, separately. For each trajectory group, the model defined the shape of the trajectory (i.e., stable, increasing, desisting) and estimated the proportion of the population belonging to each group. A key step in the estimation of models is selecting the number of trajectory groups that best fit the data. Model selection was based on the Bayesian Information Criteria (BIC) which is calculated as $-2\log(L) + \log(n)k$, where $L$ is the model’s maximized likelihood, $n$ is the sample size, and $k$ is the number of parameters in the group (Nagin, 1999). This statistical procedure also provides for each subject, 1) the probability of belonging to each trajectory group, and 2) the assigned trajectory group based on the highest probability. Individuals in a given trajectory should have a high probability (range 0 to 1) of assignment to their group and a low probability of being assigned to the other groups. Mean probabilities equal to or greater than .7 imply satisfactory fit (Nagin, 2005).

Second, the joint trajectories were estimated. These are the results reported in the current study. Key outputs of a joint model are the conditional and joint probabilities of trajectory membership across two behaviors. Conditional probabilities (e.g., the probability of increasing PA given decreasing RA and the converse conditional probability) and the joint probabilities of belonging to both trajectories (e.g., the proportion of boys following increasing PA and decreasing RA) are useful in concretely describing the co-occurrence of two related but distinct behaviors (Nagin & Tremblay, 2001).

In the third step, a cross-tabulation of gang affiliation between the ages of 13 to 17 and the boys’ joint trajectory membership was estimated. The tabulation was conducted in SAS (SAS Institute, 2001). The joint posterior probabilities served as a weight for the group membership, correcting for potential uncertainty in trajectory assignment.

Results

Hypotheses 1, 2 and 3: Individual trajectories

A decision was made to stop at three-group models. Additional groups were subdivisions of low trajectories. Each trajectory for PA and RA was modeled as a quadratic function of age. The average group assignment probabilities were between .78 and .89.

The trajectories for PA and RA were highly similar (Figure 1). For both PA (58.7%) and RA (52.6%), the modal trajectory reflected near zero means. The second largest trajectory was a group of boys (PA 34.6%; RA 40.8%) that showed initial moderate levels but desisted thereafter, i.e., the ’moderate desisters.’ The third group, the ‘high peaking group,’ was the most distinct in terms of shape. This trajectory for PA (6.7%) and RA (6.6%) increased from age 13, peaked at age 15, and decreased thereafter to a lower rate than that reported at the base-line assessment.

The identified RA trajectories were consistent with our first hypothesis. A majority of boys were non-aggressive. The second hypothesis was validated only for RA; the second largest group was that of desistance. The same was true for PA, but we had hypothesized this group would increase. Conversely, hypothesis 3 was validated only for PA; a minority of the boys exhibited high levels. PA and RA did not appear to increasingly diverge in developmental patterns.

Hypotheses a through d: Joint trajectories

Table 1 supports the developmental similarity of PA and RA. The first part of the table contains the probability of membership in each of the three PA trajectories, conditional on membership in each of the three RA trajectories. The second part of the table consists of the converse set of probabilities. The high overlap between the two types of aggression is evident in the diagonal elements of the probability matrices. For example, the probability of belonging to the
high peaking trajectory group for RA conditional on membership in the counterpart PA group is .966 (first part of Table 1). The converse probability is also high (.947, second part of Table 1). These results indicate that high PA and RA co-occurred within the same adolescent. Important differences, however, did exist, particularly for the medium desisting groups. Twenty-five percent of the adolescents following moderate desisting RA belonged to never PA (first part of Table 1) and about 17% following the moderate desisting PA group belonged to the never RA group (second part of Table 1).

Joint probabilities are located in the 3rd part of Table 1. The highest probabilities are again located on the diagonal elements of the matrix. The modal group is comprised of boys who followed the never trajectories. This group accounts for 49% of the population. In total, 79% percent belonged to the desisting or never trajectories for both types of aggression. Approximately 6% of the boys followed the high peaking trajectories. Ten percent of the boys were moderate desisters in RA and never PA. Also note the absence of boys who were high in one type of aggression and low in the other.

The outcome of the joint trajectories supported only hypothesis a. The majority never engaged in either type of aggression. The other hypotheses were not supported. A sizable proportion of boys were not increasing in PA while decreasing in RA, and children did not specialize in either type of aggression (e.g., increase PA/never RA).

Gang affiliation

Figure 2 contains the percentage of the boys within each group that reported they had been a ‘member of a gang that did reprehensible acts.’ Results clearly indicate – contrary to our expectations – that boys in
the high peaking trajectories for PA and RA (n = 66) were at least twice as likely to affiliate with gangs (range 43% to 64%) compared to the boys in any other trajectory group (7 to 25%). Note that the remaining trajectories were indistinguishable from each other.

Discussion

The present results appear to speak against a clear empirical developmental distinction for male adolescent PA and RA (see Dodge et al., 1997), but appear, in part, to support theoretical arguments that PA and RA generally co-occur (Bushman & Anderson, 2001). We found that the developmental trajectories of proactive aggression and reactive aggression were very similar. The best model for each type of aggression contained three trajectory groups where the mode was of low levels and desistance for each type of aggression. There was also high co-morbidity between trajectories. The likelihood to develop in different PA and RA trajectories was restricted primarily to the desisting and never trajectories.

The peak in RA was not consistent with our expectations. Our findings indicate that early adolescence may be a challenging period for a substantial number of males with weak abilities to regulate emotionally based reactions. The 'hump-shaped' trajectory for high PA is consistent with previous research on physical aggression and juvenile delinquency, and lends support for the 'age-crime curve' model based on official crime data (e.g., Farrington, 1987; Quetelet, 1833; Sampson & Laub, 2003). High trajectories of antisocial behaviors, after early childhood, including the use of physical aggression to steal or dominate others, are expected to peak during late adolescence or early adulthood, and then decline steadily during adulthood (Sampson & Laub, 2003; Tremblay, 2003; White, Bates, & Buyske, 2001). Our results should not be interpreted as support for adolescent-onset aggression, since the group of subjects with increasing frequency of PA was already showing the highest levels of physical aggression at the initial assessment (see Brame et al., 2001).

The conditional probabilities confirmed the converging developmental course for PA and RA, especially for the high peaking trajectories. Nearly 100% of the children who followed the high peaking trajectory for one type of aggression followed the same trajectory in the other form of aggression. The joint probabilities also indicated a substantial behavioral overlap. The majority of the children were estimated to be in the never trajectories, followed by the medium desisting and high trajectories. Adolescents high in PA but low in RA (n = 1), and the converse (n = 0), were virtually non-existent. This does not preclude different developmental processes before or after adolescence for RA and PA; however, if these developmental processes are different the resulting trajectories are very similar, except for the fact that RA is more frequent than PA.

To test the hypothesis that adolescents on a high trajectory of PA would be more likely to be involved in a delinquent lifestyle, we compared the percentage of boys in the joint trajectories who reported affiliating with deviant peers. We found that the adolescents in the high peaking aggression group (PA and RA) were twice as likely to have affiliated with a gang across all 5 years. This finding is supported by research that suggests boys who associate with delinquent peer groups are more delinquent and physically aggressive (Dishion, Patterson, & Griesler, 1994; Thornberry, 1998; Vitaro, Tremblay, Kerr, Pagani, & Bukowski, 1997; Warr, 2002).

The boys on the high peaking PA and RA trajectories were increasing in PA and RA from 13 to 15 years of age but decreased from 15 to 17. What causes the increase and the decrease of these socially
disruptive behaviors? As discussed above, because high PA and RA are found in the same individuals, it is tempting to conclude that they have the same causes. This may not be the case. For example, if participation in gangs increases PA, an intervention that prevents gang participation should deflect only the PA trajectory. On the other hand, an intervention that targets only RA may not have an impact on PA. To the contrary, increased control over emotions could, in some cases, increase the use of proactive aggression. Preliminary evidence for this idea comes from a study by Phillips and Lochman (2003). In a normative sample of 10–12-year-old boys, a PA-based intervention successfully reduced both PA and RA whereas an RA-based intervention reduced only RA.

It will be important to reconcile the contradictory findings of the current study with those studies that have reported a distinction between the two types of aggression. The majority of prior studies, however, have not longitudinally modeled the two types of aggression. For example and as stated in the introduction, PA and RA have been distinguished on the basis of temperament, social cognition and conduct problems, etc. These studies, however, are primarily cross-sectional or have pooled multiple data points to serve as predictors or outcomes. When person-centered strategies are employed, such as using a threshold basis for distinguishing high and low levels of PA and RA (i.e., never, proactive/reactive mixed, reactive only, proactive only), these classes must be assumed a priori. Thus the analysis cannot test for the presence of groups, a fundamental shortcoming. A second and related pitfall is that ex ante specified rules contain no basis for calibrating the precision of the individual classifications to the different groups that comprise the taxonomy, thus uncertainty about an individual’s group membership cannot be quantified in the form of probabilities.

The current study employed dual group-based modeling (for review, see Nagin, 2005). A principal advantage of this approach is that it is well suited for identifying heterogeneity in developmental trajectories, rather than assuming it. Individuals are assigned to trajectory groups on the basis of probabilities. These probabilities, in turn, were used in subsequent analyses to correct for potential uncertainty in class assignment. Similar to highly physically aggressive youth, high PA and RA boys were the most likely to engage in delinquent lifestyles.

It is important to note that the high trajectories did function remarkably similar to trajectories of physical aggression estimated in the same sample: 1) a majority of the boys showed low and desisting levels during adolescence (Nagin & Tremblay, 1999), 2) a small proportion of the boys followed a high trajectory, and that group peaked at 15 years of age and thereafter desisted (e.g., Brame et al., 2001), and 3) these boys were at the greatest risk for engaging in delinquent lifestyles (e.g., Lacourse et al., 2003; Nagin & Tremblay, 1999). Because Little et al. (2003) found, in a cross-sectional study, that PA and RA were not correlated after controlling for the form of aggression (e.g., physical, verbal, and indirect), it will be important in future efforts to model the joint development of PA and RA while controlling for different forms of aggression. However, longitudinal studies from early childhood to adulthood are needed to describe the development of PA and RA.

This study had limitations that should be noted. Because it was restricted to a sample of French-speaking adolescent boys who were brought up in low socioeconomic areas of a large North American city, replications will be needed with other populations to verify the generalizability of the results. The high overlap between the two types of aggression may be an artifact of a high-risk sample that consisted of boys. It may also be due to the use of a different rating source compared to most of the prior literature (i.e., self-reports versus teacher-reports) with younger children. Recall, however, in this sample, self-reports (ages 13–17) were associated at a lower rate than teacher-reports (ages 13–15). It will be also important to replicate this study on a normative and, presumably, less aggressive sample of boys. It will be especially interesting to replicate the study with females as well as with participants from other cultures. Because the data in the present study covered a limited range of development, the observed trajectories may change substantially in a study that would include observations from childhood and observations from young adulthood (Nagin, 2005; Tremblay, 2003). In addition, future work should include multiple informants due to the possibility of biased or false self-reports – agreement between mother-reports, teacher-reports, peer-reports and self-reports will add significantly to our knowledge about the developmental course of PA and RA.

Conclusion

In sum, this study provides new insight into the developmental course of adolescent PA and RA. Our results, based on over-sampling of at-risk males, suggest that boys who are high in the use of one form of aggression are almost 100% likely to be high in the other. It is these males who had a high affiliation with gangs. It is also these males that we should also be the most concerned about. Future studies should examine how these boys differ in demographic, psychosocial, biological, family, and environmental variables compared to boys on the other trajectories. The distinction between PA and RA appeared to largely be restricted to the boys following these other trajectories.
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Correspondence to

Ted Barker, GRIP, University of Montréal, 3050 Édouard-Montpetit, Montréal, (Québec) H3T 1J7, Canada; Tel: 514-343-6111 Ext. 1 + 2538; E-mail: edward.dylan.barker@umontreal.ca

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