



# Developmental trajectories of conduct problems and hyperactivity from ages 2 to 10

Daniel S. Shaw,<sup>1</sup> Eric Lacourse,<sup>2</sup> and Daniel S. Nagin<sup>3</sup>

<sup>1</sup>Department of Psychology, University of Pittsburgh, USA; <sup>2</sup>Ste-Justine Hospital Research Center, Research Unit on Children's Psychosocial Maladjustment, University of Montreal, Canada; <sup>3</sup>H. John Heinz III School of Public Policy and Management, Carnegie Mellon University, USA

**Background:** Conduct problems (CP) and hyperactivity/attention problems (HAP) are thought to covary with regularity, yet few studies have examined their co-occurrence or risk factors that discriminate their trajectories beginning in early childhood. **Method:** The present study sought to advance our understanding of this issue by examining separate trajectories of overt CP and HAP symptomatology among 284 boys from urban, low-income families followed from ages 1.5 to 10. We also investigated the co-occurrence of persistent CP and HAP and explored risk factors that discriminate CP and HAP trajectories. **Results:** Four similar trajectory groups were identified for both CP and HAP symptoms. Chronic CP was differentiated from persistent low CP by risk factors in child, parenting, and family domains, while chronic trajectories of HAP were typified by elevated maternal depressive symptoms compared to children with persistent low HAP. **Conclusions:** The findings extend previous research with older children of HAP and/or CP, highlighting the effects of proximal family and child risk factors that are identifiable in the first two years of children's lives and associated with trajectories of disruptive behavior. **Keywords:** Hyperactivity, antisocial behavior, longitudinal studies, disruptive behavior, parenting, family factors.

Most prominent theories of early-starter trajectories of antisocial behavior emphasize the significance of the co-occurring pattern of conduct problems (CP) and hyperactivity/attention problems (HAP) (Moffitt, 1993; Patterson, 1982). Although there is widespread agreement that the co-occurrence of these two sets of behaviors is highly predictive of serious forms of later antisocial behavior, few studies have traced the probability of co-occurring CP and HAP longitudinally, particularly beginning in early childhood (Moffitt, 1990; Nagin & Tremblay, 2001a).

There is a broad consensus about some issues regarding the relationship between overt conduct problems and HAP. Both are viewed as relatively stable from the preschool period onward (Campbell, Shaw, & Gilliom, 2000), and most children show decreasing frequencies of both behaviors as a function of age, despite a relatively small group of children who show clinically elevated symptoms of one or both patterns (Nagin et al., 2001a). The cooccurrence of HAP and CP is also thought to be high, particularly among children with serious CP (Barkley, Fischer, Edelbrock, & Smallish, 1990; Weiss & Hechtman, 1993). Nevertheless, CP and HAP are viewed as related but distinct dimensions (Fergusson, Horwood, & Lloyd, 1991; Hinshaw, 2002). In a recent review, it was noted that CP and HAP co-occur at a greater than random rate and that this comorbid pattern differs from HAP-only and CP-only by having an earlier onset and a more serious course (Waschbusch, 2002).

Despite these areas of agreement, there is little prospective data on the progression of HAP and CP

symptomatology beginning in the toddler period, and even less information on child, family, and socioeconomic factors that differentiate trajectories of CP and HAP. Thus, a primary goal was to explore the co-occurrence of CP and HAP beginning at age two. We were also interested in exploring risk factors associated with chronic CP versus HAP-only, and comparing these pathways to trajectories with consistently low levels of CP and HAP. Although recently a few investigators have examined the issue of risk factors that discriminate trajectories of CP beginning in early and middle childhood (Nagin & Tremblay, 2001a; Shaw, Gilliom, Ingoldsby, & Nagin, 2003), fewer studies have explored if chronic trajectories of CP and HAP have distinct correlates, and how these patterns might vary from those children with low levels of both CP and HAP. For example, Shaw and colleagues (2003), using data from the present cohort from ages 2 to 8, reported that chronic and high desistant CP trajectories were distinguished from moderate desistant and persistent low CP trajectories by levels of maternal depression and child fearlessness assessed when children were age 2, whereas chronic high versus initially high but desistant pathways were distinguished by early child fearlessness and rejecting parenting. However, this study did not investigate trajectories of HAP. Closer to the goals of the present study, Nagin and Tremblay explored the joint trajectories of aggression and hyperactivity from ages 6 to 15. They found that children following trajectories of low hyperactivity nearly always demonstrated trajectories of low physical aggression; however, 72% of youth in the chronic physical aggression group were not

members of the chronic hyperactivity group, suggesting a complex relationship between aggression and hyperactivity. It should be noted that this study did not examine factors associated with trajectories of HAP, nor begin prior to school entry when patterns of both early-starting CP and HAP become stable.

Several investigators have postulated and shown that children with persistent trajectories of HAP or CP are characterized by a co-occurring pattern of family risk factors; child problem behaviors have been found to more likely persist in the context of family dysfunction and stress (Ackerman, Kogos, Youngstrom, Schoff, & IZard, 1999; Campbell, Pierce, Moore, Marakovitz, & Newby, 1996; Greenberg, Leguna, Coie, & Pinderhughes, 1999). In fact, previous research has suggested that several factors in the child's distal and more proximal caregiving environment are associated with pathways leading to chronic externalizing trajectories. More distal factors include low maternal educational attainment, overcrowding in the home, and teenage parenthood (Loeber & Dishion, 1983; Nagin, 1999; Rutter, Cox, Tupling, Berger, & Yule, 1975), with more proximal factors including parental well-being and caregiving practices (Shaw et al., 2003; Shaw, Owens, Giovannelli, & Winslow, 2001; Spieker, Larson, Lewis, Keller, & Gilchrist, 1999). Child factors have also been shown to be associated with early and chronic patterns of externalizing problems, including such factors as negative emotionality, effort control, impulsivity, and fearlessness (Barkley, 1997; Bates, Dodge, Pettit, & Ridge, 1998; Olson, Schilling, & Bates, 1999; Rothbart & Bates, 1998; Shaw et al., 2001, 2003). However, most longitudinal research of this type has focused on trajectories associated with CP rather than HAP. We are unaware of research that has directly compared early correlates of CP and HAP trajectories beginning in early childhood.

Based on previous studies, including an earlier report of the present cohort, we expected persistent trajectories of CP to be characterized by a broad range of child, family, and socioeconomic risk factors (Fergusson, Horwood, & Lynskey, 1993; Nagin & Tremblay, 2001a; Shaw et al., 2003), including maternal depressive symptoms, rejecting parenting, child fearlessness, and sociodemographic risk. Based on a model of CP postulated by Patterson, DeGarmo, and Knutson (2000), in which HAP place young children at risk for later CP when accompanied by disruption in parental discipline strategies, we expected chronic trajectories of HAP-only symptoms would be differentiated more by child factors in combination with sociodemographic risk, rather than such proximal caregiving factors as rejecting parenting and maternal depression. That is, we would expect a pattern of early HAP symptoms to be accompanied by high CP in the context of high proximal family risk. Thus, we expected chronic CP/HAP children to show higher levels of rejecting parenting and maternal depression than chronic

HAP-only children, but show similar levels of child (e.g., negative emotionality) and sociodemographic (e.g., low maternal educational attainment) risk.

Accordingly, the first goal of this paper was to use a semiparametric mixture model (Nagin & Tremblay, 1999) to trace individual trajectories of overt CP and HAP symptomatology from ages 2 to 10 using data on 284 boys from ethnically diverse, low-income urban families. Based on recent research that has documented a similar pattern of decreasing growth of HAP and CP between the school-age period and adolescence (Nagin & Tremblay, 1999), we hypothesized that similar developmental trajectories would be identified from ages 2 to 10, including groups that would follow a persistently high or persistently low course, and those that would demonstrate a pattern of desistence.

A second goal was to examine the rate of comorbidity of persistent overt CP and persistent HAP trajectories, with the expectation that a majority of children with overt CP would also have a persistent trajectory of HAP, but that a lower percentage of persistent HAP children would show a chronic pathway of overt CP.

Our third goal was to examine child, family, and sociodemographic risk factors that would differentiate developmental trajectories of persistent CP, persistent HAP and a persistent course of low rates of CP and HAP symptoms. Based on prior research (Aguilar, Sroufe, Egeland, & Carlson, 2000; Campbell et al., 2000; Greenberg et al., 1999), it was hypothesized that persistent trajectories of CP and persistent trajectories of HAP would both be characterized by a greater number of child and socioeconomic risk factors than those with persistent trajectories of low CP and HAP symptoms, but that persistent trajectories of CP, many of whom were expected to share a history of HAP symptoms, would demonstrate high levels of rejecting parenting and maternal depression (Bates et al., 1998; Shaw, Bell, & Gilliom, 2000).

Finally, as our trajectory groups were defined solely by maternal report, a fourth goal was to examine whether teacher report would discriminate groups of children characterized by persistently high versus persistently low trajectories of CP, HAP, and/or co-occurring CP/HAP as reported on by mothers.

## Method

### *Participants*

Participants included a community sample of low-income boys and their families recruited from the Women, Infants, and Children (WIC) Nutritional Supplement Programs in the Pittsburgh metropolitan area (Shaw, Winslow, & Flanagan, 1999). WIC provides nutritional food supplements for income-eligible participants from pregnancy until children are 5 years old. Three hundred and ten participants were recruited from WIC sites

throughout the Pittsburgh metropolitan area over the course of 2 years. The sample was limited to boys because of their higher risk for serious antisocial behavior, which was the study's primary focus. Participants were recruited when target children were between 6 and 17 months old. At the time of the first assessment, at which time infants were 1.5 years old, mothers ranged in age from 17 to 43 years, with a mean age of 28. Fifty-three per cent of participants were Caucasian, 36% were African American, 5% were biracial, and 6% were other (e.g., Hispanic). At the age 1.5 visit, 65% were either married or living together, 26% were single, 7% were divorced, and 2% were other. Mean per capita family income was \$241 per month (\$2,892 per year), and the mean Hollingshead socioeconomic status score was 24.8, indicative of a working class sample.

Of the 310 families recruited for the initial assessment at age 1.5 years, data were available on 302 at the age 2 assessment. Subsequent lab or home assessments were convened when children were ages 3.5, 5, 6, 8, and 10, during which time retention rates ranged from 84–91% per assessment. At age 10, 85% of the 310 remained in the study with an average of > 90% retention for individual assessments. For the purposes of modeling individual trajectories, measures of CP were required at three or more time points, resulting in a sample of 284 boys. To examine whether attrition may have biased the sample selection, we compared families whose data were used in the present study (i.e.,  $\geq$  three assessments) to those with fewer than three assessment points. Families who were included versus excluded in the analyses did not differ on any variables used in the study.

### Procedures

A full description of the procedures used in the study can be found elsewhere (Shaw et al., 2003; Shaw, Winslow, & Flanagan, 1999). At ages 1.5 and 2, mothers and target children were seen in our laboratory for approximately 2 hours. These visits included structured parent-child interactive tasks, free play, and maternal interviews. Assessment tasks in the lab were selected to vary in stress level so that mother and child behavior could be observed across a broad spectrum of conditions. All tasks conducted in the lab were recorded on videotape for future coding. The age-2 laboratory visit was preceded by a 1.5-hour-long home visit (i.e., occurred on the same day) to observe the quality of the home environment and parent-child interaction during structured tasks and during an interview with the mother. As part of both lab visits, mothers completed inventories about depressive symptomatology and were observed with their sons in a clean-up task. At the age-2 lab visit, children were also observed in the inhibition paradigm.

Negative emotionality was rated from all observational tasks (approximately 70 minutes in length) at the age 1.5-year assessment, including such procedures as a free play, a clean-up, a no toys waiting task (Smith & Pederson, 1988), a high-chair task (Martin, 1981), teaching tasks, and the Strange Situation (Ainsworth & Wittig, 1969).

The clean-up task is widely used in research on parenting behavior with young children. After a

15-minute warm-up period in which boys played with a variety of toys while mothers completed questionnaires with an examiner, mothers were told to instruct their child to put the toys in a basket. Mother-child dyads were allowed five minutes to complete the task.

A measure of nonsocial behavioral inhibition (i.e., fearlessness/fearfulness), adapted from the work of Kagan (1997), was administered midway through the age-2 lab assessment. After the lab room was cleared of toys and mothers were given several questionnaires to complete, an audio recording of gorilla noises was played intermittently for 2 minutes, concealed in a closed cabinet across the room from where the child and mother were located. The audio recording was a compilation of scenes from the movie, *Gorillas In the Mist*, in which gorillas howled in a threatening manner while being chased by hunters.

### Measures

**Maternal age and education.** As part of a demographic interview conducted at the age 2 assessment, information about maternal age at the birth of her first child and educational attainment was gathered. It should be noted that because families were required to have another sibling living at home at the time of the recruitment, relatively few of the mothers were under 20 years of age at the time the target child was born ( $n = 17$ ).

**Child fearlessness.** Ratings of fearlessness were assessed from boys' behavior during the Gorilla Task on two molecular and two global scales (Shaw et al., 2003). Coders included one full-time research staff and one advanced undergraduate student, who were trained over a four-month period by the first author. The molecular codes included *latency to approach the cabinet* (the source of the recorded gorilla sounds) and *time in close proximity to mother*. The global ratings included *distress* and *approach/avoidance*. Distress was defined as facial or vocal expressions of fear and anxiety (e.g., crying; whimpering; statements indicating distress, such as 'I'm scared'). Coders took into account both the duration and intensity of distress cues. Ratings of approach/avoidance were based on the extent to which they approached and investigated the cabinet. The global ratings were made on 4-point scales. Inter-rater reliability was .9 or greater on all scales based on 20% of cases coded by two raters. To create a single index of behavioral inhibition, the four ratings were subjected to principal-components analysis. One factor emerged with an eigenvalue greater or equal to one. This factor accounted for 49.22% of the total variance.

**Child negative emotionality.** Negative emotionality was assessed based on the amount fussing and crying shown during all of the observational procedures during the age 1.5 lab visit, which included exposure to both stressful (i.e., Strange Situation) and nonstressful (e.g., free play) tasks approximately one hour in duration. The final scale was based on one molecular and three global codes, the latter of which were made after watching the entire 70-minute session (Owens, Shaw, & Vondra, 1998). For the molecular rating, coders

recorded the amount of time (i.e., in seconds) the infant spent fussing and crying. Percent of time spent fussing and crying was calculated by dividing seconds of fussing and crying by total seconds in which the infant was observable. The same coders made global ratings of the amount and intensity of negative emotionality. Coders also made a global rating of difficulty, which was based on the amount and intensity of the infant's fussing and crying during the assessment. To inform overall global ratings, each episode was assigned a score (e.g., teaching tasks, Strange Situation), but coders were also permitted to use critical events to influence final global scores (e.g., child has a severe tantrum during the free play). Coders received formal training in normative behavior for children this age to provide a foundation for their ratings. Interrater agreement in the form of weighted kappa coefficients for all components of the measure was calculated across 10 randomly selected tapes and ranged from .77 to .88, with a mean of .83. The molecular and global ratings were standardized and summed to create an observed negative emotionality score (Cronbach's  $\alpha = .90$ ).

### Maternal depressive symptoms

*Beck Depression Inventory (BDI)*. The BDI, a well-established and widely used measure of depressive states (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), was administered at the age 1.5- and 2-year assessments. Split-half reliability of the scale is high (.86 to .93). A composite was formed based on the scores at ages 1.5 and 2 (see Shaw et al., 2003). Empirically, this was justifiable given that correlations between composited BDI scores were equal to  $r = .66$ ,  $p < .0001$ .

### Rejecting parenting

Maternal rejecting parenting was measured in two ways at ages 1.5 and 2: from videotapes of the clean-up task using the Early Parenting Coding System (EPCS; Winslow & Shaw, 1995) and from examiner report using the Home Observation for Measurement of the Environment (age 2 only; HOME; Caldwell & Bradley, 1984). The EPCS measure of harsh parenting included two molecular ratings – *verbal/physical approval* and *critical statement* – and three global ratings – *hostility*, *warmth*, and *punitiveness*. For molecular ratings, Cohen's kappa coefficients ranged from .79 (critical statement) to .83 (verbal/physical approval). Principal-components analysis of the two molecular and three global ratings yielded a single factor with an eigenvalue greater than one. For the present study, a composite rating was created by averaging rejecting factor scores from the age 1.5 and 2 assessments.

The HOME assesses the quality and quantity of support and stimulation in the child's home environment using semi-structured observation and parent interview. The eight-item *Acceptance of Child's Behavior* subscale taps parent's responses to child misbehavior or distress. The HOME has demonstrated good reliability and validity properties (Caldwell & Bradley, 1984). Trained graduate student research assistants completed the HOME during home visits when boys

were 2 years old. The HOME Acceptance scale and EPCS rejecting parenting factor were negatively correlated  $r = -.33$ ,  $p < .01$ ). To create a single measure of rejecting parenting, HOME Acceptance standard scores were reverse scored and added to standard scores derived from the EPCS rejecting composite at ages 1.5 and 2 years (Shaw et al., 2003).

### Child conduct problems

*Child Behavior Checklist (Achenbach, 1991, 1992)*. The Child Behavior Checklist is a widely used parent-report measure of childhood adjustment problems. There are two versions of the CBCL, one designed for children ages 2–3 and a second for children ages 4–18. Both versions contain items tapping externalizing and internalizing problems, although the content of some items varies across versions to capture developmental change within these domains. We selected five items that appeared on both versions to create a measure of overt CP that could be used across time points: 'cruel to animals,' 'disobedient,' 'gets in many fights,' 'physically attacks people,' and 'temper tantrums or hot temper.' Cronbach's alpha was used to evaluate the internal consistency of the scale and ranged from a low of .56 at age 2 to a high of .71 at age 10. Three items that were the same or comparable that appeared on both versions of the CBCL were selected to generate a composite of HAP symptoms: 'can't concentrate,' 'can't sit still,' and 'quickly shifts activities' (ages 2 and 3.5) or 'impulsive or acts without thinking' (ages 5–10), which tap the three primary components of HAP – attention, hyperactivity, and impulsivity, respectively. Chronbach alphas ranged from .61 at ages 2 and 5 to .78 at age 10.

*Teacher Report Form (TRF; Achenbach, 1991)*. The teacher version of the Child Behavior Checklist assesses childhood problem behavior in the school setting, from which similar factors of narrow- and broad-band factors of child externalizing and internalizing problem behavior have been developed as for the CBCL. Teachers completed the TRF on target children annually from ages 6 to 10 in the present study. The narrow-band Delinquency, Aggression, and Attention factors were employed, the Delinquency factor representing more proactive and covert antisocial activities, the Aggression factor representing more reactive and impulsive antisocial behavior, and the Attention factor including items related to HAP. As the rationale for using the TRF was to examine trajectory group differences derived from maternal report of problem behavior, we selected reports from the end of the study period when children were ages 9 ( $n = 141$ ) and/or 10 ( $n = 168$ ), for which there were 204 cases (72% of the 284 subjects). When TRFs were available at both ages, the mean score was used. When a report was available at only age 9 or 10, that score was used.

### Data analyses

The statistical analysis was designed to identify the risk factors distinguishing trajectories of both HAP and CP. In a first step, we used a group-based method described

in Jones, Nagin, and Roeder (2001), Nagin (1999), Nagin and Land (1993), and Roeder, Lynch, and Nagin (1999) to identify the developmental trajectories of hyperactivity and conduct problems. Using finite mixtures of suitably defined probability distributions, the group-based approach for modeling developmental trajectories is intended to provide a flexible and easily applied method for identifying distinctive clusters of individual trajectories within the population and for profiling the characteristics of individuals within these clusters. Thus, whereas the hierarchical and latent growth curves methodology models population variability in growth with multivariate continuous distribution functions, the group-based approach utilizes a multinomial modeling strategy that has the strength of being able to identify trajectories of individuals on selected outcomes over time. Technically, the group-based trajectory model is an example of a finite mixture or latent class model. Its parameters are estimated by Maximum Likelihood.

One valuable feature of the model is that it is easily adapted to accommodate different forms of data (i.e., binary, censored normal, and count data). In this analysis, a Censored Normal model was fitted to the data because the response variable is a psychometric scale which can have censored values at its minimum and maximum. In this mixture model, a polynomial relationship is used to link age to behavior.

A key issue in the application of a group-based model is making a determination of how many groups define the best fitting model. We have followed the lead of D'Unger, Land, McCall, and Nagin (1998) and use the Bayesian Information Criterion (BIC) as a basis for selecting the optimal model. Kass and Raftery (1995) and Raftery (1995) argue that BIC can be used for comparison of both nested and non-nested models under fairly general circumstances. When prior information on the correct model is limited, they recommend selection of the model with the maximum BIC (i.e., closest to zero).

Based on the selected model, this procedure can assign people into trajectory groups based on the *posterior probabilities of group membership*. For example, a child who displays high levels of HAP or CP from ages 2 to 10 will have a greater probability of following a persistently high versus a persistently low trajectory. Inversely, a child displaying near zero behaviors related to HAP or CP during this period will have a high probability of following a persistently low versus a persistently high trajectory. Children are assigned to the group with the largest posterior probability estimate. These group membership designations enabled us to create groups with different levels of comorbidity in terms of the level of HAP and CP behaviors displayed over an 8-year period. Analysis of variance was used to identify child, parent, and family risk factors that could discriminate these different groups. Two-tailed tests of significance were conducted for [symbol that looks like a capital A upside down] $\forall = .05$ .

## Results

Results will be presented in four different sections. A first section displays the developmental trajectories

for HAP and CP that were identified using a semi-parametric mixture model (Nagin, 1999). A second section investigates the co-occurrence of HAP and CP over time. A third section analyzes the risk factors related to different trajectory group membership for children without persistent trajectories of HAP or CP, specifically between those children with persistent trajectories of HAP-only versus those with persistent trajectories of CP (55% of whom showed co-occurring HAP symptoms), and those with persistently low trajectories of both HAP and CP. Finally, we examine how maternal-reported trajectory groups of CP and HAP predict teacher-reported externalizing problem factors when children were ages 9–10.

The first task was to model developmental trajectories of HAP and CP from ages 2 to 10. We used the BIC statistic to identify the optimal number of groups, with the lowest BIC score indicating the best model fit (D'Unger et al., 1998). A four-group model was selected as the best fitting model for both HAP and CP. Figures 1 and 2 depict the four predicted and observed trajectories for HAP and CP, respectively. As can be noted, the predicted and observed values have a high level of correspondence, suggesting a good fit of the model. Three of the four HAP trajectories (e.g., 80% of the participants) and all four CP trajectories showed a decline in mean levels of behaviors between the ages of 2 and 10. For both HAP and CP trajectories, one small group of children was identified that demonstrated a persistently low level of symptoms between ages 2 and 10, comprised of 5.7% (HAP) and 10.1% (CP) of the sample. A larger group of 'moderate desisters' was also identified for both HAP and CP trajectories, comprised of 26.9% (HAP) and 33.2% (CP) of the sample. These children displayed initially higher scores at age 2 that declined sharply by age 10. The modal group for both HAP and CP trajectories included 47.3% and 49.9% of the sample, respectively. For HAP, this was an initially moderately high level that was maintained through age 10. For CP, this group showed a gradual decline. Finally, a persistently high or 'chronic' group was identified for both patterns of behavior, and was comprised of 20% (HAP) and 6% (CP) of the sample. These children maintained their initially high levels of HAP or CP from the toddler to school-age periods.

Our second goal was to examine the co-occurrence of HAP and CP trajectory groups. Developmental trajectories of HAP and CP are quite similar suggesting that these behaviors follow a comparable developmental course. Results in Table 1 shows that, although there is some overlap between the developmental course of these behaviors, it is far from being complete. The upper part of Table 1 presents the probabilities of following a specific CP trajectory conditional on HAP trajectory group. The lower part of the table shows the converse set of probabilities. The large diagonal elements of the probability matrices indicate that there is considerable overlap between these developmental trajectories, with some important

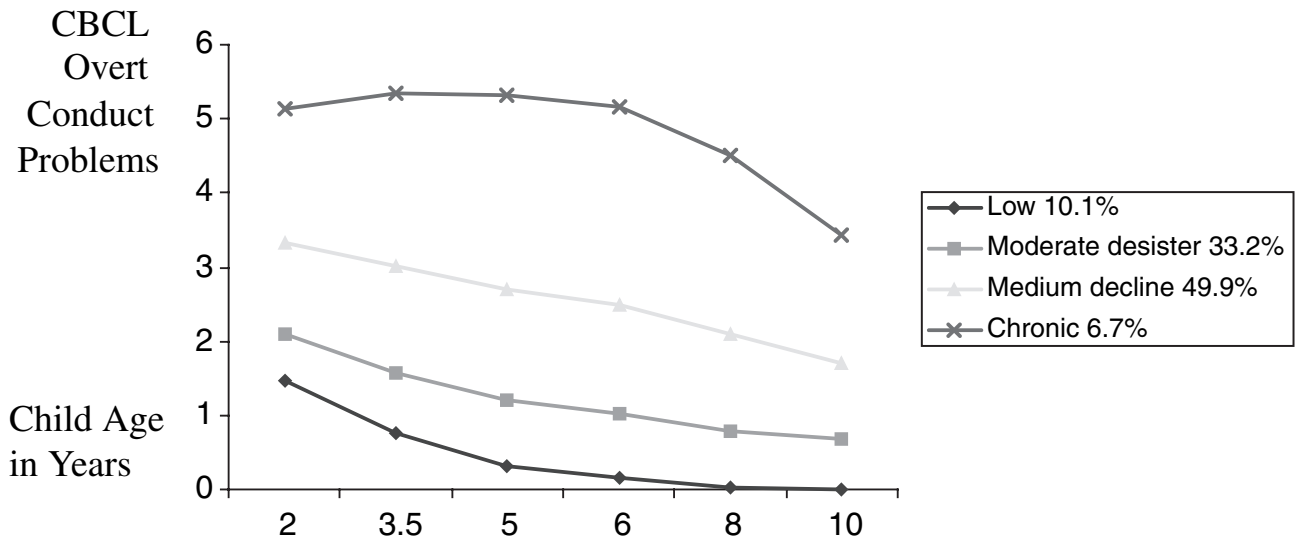


Figure 1 Trajectories of overt conduct problems from ages 2 to 10

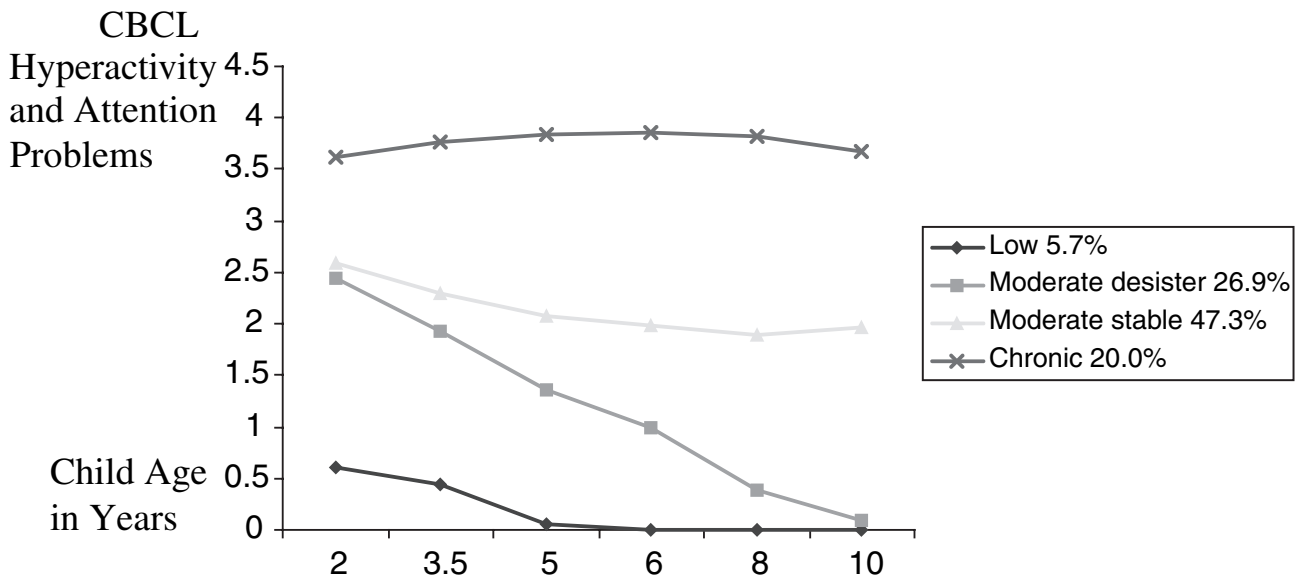


Figure 2 Trajectories of hyperactivity/attention problems from ages 2 to 10

differences primarily at the extremes. Consistent with Nagin and Tremblay’s (2001) findings of 6- to 15-year-old Canadian youth, almost all children (93%) who are following a low HAP trajectory will also follow the two lowest CP trajectories. Fewer children following a low CP trajectory (72%) follow the two lowest developmental trajectories of HAP. At persistent levels of CP or HAP, 55% of children following a chronic CP trajectory are also following a persistent hyperactivity trajectory, but only 19% of the chronic HAP children display a chronic CP trajectory.

Our third goal was to examine risk factors associated HAP or CP trajectory group membership, the results of which are presented in Table 2. As the focus was examining child, family, or sociodemographic risk factors that would differentiate chronically high trajectories of HAP-only and CP from low externalizing trajectory pathways, the fol-

lowing groups of children were compared: 1) those in the chronic HAP group without chronic CP (i.e., 82% of the chronic HAP sample), 2) the entire chronic CP group, 3) those with low trajectories of HAP and CP (e.g., the two lowest trajectories of HAP and CP), and 4) those encompassing all remaining trajectories. Results indicated that compared to the low CP/HAP group, the chronic CP group was characterized by lower maternal age (Cohen’s  $d = -.93$ ), higher maternal depression ( $d = .85$ ) and maternal rejection ( $d = .68$ ), and higher child fearlessness ( $d = -.80$ ). The chronic HAP group differed from the low CP/HAP group only on one risk factor: maternal depression ( $d = .71$ ). Finally, no differences were evident on any risk factor between the chronic CP and the chronic HAP-only groups.

Finally, because our trajectories of CP and HAP were based solely on maternal report, we used tea-

**Table 1** Comorbidity of HAP and CP

Group	Low	Moderate desist	Moderate	Chronic
		Probability of CP group conditional on HAP group		
Low HAP	.400	.533	.067	.000
Moderate desist HAP	.205	0.425	.356	.014
Moderate HAP	.050	.350	.550	.050
Chronic HAP	.019	.058	.731	0.192
		Probability of HAP group conditional on CP group		
Low CP	.207	.517	.241	.034
Moderate desist CP	.088	.341	.538	.033
Moderate CP	.007	.183	.542	.268
Chronic CP	.000	.056	.389	0.556
		Joint probability of HAP and CP trajectory group		
Low CP	.021	.054	.025	0
Moderate desist CP	.029	.111	.175	.011
Moderate CP	.000	.093	.275	.136
Chronic CP	.000	.000	.025	.036

**Table 2** Child, parent, and family characteristics by trajectory groups

Variable	Chronic CP ( <i>n</i> = 18)	Chronic HAP + No CP ( <i>n</i> = 42)	Low CP + Low HAP ( <i>n</i> = 60)	Others ( <i>n</i> = 160)	<i>F</i>	<i>p</i>
Maternal age	25.50 <sub>b</sub> (3.74)	27.59 <sub>ab</sub> (5.82)	29.72 <sub>a</sub> (4.89)	27.65 <sub>ab</sub> (5.39)	3.51	0.02
Maternal education	12.61 (1.54)	12.63 (1.91)	12.65 (1.31)	12.54 (1.47)	.11	.96
Maternal depression	11.31 <sub>bc</sub> (4.91)	11.66 <sub>c</sub> (8.38)	6.21 <sub>a</sub> (6.88)	7.91 <sub>ab</sub> (5.03)	8.37	.00
Maternal rejection	.77 <sub>b</sub> (2.28)	.17 <sub>ab</sub> (1.71)	-.48 <sub>a</sub> (1.30)	.07 <sub>ab</sub> (1.56)	3.28	.02
Infant negative emotionality	13.67 (6.69)	14.85 (4.61)	12.29 (5.53)	12.98 (5.43)	1.95	.12
Fearlessness	-.61 <sub>b</sub> (1.20)	-.21 <sub>ab</sub> (1.14)	.23 <sub>a</sub> (0.86)	.09 <sub>a</sub> (.91)	4.14	.01

Note: Means with different subscripts are significantly different based on Scheffé post-hoc comparisons.

cher reports of CP at ages 9 and 10 to examine whether group differences in trajectory group classification were related to child antisocial behavior and hyperactivity/attention problems at school. For these analyses, the Delinquency, Aggression, and Attention factors from Achenbach and Edelbrock's (1986) Teacher Report Form were utilized. MANOVAs were computed separately for CP, HAP, and comorbid trajectory groups. For CP and HAP trajectory groups, MANOVAs were significantly related to teacher-rated Delinquency, Aggression, and Attention factors (see Tables 3 and 4). Wilks-Lambda criterion for the CP analysis was  $F(6, 398) = 4.48$   $p < .001$ , and for HAP,  $F(6, 398) = 2.52$   $p < .05$ . Univariate *F*-tests were statistically significant for all three dependent variables related to CP and HAP. Using Scheffé post-hoc tests, a general pattern emerged that the chronic and modal groups showed significantly higher scores on the three TRF factors than the moderate desister and low groups. Although the chronic group demonstrated a higher score than the modal group on all three factors, in all cases this fell short of statistical significance.

When Scheffé post-hoc tests were computed for the HAP groups, a consistent pattern also emerged; the chronic and modal HAP groups showed statistically significant higher scores than the moderate desister groups for all three factors. Although mean scores of the chronic and modal groups were consistently higher than the low group, significant

differences emerged only for the inattention factor. These null findings appear largely due to the modest number of children in the low HAP group ( $n = 11$ ), and the limited power to detect group differences.

Our final goal was to compare the mean score on delinquency, aggression and attention behaviors for the post-hoc comorbidity grouping. As expected, the chronic CP, the HAP-only and the 'others' trajectory grouping demonstrated significantly higher delinquency, aggression and attention scores than the low HAP and low CP group (Table 5). There was one exception to this trend; the 'others' group did not statistically differ from the low HAP and low CP group on delinquency.

## Discussion

This paper sought to extend our understanding of the early developmental trajectories of HAP and overt CP, characterize the degree of comorbidity between persistent HAP and CP trajectories, and examine child and family risk factors that discriminate persistent HAP and CP trajectories from those with lower levels of both behavioral patterns. For both HAP and CP, four trajectories were identified, including chronic HAP and CP groups representing 20% and 6% of the sample, respectively. In terms of their co-occurrence, persistently low trajectories of HAP predicted similar courses of CP (93%), and approxi-

**Table 3** Conduct problems trajectory groups and teacher reports of conduct problems and inattention

Variable	Chronic group ( <i>n</i> = 15)	Modal group ( <i>n</i> = 109)	Moderate desisters group ( <i>n</i> = 59)	Low group ( <i>n</i> = 21)	<i>F</i>	<i>p</i>
Teacher-rated delinquency (age 9–10)	4.27 <sub>c</sub> (3.39)	2.87 <sub>bc</sub> (2.32)	2.08 <sub>ab</sub> (2.64)	1.31 <sub>a</sub> (1.68)	5.56	.01
Teacher-rated aggression (age 9–10)	14.10 <sub>ab</sub> (12.18)	13.10 <sub>b</sub> (10.57)	7.66 <sub>a</sub> (9.86)	6.26 <sub>a</sub> (9.05)	5.45	.01
Teacher-rated Inattention (age 9–10)	17.63 <sub>c</sub> (8.44)	14.34 <sub>bc</sub> (9.48)	9.97 <sub>a</sub> (8.25)	9.50 <sub>ab</sub> (8.05)	5.48	.01

Note: Means with different subscripts are significantly different based on Scheffé post-hoc one-tailed comparisons.

**Table 4** Hyperactivity trajectory groups and teacher reports of conduct problems and inattention

Variable	Chronic group ( <i>n</i> = 43)	Modal group ( <i>n</i> = 98)	Moderate desisters group ( <i>n</i> = 52)	Low group ( <i>n</i> = 11)	<i>F</i>	<i>p</i>
Teacher-rated delinquency (age 9–10)	3.17 <sub>b</sub> (2.53)	2.92 <sub>b</sub> (2.45)	1.68 <sub>a</sub> (2.44)	1.59 <sub>ab</sub> (2.66)	4.30	.01
Teacher-rated aggression (age 9–10)	13.70 <sub>b</sub> (11.12)	12.24 <sub>b</sub> (10.55)	6.76 <sub>a</sub> (9.83)	7.55 <sub>ab</sub> (8.62)	4.70	.01
Teacher-rated inattention (age 9–10)	16.59 <sub>b</sub> (9.67)	14.04 <sub>b</sub> (8.80)	8.24 <sub>a</sub> (7.83)	8.91 <sub>a</sub> (8.21)	8.82	.01

Note: Means with different subscripts are significantly different based on Scheffé post-hoc one-tailed comparisons.

**Table 5** Comorbid trajectory groups and teacher reports of conduct problems and inattention

Variable	Chronic CP ( <i>n</i> = 15)	Chronic ADHD + No CP ( <i>n</i> = 35)	Low CP + Low ADHD ( <i>n</i> = 44)	Others ( <i>n</i> = 110)	<i>F</i>	<i>p</i>
Teacher-rated delinquency (age 9–10)	4.27 <sub>b</sub> (3.39)	3.10 <sub>b</sub> (2.62)	1.65 <sub>a</sub> (2.57)	2.57 <sub>ab</sub> (2.22)	4.96	.01
Teacher-rated aggression (age 9–10)	14.10 <sub>b</sub> (12.18)	14.01 <sub>b</sub> (11.47)	6.10 <sub>a</sub> (9.33)	11.39 <sub>b</sub> (10.21)	4.72	.01
Teacher-rated inattention (age 9–10)	17.63 <sub>b</sub> (8.44)	17.00 <sub>b</sub> (9.91)	7.84 <sub>a</sub> (7.75)	12.83 <sub>b</sub> (8.72)	8.98	.01

Note: Means with different subscripts are significantly different based on Scheffé post-hoc one-tailed comparisons.

mately three-quarters of children following a persistently low course of CP followed a similarly low trajectory of HAP. However, at chronically high levels co-occurrence was less frequent, with only 19% of those in the persistent HAP group demonstrating persistently high levels of CP, and 55% of those in the chronic CP group showing a persistent pattern of HAP. Contrary to our expectations, risk factors between the persistent HAP-only and persistent CP group were not significantly different; however, more in line with our hypotheses, compared to children with persistently low patterns of both HAP and CP, significant differences were more consistently found for the persistent CP group than for the HAP-only group. Children with chronic HAP-only differed from low HAP/CP children only on rates of maternal depressive symptoms, while children in the persistent CP group showed higher rates of maternal depression, rejecting parenting, and child fearlessness, and younger mothers than those in the persistently low HAP/CP group.

These results extend previous research in this area on several frontiers. First, very few studies have followed the trajectories of HAP or CP for a period of 8 or more years beginning from the preschool age (Campbell et al., 1996); still fewer have been initiated beginning as young as age 2 (Renken, Egeland, Marvinney, Mangelsdorf, & Sroufe, 1989). Similarly, person-oriented approaches have recently been applied to tracing the course of externalizing problems in childhood, but primarily with older children and

adolescents (Nagin & Tremblay, 1999). The present findings strongly parallel those found for trajectories of HAP and physical aggression documented for boys 6–15 years of age (Nagin & Tremblay, 2001b).

Second, Nagin and Tremblay (1999) also found four trajectories for HAP and aggression, including persistently low and high groups and two mid-level desister groups. The present findings and Nagin's suggest that there are relatively few groups of children that show increasing rates of either HAP or CP after age 2, and only a select few that maintain a chronic high pattern of externalizing symptoms from the toddler period through adolescence (e.g., 6% for CP in the current study, 4% for physical aggression in the Nagin study).

Third, rates of co-occurrence of chronic HAP and CP were comparable but slightly different than those found for older children by Nagin and Tremblay. In the current study, 55% of children in the chronic CP group showed a persistent trajectory of HAP, but only 19% of those in the chronic HAP showed a persistent pattern of CP. Rates in the Nagin study were 72% and 27%, respectively. The co-occurrence of HAP in the chronic CP group was likely greater in Nagin's study (i.e., 72% vs. 55%) because of the Montreal's sample slightly higher socioeconomic level.

The one risk factor for which the chronic HAP group did differ from the low HAP/CP group was maternal depressive symptoms. This pattern has been detected previously for mothers of HAP children

compared to controls in both preschoolers and older children (Byrne, DeWorlfe, & Bawden, 1998; Cunningham & Boyle, 2002; Johnston, 1996). However, the directionality of the relation cannot be determined because of the nonexperimental nature of the study's design. We do know that both levels of HAP in the chronic group and levels of depressive symptoms in the entire sample (i.e.,  $r = .51$  from when children were age 2 to 6) were relatively stable. Research has suggested that depressed mothers are likely to attribute the behavior of disruptive preschoolers to stable, internal child characteristics, which could likely affect their response to them (White & Barrowclough, 1998). Alternatively, past research suggests that externalizing problems are more stable in the presence of family adversity, a finding that is also corroborated by the greater level of depression amongst the chronic CP group compared to the low CP/HAP group.

There are several significant methodological limitations of the study. First, participants were limited to low-income European American and African American boys living in an urban setting. Future work with boys and girls from other socioeconomic strata and ethnic backgrounds is recommended to replicate or disconfirm these results. Measurement error could have influenced the findings, as predictor variables were assessed on only one or two occasions. Relatedly, while many of the relations cannot be attributed to shared reporter or method variance because of the reliance on observations to measure child behavioral inhibition and rejecting parenting and the use of parent report to assess overt antisocial behavior, the linkage between early maternal depressive symptoms and persistence of child HAP and CP is confounded by shared informant and method variance. Maternal depression has been consistently found to inflate relations with child behavior problems (Fergusson, Lynskey, & Horwood, 1993). The concern about reporting bias is tempered by corroboration of the finding using the same composite of maternal depressive symptoms at ages 1.5 and 2 and teacher's report of age 8 CP (Shaw et al., 2000). Report of child CP and HAP was limited to maternal report. Ideally, this would be supplemented by a second parent, teacher, and youth reports. However, because use of the same items are currently a prerequisite for using Nagin's semiparametric method, alternative caregiver, teacher, and youth reports available only at later ages could not be used. Regarding the identification of trajectory groups, it should be emphasized that such groups are probabilistic in nature and that a single trajectory group may include individuals with relatively high and low probability of membership in that group. However, our analysis revealed such probabilities were generally very high, which suggests little classification error. Finally, the present results regarding risk factors associated with chronic trajectories of CP need to consider that we only traced

the course of a narrow few items encompassing *overt* conduct problems. Whether similar differences would be found for covert antisocial activities, particularly for older children, remains an open question.

### *Implications for early intervention and social policy*

The present results show that the course of chronic CP and, to a lesser extent, HAP, can be differentiated from more normative trajectories by specific types of child and family risk factors. Note that although there were more risk factors that discriminated chronic CP versus low CP/HAP trajectories than between chronic HAP-only versus low CP/HAP trajectories, no risk factors differentiated chronic CP versus chronic HAP-only trajectories from one another, suggesting that similar processes might be involved in at least maintaining such pathways. In fact, recent research suggests that parental warmth may be a factor in the prevention of HAP among low birth-weight children (Tully, Arseneault, Caspi, Moffitt, & Morgan, 2004). In the current study, maternal depression was strongly linked to a persistent high versus persistent low course, which could indicate that mothers with HAP children are more likely to be depressed, or that the course of HAP is enhanced by maternal psychopathology. Although the nonexperimental nature of the study's design precludes inferring directionality of this relationship, the results suggest that interventions addressing HAP in early childhood may be enhanced by supplementing child-oriented interventions (e.g., behavioral treatment, medication) with those that address maternal well-being.

For CP, it is likely that successful interventions will need to address the multiple risk factors facing families in the persistent high group. While parent training may be helpful in improving consistency and decreasing the use of harsh and hostile discipline practices, the current results suggest that interventions will also need to be tailored to the demands of children who are uninhibited in approaching provocative or even scary stimuli, and the match or mismatch between parenting and child characteristics (Thomas, Chess, & Birch, 1968). It also needs to be reiterated that the vast majority of families in the present study face the implicit challenges associated with poverty. Thus, it is clear that the development of antisocial behavior in children is embedded within a context of child characteristics, parental psychological resources and childrearing practices, and the family's social adversity. Interventions are recommended that are multi-systemic (Henggeler, Schoenwald, Borduin, Rowland, & Cunningham, 1998), geared to the developmental challenges and transitions of early childhood (Shaw & Bell, 1993), and tailored to the issues that compro-

mise individual parents' abilities to provide safe and caring environments for their offspring.

At a broader level, the findings suggest that early identification may be warranted for children showing early co-occurring patterns of CP and HAP, and other family and child risk factors. Providing resources to identify such children in early childhood poses a formidable challenge for policy makers; however, over the past decade programs that have addressed early parent-child relationships during infancy (Olds, 2002) and the preschool period (Webster-Stratton, 1998) have demonstrated significant reductions in child antisocial behavior. The present findings suggest that the toddler period may also be another promising target for identification and treatment of at-risk children.

## Acknowledgements

Findings from the present study were presented at the International Society for Research on Aggression, Montreal, July 28–31, 2002. This work was supported by grants MH 50907 and MH 01666 from the National Institute of Mental Health awarded to the first author.

## Correspondence to

Daniel S. Shaw, Department of Psychology, University of Pittsburgh, 210 S. Bouquet Street, 4101 Sennott Square, Pittsburgh, PA, 15260-0001, USA; Tel: 412 624-2836; Fax: 412: 624-8827; Email: casey@pitt.edu

## References

- Achenbach, T.M. (1991). *Manual for the Child Behavior Checklist/4–18 and 1991 Profile*. Burlington, VT: University of Vermont Department of Psychiatry.
- Achenbach, T.M. (1992). *Manual for the Child Behavior Checklist/2–3 and 1992 Profile*. Burlington, VT: University of Vermont Department of Psychiatry.
- Achenbach, T.M., & Edelbrock, C. (1986). *Manual for the Teacher's Report Form and Teacher Version of the Child Behavior Profile*. Burlington, VT: University of Vermont, Department of Psychiatry.
- Ackerman, B.P., Kogos, J., Youngstrom, E., Schoff, K., & Izard, C. (1999). Family instability and the problem behaviors of children from economically disadvantaged families. *Developmental Psychology, 35*, 258–268.
- Aguilar, B., Sroufe, L.A., Egeland, B., & Carlson, E. (2000). Distinguishing the life-course-persistent and adolescent-limited antisocial behavior types: From birth to 16 years. *Development and Psychopathology, 12*, 109–132.
- Ainsworth, M.S., & Wittig, B.A. (1969). Attachment and exploratory behavior of one-year-olds in a Strange Situation. In B.M. Foss (Ed.), *Determinants of infant behavior* (vol. 4, pp. 111–136). London: Methuen.
- Barkley, R.A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin, 121*, 65–94.
- Barkley, R.A., Fischer, M., Edelbrock, C.S., & Smallish, L. (1990). The adolescent outcome of hyperactive children diagnosed by research criteria, I: An 8-year prospective follow-up study. *Journal of the American Academy of Child and Adolescent Psychiatry, 29*, 546–557.
- Bates, J.E., Dodge, K.A., Pettit, G.S., & Ridge, B. (1998). Mothering, fathering and infant negativity as antecedents of boys' externalizing problems and inhibition at age 3 years: Differential susceptibility to rearing experience? *Developmental Psychology, 34*, 982–995.
- Beck, A.T., Ward, C.H., Mendelson, M., Mock, J.E., & Erbaugh, J.K. (1961). An inventory for measuring depression. *Archives of General Psychiatry, 4*, 561–571.
- Byrne, J.M., De Wolfe, N.D., & Bawden, H.N. (1998). Assessment of attention-deficit hyperactivity disorder in preschoolers. *Child Neuropsychology, 4*, 49–66.
- Caldwell, B.M., & Bradley, R.H. (1984). *Home observation for measurement of the environment*. Little Rock: University of Arkansas at Little Rock.
- Campbell, S.B., Pierce, E.W., Moore, G., Marakovitz, S., & Newby, K. (1996). Boys' externalizing problems at elementary school: Pathways from early behavior problems, maternal control, and family stress. *Development and Psychopathology, 8*, 701–720.
- Campbell, S.B., Shaw, D.S., & Gilliom M. (2000). Early externalizing behavior problems: Toddlers and preschoolers at risk for later maladjustment. *Development and Psychopathology, 12*, 467–488.
- Cunningham, C.E., & Boyle, M.E. (2002). Preschoolers at risk for attention-deficit hyperactivity disorder and oppositional defiant disorder: Family, parenting, and behavioral correlates. *Journal of Abnormal Child Psychology, 30*, 555–569.
- D'Unger, A., Land, K., McCall, P., & Nagin, D. (1998). How many latent classes of delinquent/criminal careers? Results from mixed Poisson regression analyses of the London, Philadelphia, and Racine cohort studies. *American Journal of Sociology, 103*, 1593–1630.
- Fergusson, D.M., Horwood, L.J., & Lloyd, M. (1991). Confirmatory factor models of attention deficit and conduct disorder. *Journal of Child Psychology and Psychiatry, 22*, 257–274.
- Fergusson, D.M., Horwood, L.J., & Lynskey, M.T. (1993). Prevalence and comorbidity of DSM-III-R diagnoses in a birth cohort of 15 year olds. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 1127–1134.
- Fergusson, D.M., Lynskey, M.T., & Horwood, L.J. (1993). The effect of maternal depression on maternal ratings of child behavior. *Journal of Abnormal Child Psychology, 21*, 245–270.
- Greenberg, M.T., Lengua, L.J., Coie, J., & Pinderhughes, E. (1999). Predicting developmental outcomes at school entry using a multiple risk model: Four American communities. *Developmental Psychology, 35*, 403–417.
- Henggeler, S.W., Schoenwald, S.K., Borduin, C.M., Rowland, M.D., & Cunningham P.B. (1998). *Multi-*

- systemic treatment of antisocial behavior in children and adolescents.* New York: Guilford.
- Hinshaw, S.P. (2002). Process, mechanism, and explanation related to externalizing behavior in developmental psychology. *Journal of Abnormal Child Psychology*, 30, 431–446.
- Johnston, C. (1996). Parent characteristics and parent-child interactions in families of nonproblem children and HAP children with higher and lower levels of oppositional-defiant behavior. *Journal of Abnormal Child Psychology*, 24, 85–104.
- Jones, B., Nagin, D., & Roeder, K. (2001). A SAS procedure based on mixture models for estimating developmental trajectories. *Sociological Methods and Research*, 29, 374–393.
- Kagan, J. (1997). Temperament and the reactions to unfamiliarity. *Child Development*, 68, 139–143.
- Kass, R.E., & Raftery, A.E. (1995). Bayes factor. *Journal of the American Statistical Association*, 90, 773–795.
- Loeber, R., & Dishion, T.J. (1983). Early predictors of male delinquency: A review. *Psychological Bulletin*, 94, 68–99.
- Martin, J. (1981). A longitudinal study of the consequences of early mother-infant interaction: A micro-analytic approach. *Monographs of the Society for Research in Child Development*, 46, (3, Serial No. 190).
- Moffitt, T.E. (1990). Juvenile delinquency and Attention Deficit Disorder: Boys' developmental trajectories from age 3 to age 15. *Child Development*, 61, 893–910.
- Moffitt, T.E. (1993). The neuropsychology of conduct disorder. *Development and Psychopathology*, 5, 135–151.
- Nagin, D.S. (1999). Analyzing developmental trajectories: A semiparametric group-based approach. *Psychological Methods*, 4, 139–157.
- Nagin, D.S., & Land, K.C. (1993). Age, criminal careers and population heterogeneity: Specification and estimation of a nonparametric, mixed Poisson model. *Criminology*, 31, 327–362.
- Nagin, D.S., & Tremblay, R. (1999). Trajectories of physical aggression, opposition, and hyperactivity on the path to physically violent and non-violent juvenile delinquency. *Child Development*, 70, 1181–1196.
- Nagin, D.S., & Tremblay, R. (2001a). Parental and early childhood predictors of persistent physical aggression in boys from kindergarten to high school. *Archives of General Psychiatry*, 58, 389–394.
- Nagin, D.S., & Tremblay, R. (2001b). Analyzing developmental trajectories of distinct but related behaviors: A group-based method. *Psychological Methods*, 6, 18–34.
- Olds, D. (2002). Prenatal and infancy home visiting by nurses: From randomized trials to community replication. *Prevention Science*, 3, 153–172.
- Olson, S.L., Schilling, E.M., & Bates, J.E. (1999). Measurement of impulsivity: Construct coherence, longitudinal stability, and relationships with externalizing problems in middle childhood. *Journal of Abnormal Child Psychology*, 27, 151–165.
- Owens, E., Shaw, D.S., & Vondra, J.I. (1998). Relations between infant irritability and maternal responsiveness in low-income families. *Infant Behavior and Development* 21, 761–777.
- Patterson, G.R. (1982). *A social learning approach: 3. Coercive family process.* Eugene, OR: Castalia.
- Patterson, G.R., DeGarmo, D.S., & Knutson, N. (2000). Hyperactive and antisocial behaviors: Comorbid or two points in the same process? *Development and Psychopathology*, 12, 91–107.
- Patterson, G.R., Reid, J.B., & Dishion, T.J. (1992). *Antisocial boys.* Eugene, OR: Castalia.
- Raftery, A.E. (1995). Bayesian model selection in social research. *Sociological Methodology*, 25, 111–164.
- Renken, B., Egeland, B., Marvinney, D., Mangelsdorf, S., & Sroufe, A. (1989). Early childhood antecedents of aggression and passive-withdrawal in early elementary school. *Journal of Personality*, 57, 257–281.
- Roeder, K., Lynch, K.G., & Nagin D.S. (1999). Modeling uncertainty in latent class membership: A case study in criminology. *Journal of the American Statistical Association*, 94, 766–776.
- Rothbart, M.K., & Bates, J.E. (1998). Temperament. In W. Damon and N. Eisenberg (Eds.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (5th edn, 105–176). New York: Wiley.
- Rutter, M., Cox, A., Tupling, C., Berger, M., & Yule, W. (1975). Attainment and adjustment in two geographical areas: 1. The prevalence of psychiatric disorder. *British Journal of Psychiatry*, 126, 493–509.
- Shaw, D.S., & Bell, R.Q. (1993). Developmental theories of parental contributors to antisocial behavior. *Journal of Abnormal Child Psychology*, 21, 493–518.
- Shaw, D.S., Bell, R.Q., & Gilliom, M. (2000). A truly early starter model of antisocial behavior revisited. *Clinical Child and Family Psychology Review*, 3, 155–172.
- Shaw, D.S., Gilliom, M., Ingoldsby, E.M., & Nagin, D. (2003). Trajectories leading to school-age conduct problems. *Developmental Psychology*, 39, 189–200.
- Shaw, D.S., Owens, E.B., Giovannelli, J., & Winslow, E.B. (2001). Infant and toddler pathways leading to early externalizing disorders. *Journal of the American Academy of Child and Adolescent Psychiatry*, 40, 36–43.
- Shaw, D.S., Winslow, E.B., & Flanagan, C. (1999). A prospective study of the effects of marital status and family relations on young children's adjustment among African American and European American families. *Child Development*, 70, 742–755.
- Shaw, D.S., Winslow, E.B., Owens, E.B., Vondra, J.I., Cohn, J.F., & Bell, R.Q. (1998). The development of early externalizing problems among children from low-income families: A transformational perspective. *Journal of Abnormal Child Psychology*, 26, 95–107.
- Smith, P.B., & Pederson, D.R. (1988). Maternal sensitivity and patterns of infant-mother attachment. *Child Development*, 59, 1097–1101.
- Spieker, S.J., Larson, N.C., Lewis, S.M., Keller, T.E., & Gilchrist, L. (1999). Developmental trajectories of disruptive behavior problems in preschool children of adolescent mothers. *Child Development*, 70, 443–458.
- Thomas, A., Chess, S., & Birch, H. (1968). *Temperament and behavior disorders in children.* New York: New York University Press.
- Tully, L.A., Arseneault, L., Caspi, A., Moffitt, T.E., & Morgan, J. (2004). Does maternal warmth moderate the effects of birth weight on twins' attention-deficit/

- hyperactivity disorder symptoms and low IQ? *Journal of Consulting and Clinical Psychology*, 72, 218–226.
- Waschbusch, D. A. (2002). A meta-analytic examination of comorbid hyperactive-impulsive-attention problems and conduct problems. *Psychological Bulletin*, 128, 118–149.
- Webster-Stratton, C. (1998). Preventing conduct problems in head start children: Strengthening parenting competencies. *Journal of Consulting and Clinical Psychology*, 66, 715–730.
- Weiss, G., & Hechtman, L.T. (1993). *Hyperactive children grown up: HAP in children, adolescents and adults* (2nd edn). New York: Guilford Press.
- White, C., & Barrowclough, C. (1998). Depressed and non-depressed mothers with problematic preschoolers: Attribution for child behaviors. *British Journal of Clinical Psychology*, 37, 385–398.
- Winslow, E.B., & Shaw, D.S. (1995). *Early parenting coding system*. Unpublished manuscript, University of Pittsburgh.

Manuscript accepted 24 June 2004