Running head: EARLY GENDER DIFFERENCES IN PHYSICAL AGGRESSION

Gender Differences in Physical Aggression:

A Prospective Population-based Survey of Children Before and After Two Years of Age

by

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Abstract

There has been much controversy over the past decades on the origins of gender differences in children's aggressive behavior. A widely held view is that gender differences emerge sometime after two years of age and increase in magnitude thereafter, due to gender-differentiated socialization practices. The objective of this study was to test for: (a) gender differences in the prevalence of physical aggression in the general population of 17 month-old children, and (b) change in the magnitude of these differences between 17 and 29 months of age. Contrary to the differential socialization hypothesis, the results showed substantial gender differences in the prevalence of physical aggression at 17 months of age, with 5% of boys, but only 1% of girls manifesting physically aggressive behaviors on a frequent basis. In addition, the results suggest that there is no change in the magnitude of these differences between 17 and 29 months of age.

Keywords: Aggression, gender differences, epidemiology, longitudinal study, preschool

Gender Differences in Physical Aggression:
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There has been much controversy over the past decades on the origins of gender differences in children's aggressive behavior (e.g., Cairns, 1979; Earls, 1987; Hyde, 1984; Lytton, 1990; Maccoby & Jacklin, 1980; Moffitt, Caspi, Rutter & Silva, 2001; Tieger, 1980; Zahn-Waxler, 1993; Zoccolillo, 1993). Advocates of a social-learning approach generally argue that gender differences do not exist early in life, but only emerge later during the preschool period, at a time when gender-differentiated socialization pressures are believed to be well-established. Keenan and Shaw (1997), for instance, argue that gender differences emerge because socializing agents, such as parents, selectively encourage traditional sex-type behaviors (e.g., shyness, fearfulness and withdrawal in girls) and/or discourage non-sex-type behaviors (e.g., aggressive behavior in girls). In addition, according to a differential socialization hypothesis, girls are more responsive than boys to the socialization efforts of their parents and caregivers because they may present superior adaptive skills (e.g., language skills and empathic and prosocial behavior). As a result, the magnitude of gender differences in aggressive behavior is believed to increase over time. In contrast, those in favor of a biological basis argue that gender differences in aggressive behavior are present very early on in life before gender-differentiated socialization pressures could cause them. Maccoby and Jacklin (1974), for instance, argue that boys and girls differ in their degree of preparedness toward aggression, with boys being more inclined to respond in aggressive ways to their environment. Other factors may account for the presence of gender differences early on in life, such as prenatal exposure to androgens, as well as pregnancy, labor and delivery complications (Raine, 2002a, 2002b). At the heart of this controversy lie the questions of how early we can detect genuine gender differences

in children's aggressive behavior and, once they have emerged, whether the magnitude of these differences is increasing over time.

The answer to this second question is especially critical to the origin of early gender differences in children's aggressive behavior. It may be that gender-differentiated socialization practices are being established and their effect on children's aggressive behavior is being felt earlier in development than previously thought (Fagot, 1984; Fagot & Hagen, 1985; Smetana, 1989). Similarly, toddlers may apply socially prescribed rules and standards to regulate their own aggressive behavior--for instance, girls shunning away from aggressive behavior to avoid self-criticism and maintain self-satisfaction and self-worth (Bussey & Bandura, 1999; Maccoby, 2002). Early gender differences in children's aggressive behavior could be culturally rather than biologically-driven, but that would seem rather unlikely if their magnitude is not increasing over time. In this prospective population-based cohort study, we will test not only for the presence of gender differences in physical aggression in children before two years of age, but also for change in their magnitude during toddlerhood.

Investigating Gender Differences in Physical Aggression from a Developmental Epidemiology Perspective

How early can we detect genuine gender differences in children's physical aggression? Form a developmental epidemiology perspective, this question refers to the prevalence of physical aggression in the general population of children before two years of age. It can be defined as the proportion of toddlers in the general population whose propensity to manifest physically aggressive behaviors (e.g., hitting, pushing) is much higher than that of other children of the same age. One reason for focusing on these toddlers is that physical aggression is not necessarily maladaptive in and of itself. However, when physically aggressive behaviors are

manifested on a frequent/severe basis, it may well be so. In fact, many toddlers in the general population manifest these behaviors on an occasional basis, but there are relatively few who do so on a frequent basis (see below). Hence, while the latter may be considered physically aggressive, the former should not; and therefore, only gender differences among the latter refer to atypical or pathological development. Focusing on physically aggressive toddlers may be especially important if a majority of them continue to manifest physically aggressive behaviors on a frequent basis after two years of age. There is some epidemiological evidence that frequent/severe specific behaviors including forceful actions against peers present during the preschool years can predict maladaptive behavior in adolescence and early adulthood (Caspi, Elder & Bem, 1987; Stevenson & Goodman, 2001). Is it possible to distinguish between toddlers who manifest physically aggressive behaviors on a frequent basis and those who do so only occasionally or not at all? This issue and the one of gender differences in the prevalence of physical aggression before two years of age will be investigated using a logit-based latent class model (Hagenaars, 1993). Beside allowing for the identification of physically aggressive toddlers another advantage of this latent class model is that it offers the potential to reconcile the inconsistent findings obtained from previous epidemiological studies that have found gender differences in some physically aggressive behaviors, but not in others (see below). The gender paradox hypothesis stipulates that the gender least frequently affected by a childhood disorder is paradoxically the one more severely affected (Eme, 1992; Keenan, Loeber & Green, 1999; Moffitt et al., 2001; Silverthorn & Frick, 1999). Accordingly, there may be fewer aggressive girls before two years of age but they may be more likely than their male counterparts to manifest some physically aggressive behaviors on a frequent/severe basis; and, therefore, one would possibly not observe gender differences in these behaviors.

Does the magnitude of early gender differences in the prevalence of physical aggression increase over time? This question refers to the continuity and discontinuity in children's physical aggression status during toddlerhood. Some aggressive toddlers will stop manifesting physically aggressive behaviors on a frequent basis (i.e. remission); conversely, some non-aggressive toddlers will start doing so after two years of age (i.e. incidence). Are girls more likely to stop manifesting physically aggressive behaviors on a frequent basis, or are boys more likely to start doing so after two years of age, or both? Gender differences in the incidence and remission of physical aggression in toddlers, as well as the predictive accuracy of physical aggression before two years of age, will be investigated using a time-specific latent variables (Markov) model. This model allows testing for change over time in the magnitude of gender differences in the prevalence of physical aggression. Evidence for change is present if there are gender differences in the prevalence of physical aggression after two years of age after controlling for such differences before two years of age. Another advantage of this model is that it allows investigating the mechanism behind such change (i.e. greater remission among girls or greater incidence among boys or both).

Physically Aggressive Behaviors in Children Under Two Years of Age

There is evidence from observational studies that the ability to selectively and strategically use physical force against one's peers[1] emerges around the time of the child's first birthday (for a review see Hay, 2005; see also Tremblay, 2003), with the child's repertoire of physically aggressive behaviors diversifying and expanding during the second year of life (e.g., Bronson, 1981; Restoin et al., 1985). For instance, in one of the earliest account of infants' social interactions, Bridges (1933) documented the occurrence of "aggressive attacks" involving biting,

hair-pulling and hitting at around 14-15 months of age (see also Brownlee & Bakeman, 1981; Bronson, 1981; Bühler, 1931, 1935; Dunn & Munn, 1985; Eckerman, Whatley & Kutz, 1975; Goodenough, 1931; Shirley, 1933). More recently, based on mothers' retrospective reports, Tremblay et al. (1999) estimated the age of onset of some physically aggressive behaviors among children who manifested the behaviors in question at 17 months of age. The rate of onset was the steepest between 11 and 14-15 months of age, and appeared to level off thereafter.

Epidemiological surveys of physically aggressive behaviors in boys and girls under two years of age.

While narrative reviews of the literature suggest that gender differences in aggressive behavior are not present early in life (e.g., Keenan & Shaw, 1997; Loeber & Hay, 1997), a recent meta-analysis of observational studies suggests otherwise (Archer & Côté, 2005). Much of our knowledge on gender differences in aggressive behavior during infancy comes from small-scale studies that relied on nonprobability samples. Some studies have found that more boys than girls manifest aggressive behavior before two years of age (e.g., Fagot & Hagan, 1985; Hay, Castle & Davies, 2000; Tremblay et al., 1999), whereas others have found no gender differences (e.g., Hay, Castle & Davies, 2000; Holmberg, 1980; Keenan & Shaw, 1994; Shaw, Keenan & Vondra, 1994; Tremblay et al., 1999). To our knowledge, there are only three epidemiological surveys of physically aggressive behaviors in boys and girls under two years of age: the University of California Control Study (Macfarlane, Allen & Honzik, 1954), the 1956 Child Health Survey (Heinstein, 1969; Hornberger, Bowman, Greenblatt & Corsa, 1960), and the Québec Longitudinal Study of Child Development (Jetté & Des Groseilliers, 2000; Jetté, 2002; Plante,

Courtemanche & Des Groseilliers, 2002).[2] Each survey relied on a probability sample representative of a well-defined geographical unit.

The University of California Control Study is the first epidemiological study of behavioral and emotional problems in children under two years of age. This longitudinal study was conducted by Jean W. Macfarlane and her colleagues on a representative sample of children born in Berkeley (USA) in the late 1920s. Mothers' reports before five years of age were dichotomized on the basis of the presence or absence of a problem. The authors found that 59% of boys (i.e., 33 out of 56) and 43% of girls (i.e., 26 out of 60) were reported as having temper tantrums some including biting, kicking and striking at 21 months of age (Cohen's (1988) effect size index, **w** = .16). Neither these gender differences nor those observed in this problem 15 months later when children reached 36 months of age were statistically significant.

The 1956 Child Health Survey was conducted over a ten week period beginning June 4, 1956, on a representative sample of the non-institutionalized population of children under 6 years of age from the State of California. Mothers were asked to rate the intensity of behavioral and emotional problems as mild, intermediate or severe. The authors found that 7% of 12-17 month-old boys (i.e., 4 out of 54) and 16% of girls (i.e., 5 out of 32) were reported as fighting with other children, but none severely (**w** = .13). Similarly, 18% of 18-23 month-old boys (i.e., 7 out of 38) and 36% of girls (i.e., 21 out of 59) were reported as fighting with other children, but only one boy and one girl (i.e., 2 out of 97) severely (**w** = .20). The authors did *not* report on the statistical significance of gender differences for specific age groups. However, if we assume a random sample (it was actually a single stage, stratified cluster sample), it can be determined that these gender differences in fighting are not statistically significant.

The Québec Longitudinal Study of Child Development (QLSCD) is following a representative birth cohort of children born in 1997-1998 to mothers living in the Canadian province of Québec. Mothers were asked to rate the frequency of five physically aggressive behaviors (i.e., fights, attacks, kicks, bites and hits), as never, sometimes or often. At 17 months of age, between 4.5% and 24.1% of children manifested physically aggressive behaviors on an occasional basis; in contrast, less than 5% of children manifested these behaviors on a frequent basis (Baillargeon, 2002; Baillargeon et al., 2002; Baillargeon et al., 2005; Baillargeon & Zoccolillo, 2003). Boys were more likely than girls to kick (2.4% vs. 1.1%; **w** = .08), bite (4.9% vs. 3.1%; **w** = .07) and hit (.9% vs. .3%; **w** = .09) other children on a frequent basis; in addition, the magnitude of gender differences in these behaviors--with the exception of fighting and attacking--increased between 17 and 29 months of age (Baillargeon, 2002; Baillargeon et al., 2002; Baillargeon et al., 2005; Baillargeon & Zoccolillo, 2003).

Objectives

Overall, the above findings show that physically aggressive behaviors are not typical of toddlers in the general population, at least when manifested on a frequent basis; and, in addition, that gender differences are already present in at least some physically aggressive behaviors before two years of age. Many important questions remain unanswered, however. Is there a greater number of boys than girls in the general population who manifest physically aggressive behaviors on a frequent basis prior to the age of two? Are girls more likely than boys to stop manifesting physically aggressive behaviors on a frequent basis or are girls less likely than boys to start doing so during toddlerhood or both? The first objective of this study is to test for gender differences in the prevalence of physical aggression in the general population of children at 17 months of age using a logit-based latent class model. The second objective of this study is to test

for change in the magnitude of these differences between 17 and 29 months of age using a time-specific latent variables (Markov) model.

Method

Sample

The Québec Longitudinal Study of Child Development (QLSCD) is conducted by Santé Québec, a division of the Institut de la statistique du Québec (ISQ). It is following, on an annual basis, a representative birth cohort of children born between October 1997 and July 1998 to mothers living in the province of Québec (Canada). At wave 1 in 1998, the children were between 59 and 64 weeks of gestational age--gestational age was defined as the sum of the duration of pregnancy and the chronological age of the baby. (At wave 2 and 3, children were approximately 17 and 29 months old, respectively.) Children living in Northern Québec, Cree territory, Inuit territory and Indian reserves and those for whom the duration of the pregnancy could not be determined were excluded from the target population. The target population for wave 1 was representative of approximately 96.6% of the Québec population of newborns. The size of the target population was slightly smaller for subsequent waves mainly because children from families who arrived in Québec after July 1998 were not recruited. Note that 79,724 and 75,674 children were born in Québec in 1997 and 1998, respectively (ISQ, 2002).

Infants were selected from the 1997-1998 Master Birth Register of the Ministry of Health and Social Services, which contains records of all birth certificates by calendar year. Access to this information was obtained with the prior approval of the Québec Access to Information Commission. Some infants were excluded from the first wave of data collection because they were not yet listed in the register at the time of selection. Infants born either before 24 weeks or after 42 weeks of gestation were also excluded. In addition, there was a slight under-coverage of

infants whose gestational age was between 24 and 36 weeks. Finally, infants were excluded if their gender could not be determined from the register. In all, 2,940 infants were selected. They were representative of 94.5% of the target population.

Instrument

The Interviewer Completed Computerized Questionnaire (ICCQ) is the main questionnaire of the QLSCD. It was administered during a face-to-face interview conducted in the child's home with the person most knowledgeable about the child, who in over 99% of the cases was the child's biological mother. From wave 2 onwards, when children were about 17 months old, the ICCQ collected information on a wide variety of behaviors, some of which are typically associated with later child psychiatric disorders like oppositional-defiant disorder, attention-deficit hyperactivity disorder and conduct disorder. Five behavior items that necessarily involve physical aggression are being considered in this study: (a) gets into many fights, (b) physically attacks people, (c) kicks other children, (d) bites other children and (e) hits other children. Two behavior items (i.e., fights and attacks) came from the Child Behavior Checklist for Ages 2-3 (CBCL/2-3; Achenbach, Edelbrock & Howell, 1987) that was originally modeled on instruments for rating preschool- and school-aged children by parents and teachers among others (Achenbach & McConaughy, 1997). The other three behavior items (i.e., kicks, bites, and hits) were adapted from the Preschool Behavior Questionnaire (Behar & Stringfield, 1974; Fowler & Park, 1979), an adaptation of the Children's Behaviour Questionnaire (Rutter, 1967). Each behavior item was rated by the child's biological mother using a 3-point Likert scale: (1) doesn't apply or never, (2) occasional behavior or sometimes, and (3) frequent behavior or often. Mothers are generally considered valid informants of children's behavior, especially during the preschool years,

because they are likely to be familiar with their child's behavior across different settings (e.g., Carter et al., 2003; Earls, 1980).

Note that the data for the kick, bite and hit behavior items were collapsed into a single composite behavior item using the highest rating category on any one of these three behavior items. In other words, children who received a rating of 3 (i.e., often) on any of the three behavior items in question were given a 3 on the composite behavior item; among the remaining children, those who received a rating of 2 (i.e., sometimes) on any of the three items were given a 2 on the composite item; otherwise, they were given a 1 (i.e., never). This was done in an attempt to avoid large sparse multidimensional tables that may jeopardize the asymptotic suitability of the $\chi 2$ distribution for the Pearson and likelihood-ratio chi-square statistics (see below). This is especially appropriate since the third rating category (i.e., often) was generally endorsed by relatively few mothers. Moreover, this procedure did not yield a statistically significant reduction in the amount of variation present in the longitudinal data on behavior items as assessed by the method described by Goodman (1981). Baillargeon, Tremblay and Willms (1999) used data from the National Longitudinal Survey of Children and Youth and found that the reliability of a measure made up of three very similar behavior items for 2 year-old children was good (i.e., fights; kicks, bites, hits other children; reacts with anger and fighting when accidentally hurt); that is, .87 and .84 for boys and girls, respectively. In addition, very similar measures were used in previous longitudinal studies to assess, for instance, trajectories of physical aggression during early childhood as well as correlates of high-level physical aggression trajectory (Tremblay et al., 2004; see also Broidy et al., 2003; Cairns, Cairns, Neckerman, Ferguson & Gariépy, 1989).

Response and attrition rate for the ICCQ. Among the 2,940 infants who comprised the first wave sample, 123 infants did not take part in the subsequent waves. Among the 2,817 who took part in the longitudinal survey, 2,120 were ICCQ respondents (i.e., 8 ineligible; 689 non-respondents), yielding an ICCQ cross-sectional weighted response rate of 73.5% (i.e., weighted ratio of number of respondents over total number of eligible respondents). The sociodemographic characteristics of these infants' families are presented in Table 1 (see also Desrosiers, 2000). Note that 41.5% of these infants were first born and 79.8% of families were still intact when the child was 5 months old. The annual income of 33.3% of families was below 30,000 Canadian dollars and welfare represented the principal source of income for 11.7% of households. Note further that 15.7% of parents were immigrants; 3.1% of mothers but only 0.3% of fathers were under 20 years of age; and 18.0% of mothers and 17.6% of fathers did not have a high school diploma. Infants were from various cultural and linguistic backgrounds. In all, 18% of infants did not belong to one of the majority ethno-cultural groups (i.e., Canadian--native-born, French, British, Irish or Scottish). Other declared ethno-cultural origins were African/Haitian, aboriginal (Amerindian), Spanish-speaking (of the Americas) and Arab. As well, infants were from various linguistic backgrounds with 8% living in a household where the language most often spoken was neither French--the only language spoken at home in 75% of households--nor English. Among the 2,120 wave 1 ICCQ respondents, 1,985 were included in waves 2 and 3 (i.e., 19 ineligible; 116 non-respondents), yielding an ICCQ longitudinal weighted response rate of 70.5%. In fact, the attrition rate was very low, with only 3.5% of the wave 1 ICCQ respondents still eligible for the two subsequent waves not responding to wave 2 ICCQ. Similarly, only 5.8% of the wave 1 ICCQ respondents still eligible for the two subsequent waves did not respond to the wave 3 ICCQ. In this study, sampling weights designed by the ISQ to

reduce cross-sectional and longitudinal overall non-response bias as well as under-coverage of the target population were used to weight the data.

Statistical Method

Testing for gender differences in the prevalence of physical aggression at 17 months of age. A child's physical aggression status at 17 months of age was inferred from his or her data on the behavior items using a logit-based latent class model (Hagenaars & McCutcheon, 2002; Rost & Langeheine, 1997; von Eye & Clogg, 1994). We considered a latent class model with one latent variable made up of three latent classes, a low-, medium- and high-aggressive latent class. It was assumed that the behavior items elicited ratings in the same category for a given child. Members of the low-aggressive latent class would tend not to manifest physically aggressive behaviors whereas members of the medium- and high-aggressive latent classes would tend to manifest these behaviors on an occasional and frequent basis, respectively. Under this model, the physical aggression latent variable explained the interrelationships among the behavior items, with each child being in one, and only one, latent class. We estimated the conditional probability of a randomly selected boy and girl in the population manifesting a particular behavior item never, sometimes or often, given his or her latent class membership. Further, we estimated the probability of a randomly selected boy and girl in the population belonging to the low-, medium- and high-aggressive latent class. Further, we also estimated the boy/girl ratio of the odds of belonging to the high- rather than medium-aggressive latent class; and, similarly, we estimated the boy/girl ratio of the odds of belonging to the medium- rather than low-aggressive latent class.

Testing for change in the magnitude of gender differences in the prevalence of physical aggression between 17 and 29 months of age. The continuity and discontinuity in children's latent physical aggression status from 17 to 29 months of age was inferred from his or her

longitudinal data on the behavior items using a time-specific latent variables (Markov) model (Baillargeon et al., 2004; Langeheine & van de Pol, 1994; van de Pol & Langeheine, 1990). We considered a model with two time-specific latent variables each made up of a low-, medium- and high-aggressive latent class. Note that the 17-month-old latent physical aggression variable and gender were independent (i.e., explanatory) variables with fixed two-dimensional margins (i.e., there was no constraint on their association), whereas the 29-month-old latent physical aggression variable was a dependent (i.e., response) variable. Under this model each latent variable explained the interrelationships among the behavior items at a given time; hence, it was assumed to have no effect on the behavior items at another time. For each latent variable, we estimated the conditional probability of a randomly selected boy and girl in the population manifesting a particular behavior item never, sometimes or often given his or her latent class membership. Further, we estimated the conditional probability of a randomly selected boy and girl in the population belonging to the low-, medium- or high-aggressive latent class at 29 months of age, given he or she was (a) low-aggressive, (b) medium-aggressive, and high-aggressive, respectively, one year earlier. Further, we estimated simultaneously for boys and girls the association between a child's latent physical aggression status at 17 and 29 months of age. Note that we excluded children who did not have complete data on all behavior items at 17 and 29 months of age; only 3 subjects out of 1,985 ICCQ longitudinal respondents were excluded for this reason.

Because this model took into account gender differences in the prevalence of physical aggression at 17 months of age, the absence of association between gender and the 29-month-old latent physical aggression variable (beyond that expected by chance alone) would suggest that there were no gender differences in the incidence and remission of physical aggression between

17 and 29 months of age; and therefore, no change in the magnitude of gender differences in the prevalence of physical aggression during this period.

Maximum likelihood estimation and assessing model goodness-of-fit. Maximum likelihood parameter estimates of the different statistical models considered in this study were obtained using the expectation maximization (EM) algorithm from lEM (Vermunt, 1997), a computer program for the analysis of categorical data. The EM algorithm was run at least 1,000 times using different starting values. Each time the iterations were stopped when a convergence criterion was reached (i.e., the minimum increase in the log-likelihood function between subsequent iterations was set at .0000000000000001), or when a certain number of iterations were performed (i.e., 10,000). This was done to ensure that the maximum likelihood estimates represented a global rather than local maximum (McCutcheon, 1987). The fit of a particular statistical model to the QLSCD data was assessed using the Pearson chi-square (X^2), the likelihood-ratio chi-square (L^2), and the Cressie-Read (CR) statistics. The X^2, L^2 and CR statistics have a large sample χ^2 distribution under certain conditions (Clogg, 1979). However, discrepancies between the X^2 and the L^2 statistics may be due to a relatively large number of cells with zero or near zero observed frequencies--these cells receive zero weight in the summary of fit that the L^2 provides. The CR statistic represents a middle ground with a weight that is neither 1 (as in the X^2) nor 0 (as in the L^2). Cressie and Read (1984) recommend a weight of 2/3 for sparse data. Whenever the expected frequencies are close to the observed frequencies, the X^2/L^2/CR value will be small relative to the degrees of freedom (i.e., the number of non-redundant observed cell frequencies minus the number of independent parameters to be estimated), and the model being examined can be said to provide an adequate fit to the data. Two hierarchically related models can be compared using the L^2 since it can be partitioned exactly,

which is not the case for the X^2 or CR (Fienberg, 1980). Two models are hierarchically related if one includes all the parameters of the other plus some additional ones. Similarly, two models can be compared using the Bayesian information criterion (BIC; L^2 – degrees of freedom * natural logarithm (N)). The model with the smallest BIC value is to be preferred.

In order to take into account the QLSCD's design effect (i.e., the variance of the parameter estimates obtained from the QLSCD is likely to be underestimated by approximately 30% because of its stratified rather than simple random sampling design) which increased the risk of falsely rejecting the null hypothesis, we have used a conservative alpha level (i.e., $\alpha = .01$).

Results

Prevalence of Physical Aggression at 17 Months of Age

Before we could test for gender differences in the prevalence of physical aggression at 17 months of age, we needed to determine whether a three-class model was appropriate for the 17-month-old data on behavior items. Table 2 presents the goodness-of-fit test statistics associated with the different statistical models considered in this study. We considered a model with one latent physical aggression variable made up of three mutually exclusive and exhaustive latent classes. The value of the L^2 associated with this model was 21.67, with 13 degrees of freedom ($p = .06$), suggesting that this model was appropriate. Furthermore, there were no standardized residuals greater than 2.58 in absolute value associated with this model. Using the one-class model as a benchmark, we estimated that this model accounted for 96% [1 - (21.67 / 537.43)] of the observed variation in the 17-month-old data on behavior items. Note that the conventional symptom loading approach (Glidewell, Mensh & Gildea, 1957) did not seem adequate for the 17-month-old data on behavior items. In fact, the L^2 associated with a Partial Credit model (Masters, 1982) which assumed a continuous distribution of physical aggression and that the

behavior items were interval data with equal discriminating power was 83.93, with 38 degrees of freedom (p = .000). Hence, on all accounts, this three-class model seemed to provide an excellent fit to the 17-month-old data on behavior items.

Table 3 presents the estimates of the conditional probability of a randomly selected boy and girl in the population manifesting a particular behavior item never, sometimes, or often, given his or her latent class membership. As expected, the three-class model allowed to distinguish between children who manifested different physically aggressive behaviors on a frequent basis and those who did so only occasionally. For instance, consider the odds of fighting *often* rather than *sometimes* for girls. The odds were (.73 / .27) = 2.72 for high-aggressive girls; comparatively, the odds were only (.04 / .64) = .06 for medium-aggressive girls (see Table 3). Hence, the odds of fighting *often* rather than *sometimes* were (2.72 / .06) = 46.4 times higher for high- than for medium-aggressive girls. In addition, as expected, the three-class model allowed to distinguish between children who manifested physically aggressive behaviors on a occasional basis and those who tended not to manifest these behaviors. For instance, consider the odds of fighting *sometimes* rather than *never* for girls. The odds were (.64 / .33) = 1.96 and (.06 / .94) = .06 for medium- and low-aggressive girls, respectively (see Table 3). Hence, the odds of fighting *sometimes* rather than *never* were (1.96 / .06) = 32.6 times higher for medium- than for low-aggressive girls.

Gender differences in the prevalence of physical aggression at 17 months of age.

Table 3 presents the estimates of the probability of a randomly selected boy and girl in the population belonging to the low-, medium- and high-aggressive latent class. As expected, there was a substantial number of medium-, but a much smaller number of high-aggressive children at 17 months of age. While 35% of boys in the population were medium-aggressive, only 5% were

high-aggressive. Comparatively, there were 18% of medium-aggressive and 1% of high-aggressive girls in the population. Moreover, these results suggest a strong gender effect on the prevalence of physical aggression at 17 months of age. In fact, the odds of belonging to the high- rather than medium-aggressive latent class were 2.62 times higher for boys than girls [99% confidence interval: 1.31-5.24]; and, similarly, the odds of belonging to the medium- rather than low-aggressive latent class were 2.62 times higher for boys than girls.

How much of the observed variation in the 17-month-old data on behavior items was due to gender differences in the prevalence of physical aggression? To answer this question, we considered a restricted three-class model which assumed that there was no association between the latent physical aggression variable and gender (see Table 2, top panel). Under this model, there were no gender differences in the prevalence of physical aggression beyond those expected in the propensity to manifest a particular behavior item for a given latent physical aggression status. This is why these differences (in the prevalence of physical aggression) are sometimes referred to as "true" group differences (Thissen, Steinberg & Gerrard, 1986). Using the unrestricted one-class model as a benchmark, we estimated that only 1.7% [(30.61 - 21.67) / 537.43] of the observed variation in the 17-month-old data on behavior items was due to gender differences in the prevalence of physical aggression (**w =** .24--between a small and medium effect size). This is not to say, however, that the remaining 98% of the observed variation was due to within-gender variation. To evaluate the relative importance of within- versus between-gender variation we considered a restricted three-class model which assumed that there was no between-gender variation in the 17-month-old data on behavior items (see Table 2, top panel). Under this model there were neither gender differences in the prevalence of physical aggression nor in the propensity to manifest a particular behavior item for a given latent physical aggression

status. Using the one-class model as a benchmark, we estimated that 9% [(69.98 - 21.67) / 537.43] of the observed variation in the 17-month-old data on behavior items was due to between-gender variation. Hence, although gender differences in the prevalence of physical aggression at 17 months of age were substantial, most of the observed variation in the 17-month-old data on behavior items was due to within-gender variation.

Continuity and Discontinuity in Children's Latent Physical Aggression Status from 17 to 29 Months of Age

Before we could test for change in the magnitude of gender differences in the prevalence of physical aggression between 17 and 29 months of age, we needed to determine whether a time-specific latent variables (Markov) model was appropriate for the longitudinal data on behavior items. The value of the L^2 associated with this model was 768.37, with 1368 degrees of freedom (p = 1.0). Note that although the X^2 statistic suggested that this model did not fit the data, the CR statistic yielded the same conclusion as the L^2 (see Table 2, bottom panel). Overall, a time-specific latent variables (Markov) model seemed to provide an acceptable fit to the longitudinal data on behavior items.

Change in the magnitude of gender differences in the prevalence of physical aggression between 17 and 29 months of age. We considered a restricted time-specific latent variables (Markov) model, which assumed that there was no association between gender and the 29-month-old latent physical aggression variable beyond that expected by chance alone after controlling for gender differences in the prevalence of physical aggression at 17 months of age (see Table 2, bottom panel). Note that this model also implied that there were no gender differences in the association between the 17- and 29-month-old latent physical aggression variables. Under this model, high-aggressive 17-month-old boys were just as likely as their

female counterparts to stop manifesting physically aggressive behaviors on a frequent basis one year later; and, similarly, low-aggressive 17-month-old girls were just as likely as their male counterparts to start manifesting physically aggressive behaviors one year later. This model represented an increase in L^2 of 13.48, with a corresponding increase of 6 degrees of freedom from the previous model (L^2 = 781.85 - 768.37 = 13.48; *df* = 1374 - 1368 = 6; *p* = .04). These results suggest that there was neither an increase nor a decrease in the magnitude of gender differences in the prevalence of physical aggression between 17 and 29 months of age.

Table 4 presents the estimates of the conditional probability of a randomly selected 29-month-old child in the population belonging to the low-, medium- or high-aggressive latent class given his or her latent physical aggression status at 17 months of age. On the one hand, about half (i.e., 51.1%) of 17-month-old high-aggressive children continued to manifest physically aggressive behaviors on a frequent basis one year later. On the other hand, a majority (i.e., 82.8%) of 17-month-old low-aggressive children continued not manifesting physically aggressive behaviors one year later.

Discontinuity in children's latent physical aggression status from 17 to 29 months of age. Between 17 and 29 months of age, many aggressive toddlers did stop manifesting physically aggressive behaviors on a frequent basis and many non-aggressive toddlers did start doing so. Which was the most likely transition? To answer this question we considered a restricted time-specific latent variables (Markov) model wherein: (a) the likelihood of changing from low- to high-aggressive was equal to that of changing from high- to low-aggressive; and, (b) the likelihood of changing from medium- to high-aggressive was equal to that of changing from high- to medium-aggressive (see Table 2, bottom panel). This conditional symmetry model represented an increase in L^2 of only 7.62, with a corresponding increase of 2 degrees of freedom

from the preferred time-specific latent variables (Markov) model (L^2 = 789.47 - 781.85 = 7.62; *df* = 1376 - 1374 = 2; *p* = .02); and, in addition, this model had a smaller BIC value. These results suggest that non-aggressive toddlers were just as likely to start manifesting physically aggressive behaviors on a frequent basis as aggressive toddlers were to stop doing so between 17 and 29 months of age. Moreover, because there were fewer high- than low- and medium-aggressive children at 17 months of age, these results suggest that there were more children "drifting into" than "drifting out of" manifesting physically aggressive behaviors on a frequent basis between 17 and 29 months of age. In fact, under this conditional symmetry model, 2.3% of boys drifted into, but only .5% drifted out. Similarly, 2.1% of girls drifted into, but only .06% drifted out. Hence, there seemed to be a tendency for the prevalence of physical aggression to increase during this period.

Continuity in children's latent physical aggression status from 17 to 29 months of age. Was the stability of a child's physical aggression status between 17 and 29 months of age related to its severity? To answer this question, we considered a restricted time-specific latent variables (Markov) model wherein the likelihood of staying low-aggressive was equal to that of staying medium-aggressive, which in turn was equal to that of staying high-aggressive (see Table 2, bottom panel). This equal stability model represented an increase in L^2 of 3.13, with a corresponding increase of 2 degrees of freedom from the preferred time-specific latent variables (Markov) model (L^2 = 784.98 - 781.85 = 3.13; *df* = 1376 - 1374 = 2; *p* = .21), suggesting that the one-year stability of a 17-month-old child's physical aggression status was not related to its severity. In fact, under this equal stability model, 80% of 17-month-old children were estimated to be in the same physical aggression status one year later. Hence, these results suggest that the

predictive value of a 17-month-old child's latent physical aggression status was excellent, at least as far as predicting his or her status one year later was concerned.

Discussion

There is a widespread consensus that school-aged boys manifest more disruptive behaviors such as physical aggression than their female counterparts (for a review see Lahey, Miller, Gordon & Riley, 1999). What is the origin of these gender differences? A widely held view is that gender differences emerge sometime after two years of age due to gender-differentiated socialization pressures, whereby caregivers discourage aggressive behavior in girls for whom it is judged especially undesirable (Keenan & Shaw, 1997). However, there is considerable controversy as to whether such gender-differentiated socialization practices occur--and to what extent--relative to aggressive behavior (e.g., Lytton & Romney, 1991).

The Origin of Gender Differences in Aggressive Behavior Before Two Years of Age

Contrary to the differential socialization hypothesis our results show that gender differences in the prevalence of physical aggression are already present in the second year of life. Of course, these differences may at least in part, be socially-driven, with the effect of gender-differentiated socialization practices on early aggressive behavior being felt before the child's second birthday. Our study did not entail any direct measure of such practices and therefore that possibility can not be ruled out. However, a unidirectional effect of gender-differentiated practices or of gender-stereotypic self-regulatory controls on early aggressive behavior seems unlikely in light of our longitudinal results, which suggest that girls are not more likely than boys to stop manifesting physically aggressive behavior between 17 and 29 months of age. These results are consistent with two observational studies. Hay and colleagues (2000) found no change in the magnitude of gender differences for both the rate of peer to peer use of force, and mothers'

ratings of their child's aggressiveness between 18 and 24 months of age. Similarly, Shaw and colleagues (1994) found no change in the magnitude of gender differences in a global rating of socially and non-socially appropriate aggression between 18 and 24 months of age. It is possible, however, that gender-differentiated socialization practices had an effect on the continuity and discontinuity in children's latent physical aggression status from17 to 29 months of age, but that it was cancelled due to girls maturing faster than boys in the general context of an increase in the prevalence of physical aggression over time. In contrast to gender-differentiated practices such differential in maturational tempo would make girls less likely than boys to stop manifesting physically aggressive behaviors during this period. Overall, it seems unlikely that gender-differentiated socialization practices or gender-stereotypic self-regulatory controls could be responsible for the emergence of gender differences in the prevalence of physical aggression prior to age two.

How Substantial are Early Gender Differences in the Prevalence of Physical Aggression?

Gender differences in the prevalence of physical aggression account for only a small percentage of the observed variation in physically aggressive behaviors among 17 month-old children, but our results show that these differences are substantial. In fact, for every physically aggressive girl, there were 5 boys who manifested physically aggressive behaviors on a frequent basis at 17 months of age. Incidentally, this boy:girl ratio is similar to ratios obtained in epidemiological studies of conduct disorder among 4-18 year-old children and youth (Lahey et al., 1999; see also Links, 1983). These boy:girl ratios have been said to exaggerate gender differences (Rossi, 1983). One way to appreciate how substantial gender differences in the prevalence of physical aggression really are is to consider the population attributable fraction (Fleiss, Levin & Paik, 2003): the fraction of the prevalence of physical aggression in the

population that can be uniquely attributable to being a boy. In fact, if boys were no more likely than girls to manifest physically aggressive behaviors on a frequent basis, the prevalence of physical aggression in the general population of children at 17 months of age would be reduced by 67%.[3] Another way is to consider the attributable fraction among boys only. In fact, 80% (i.e., [.05 - .01] / .05) of 17 month-old physically aggressive boys in the general population might not have been expected to manifest physically aggressive behaviors on a frequent basis if it were not of the excess of prevalence among boys.

The Gender Paradox Hypothesis

Typically, measures of physical aggression show larger gender differences than any other kind of aggressive behavior in children (Hyde, 1984; Knight, Fabes & Higgins, 1996). Most of the between-gender variation in the 17-month-old data on behavior items (i.e., 9% of the observed variation) was due to gender differences in the propensity to manifest a particular behavior item for a given latent physical aggression status. Consistent with the gender paradox hypothesis, our results show that high-aggressive 17 month-old girls seem more likely than their male counterparts to fight and attack other children on a frequent basis (see Table 3). An alternative explanation, of course, is that mothers interpret these behaviors differently depending on whether they are exhibited by a son or a daughter (e.g., Condry & Condry, 1976). Mothers either downplay the severity/seriousness of these behaviors (i.e., attacks, fights) when they are manifested by boys, or they exaggerate it when manifested by girls, or both. Another explanation has to do with the conceptualization of physical aggression. The physically aggressive behaviors considered in this study are multidetermined; in other words, they likely involve a mix of various forms of physical aggression (e.g., reactive-defensive, proactive-offensive/hostile, instrumental,

etc.). It could be that these behaviors (i.e., attacks, fights) represent a qualitatively different mix compared to the other three behaviors, with gender differences in the latter but not in the former. This is not a likely explanation, however, because we did not find evidence of "local dependence" among behavior items; that is, evidence of a direct relationship between behavior items beyond and above their separate relationship with the latent physical aggression variable.[4] In fact, the three-class model provided an excellent fit to the 17-month-old data on behavior items, suggesting that the behavior items are independent within each latent class. On the other hand, contrary to the gender paradox hypothesis, we did *not* find that high-aggressive 29-month-old girls were more likely than their male counterparts to have been so one year before.

Another Look at the Arrested Socialization Hypothesis

Some researchers have suggested that extreme antisocial behavior like physical aggression is due to arrested socialization (e.g., Patterson, 1982; Tremblay, 2003). According to this view aggressive children are simply children who have not grown up, have not learned not to be aggressive, with their behavior representing that which is normative for younger children. Contrary to arrested socialization hypothesis, our results suggest that there are more children drifting into than drifting out of manifesting physically aggressive behaviors on a frequent basis during toddlerhood. Moreover, a majority of 29-month-old aggressive girls had not manifested physically aggressive behaviors on a frequent basis one year earlier. Of course, this situation may be different in school-aged children and adolescents where it is believed that there is a decreasing trend in the prevalence of physical aggression with age (e.g., Tremblay et al., 1996). Hence, it appears that this is indeed an oversimplified view of the development of aggressive behavior at least early in life, one that does not take into account the complex pattern of

continuity and discontinuity in children's physical aggression status over time (Loeber & Stouthamer-Loeber, 1998).

On the other hand, our results suggest that physically aggressive toddlers display the same continuity in their (maladaptative) behaviors as their non-aggressive counterparts. One possible explanation is that the child's aggressive dispositions systematically select him or her into environments or life circumstances that further evoke and sustain physically aggressive behaviors against other children. In his paper on the effect of constitutional characteristics of children on parenting behavior, Bell (1968) proposed that highly assertive children (e.g., overtly aggressive) elicit less nurturance and more physical punishment from their parents because they can be controlled less adequately by love-oriented child-rearing techniques. In turn, these intruding and controlling efforts may generate frustration, conflict, and the establishment of a coercive cycle of violent interactions (Patterson, 1982). Hence, it appears that the processes that sustain physically aggressive behavior across time, and possibly situations, are being established very early on in life.

The Prevalence of Physical Aggression Among Toddlers

Results from observational studies suggest that physical force is not used in a majority of toddlers' conflicts, which are otherwise relatively infrequent and short in duration (for a review see Shantz, 1987). On the one hand, it seems that many toddlers use physical force at least once during these conflicts. For instance, Hay & Ross (1982) reported that over the course of 4 consecutive days (15 minutes of observation per day), 12 out of 48 21-month-old toddlers used force in struggles over objects. Similarly, in another study by Lewis and his colleagues (Lewis, Young, Brooks & Michalson, 1975), peer-directed aggressive behaviors such as hitting, scratching and biting were manifested by 22% of 12-18 month-old toddlers during a 15-minute

play session. Similarly, Bronson (1981) reported that 36 out of 40 toddlers engaged in "physical assaults" involving mainly pushing and hitting in 3 small group play sessions around 17-20 months of age. These results are consistent with our results according to which a relatively large number of toddlers in the general population manifest physically aggressive behaviors on an occasional basis. On the other hand, our results suggest that it is possible to distinguish these toddlers from the relatively few others who manifest these behaviors on a frequent basis. Indeed, there is some evidence, albeit limited, from observational studies of older toddlers suggesting that a minority of toddlers may be responsible for the majority of forceful actions. In a study of British toddlers, Hay, Castle and Davies (2000) reported that 37 out of 66 18-, 24- and 30-month-old toddlers used force proactively at home against familiar peers, but only a minority (i.e., 15 out of 37) did so more than once. In another study, Jersild and Markey (1935) observed 54 children aged 2 to 4 years during free play. While one child was responsible for 87 attacks on peers, another child did not manifest any. Further, other studies suggest that forceful acts, such as starting a quarrel, may be stable characteristics of toddlers (Hay & Ross, 1982; see also Tremblay et al., 2004).

Studying Gender Differences in Aggressive Behavior Using a Latent Class Analysis Framework

Current research strategies in developmental psychopathology often involve using a cutoff point to distinguish non-aggressive children from aggressive children. The groups of children created by this procedure are not homogeneous, however. In fact, some non-aggressive children will be classified as aggressive (i.e., false positives); and, conversely, some aggressive children will be classified as non-aggressive (i.e., false negatives). Classification errors are known to yield biased (under or over) estimates of the true prevalence, incidence and remission (Goldberg, 1975; Yanagawa & Gladen, 1984; Baillargeon et al., 2004); thus making the comparison of these

estimates between boys and girls hazardous. The latent class analysis framework adopted in this study provided maximum likelihood--asymptotically unbiased and efficient--estimates of the prevalence, incidence and remission of physical aggression and of gender differences therein.

Limitations

This study is not without limitations, however. First, children born to mothers residing in Northern Québec, Cree and Inuit "territory" and on native reserves were not part of the target population. Although these exclusions represented only 2.1% of all live births to mothers residing in Québec, they may have resulted in slightly lower prevalence estimates, as mental health problems, at least in adults, seem more frequent among natives than in the rest of the Québec population (Daveluy, Lavallée, Clarkson & Robinson, 1994; Jetté, 1994, 1995). Another factor that may have contributed to lower prevalence estimates is that certain premature babies (i.e., < 24 weeks of gestation) were excluded from the first wave sample. However, these exclusions represented less than 0.1% of registered births at the time of data collection. Second, relying on only one informant is less than optimal, even though there is evidence that mothers are reliable for preschool-aged children (Carter et al., 2003; Earls, 1980). Of course, aggressive behavior and gender differences therein may at least in part, be context/informant specific. Moreover, the continuity in children's latent physical aggression status between 17 and 29 months of age may at least in part, reflect continuity in mothers' perception of their children's behavior or reporting biases (e.g., social desirability, negative/positive response sets). Hence, further research is needed with more than one informant, and possibly observational assessments of the child's behavior, in order to test whether gender differences in the prevalence of aggressive behavior may be present in one setting but not another. More research is also needed to examine the predictive accuracy of early physical aggression when the informant reporting on

the child's behavior vary from one time point to another. Note that these two limitations are fairly typical of large population-based surveys. Furthermore, the issue of whether early gender differences in aggressive behavior are due to boys being more vulnerable to risk factors than girls, or boys being more exposed than girls to risk factors needs to be addressed (for a different view see Plomin & Foch, 1981). Data from the QLSCD should help answer these and other important questions in the future.

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Footnotes

[1]There is an emerging sense of ownership around this age whereby one's control over possessions is being acknowledged by peers (e.g., Bakeman & Brownlee, 1982). Breaking this social/moral contract may then result in struggles with companions some involving the use of physical force in retaliation (e.g., Smetana, 1989). During the second year of life, physical force also becomes a means for obtaining desirable ends (e.g., systematically varying forceful actions in order, for instance, to tease peers or obtain objects). Further, similar to older children, one-year olds most often respond negatively to "hard hits"--high-intensity hit--or any hit to the head (Brownlee & Bakeman, 1981), suggesting that such forceful actions have a negative valence early in life (for a different view see Huesmann, 2002). Of course, the organization and the function of forceful actions will change over the first few years of life (e.g., Maudry & Nekula, 1939). The focus of this study, however, is not to describe the conditions that bring forth these forceful actions and the behavioral context in which they appear, but rather to study mothers' reports of specific physically aggressive behaviors as they co-occur within the same toddler over time.

[2]There are at least six other large-scale studies of behavior in children under two years of age. Four epidemiological studies did not report on aggressive behavior (Jenkins, Bax & Hart, 1980; Janson, 2003a, 2003b; Mathiesen & Sanson, 2000) or relied only on parents' concerns (Blumberg, Halfon & Olson, 2004). Two recent studies from the U.S.A. reported on a heterogeneous scale including aggression but also other types of disruptive behaviors (Achenbach & Rescorla, 2000; Briggs-Gowan, Carter, Skuban & Horwitz, 2001). Moreover, they excluded unhealthy children at birth and used rather broad age groupings when reporting their results on aggressive behavior items (Achenbach & Rescorla, 2000) or scales (Carter, Briggs-Gowan, Jones & Little, 2003) lumping together children under two years of age with children over two years of age. Other population surveys of children under two years of age have not generally included detailed assessment of children's aggressive behaviors (e.g., Anderson, 1936/1972; Bergsten, 1959; Bone & Meltzer, 1989; Golding, Pembrey, Jones & ALSPAC Study Team, 2001; Kasmini et al., 1993).

[3]The population attributable fraction was calculated as the proportion of physically aggressive boys in the population, minus that proportion had they been no more aggressive than girls over the proportion of aggressive children in the population (i.e., [.025 - .005] / .03 = .67).

[4]This is not to say, however, that the relative contribution of the various forms of physical aggression is the same for any given physically aggressive behavior. In fact, results from observational studies suggest that toddlers

may manifest higher rates of one form than another (see Hay, 2005). Rather, whatever the relative contribution of these different forms of physical aggression may be, it is the same for all the physically aggressive behaviors considered in this study.

Table 1

Sociodemographic Characteristics of the Infants' Household at Wave 1 of the QLSCD (percentage)

Number of brothers and sisters (*N* = 2120)	
None	41.5
1	40.2
2	12.2
3 or more	6.2
Family composition (*N* = 2112)	
Two biological parents	79.8
Step family	10.8
Single-parent family	9.3
Ethnocultural origin of the mother (*N* = 2118)	
Non-immigrant	84.3
Immigrant of European origin	3.3
Immigrant of non-European origin	12.4
Household annual income (in Can dollars) (*N* = 2077)	
<30,000	33.3
30,000 to 59,999	39.5
60,000 or more	27.2
Principal source of family income (*N* = 2092)	
Salary, wage or self-employment	83.5

Welfare		11.7
Unemployment insurance		1.8
Other		3.0
Educational attainment	Mother (N = 2116)	Father (N = 1905)
No high school diploma	18.0	17.6
High school diploma	11.4	12.6
Post-secondary studies	17.7	16.7
Vocational/technical School diploma	10.8	11.5
College diploma	17.5	16.7
University degree	24.7	24.8
Parents' age (in years)	Mother (N = 2119)	Father (N = 1924)
< 20	3.1	0.3
20-24	19.8	8.0
25-29	30.4	26.7
30-34	32.5	34.2
35-39	11.8	22.1
≥ 40	2.5	8.7

Table 2

Goodness-of-fit Test Statistics Associated with Different Statistical Models

Prevalence of physical aggression at 17 months of age								
Logit-based latent class model	X^2	*p*	L^2	*P*	CR	*p*	*df*	BIC
One-class	2229.83	.000	537.43	.000	1057.57	.000	40	233.78
Two-class	159.45	.000	96.84	.000	123.83	.000	26	-100.54
Three-class[a]	17.80	.17	21.67	.06	18.45	.14	13	-77.02
Three-class with no gender differences in the prevalence of physical aggression.	26.47	.02	30.61	.01	27.23	.02	14	-75.67
Three-class with no between-gender variation in the 17-month-old data on behavior items.	63.31	.000	69.98	.000	64.03	.000	32	-172.94
Continuity and discontinuity in children's latent physical aggression status between 17 and 29 months of age								
Time-specific latent variables (Markov) model	X^2	*p*	L^2	*P*	CR	*p*	*df*	BIC
Unconstrained	1695.90	.000	768.37	1.0	1086.61	1.0	1368	-9614.35
No change in the magnitude of gender differences in the prevalence of physical aggression over time	1718.47	.000	781.85	1.0	1105.62	1.0	1374	-9646.42

Equal likelihood of stopping versus starting manifesting physically aggressive behaviors on a frequent basis over time	1697.65	.000	789.47	1.0	1108.57	1.0	1376	-9653.97
Equal stability over time of the low-, medium- and high-aggressive statuses	1680.88	.000	784.98	1.0	1098.24	1.0	1376	-9658.47

Note. X^2 and L^2 are the Pearson and likelihood-ratio chi-square statistic, respectively. CR is the Cressie-Read statistic. df refers to the degree of freedom. BIC is the Bayesian information criterion.

a The boy/girl ratio of the odds of belonging to the high- rather than medium-aggressive latent class was set equal to the boy/girl ratio of the odds of belonging to the medium- rather than low-aggressive latent class.

Table 3

Parameter Estimates Under the Three-class Model for the 17-month-old Data on Behavior Items

	Low-aggressive		Medium-aggressive		High-aggressive	
	Boy	Girl	Boy	Girl	Boy	Girl
	Probability of belonging to a particular latent class (i.e., prevalence)					
	.604 (.06)	.812 (.03)	.346 (.06)	.178 (.03)	.050 (.02)	.01 (.004)
	Conditional probability of fighting given membership in a particular latent class					
Never	.98 (.02)	.94 (.02)	.61 (.07)	.33 (.08)	.15 (.09)	--
Sometimes	.02 (.02)	.06 (.02)	.39 (.06)	.64 (.08)	.50 (.10)	.27 (.22)
Often	.00 (.002)	--	.004 (.01)	.04 (.02)	.34 (.12)	.73 (.22)
	Conditional probability of attacking given membership in a particular latent class					
Never	.96 (.02)	.94 (.01)	.69 (.05)	.46 (.07)	.20 (.14)	.18 (.22)
Sometimes	.04 (.02)	.06 (.01)	.31 (.04)	.52 (.07)	.32 (.09)	--
Often	.006 (.004)	.004 (.004)	.002 (.02)	.02 (.02)	.49 (.14)	.82 (.22)
	Conditional probability of kicking, biting and hitting given membership in a particular latent class					
Never	.83 (.04)	.75 (.02)	.23 (.07)	.29 (.06)	.11 (.07)	.60 (.18)
Sometimes	.17 (.04)	.23 (.02)	.64 (.06)	.60 (.06)	.20 (.13)	.15 (.14)
Often	--	.02 (.01)	.13 (.04)	.11 (.03)	.68 (.15)	.25 (.16)

Note. Standard errors appear in parentheses. A dash indicates that no estimates were obtained.

Table 4

Estimates of the Conditional Probability of a Randomly Selected 29-month-old Child Belonging to the Low-, Medium- or High-aggressive Latent Class Given his or her Latent Physical Aggression Status at 17 Months of Age[a]

	Latent physical aggression status at 29 months of age		
	Low-aggressive	Medium-aggressive	High-aggressive
Latent physical aggression status at 17 months of age			
Low-aggressive	.828 (.025)	.171 (.025)	.0005 (.0003)
	[.514; .594]	[.106; .123]	[.0003; .0003]
Medium-aggressive	.190 (.042)	.768 (.044)	.042 (.015)
	[.059; .052]	[.237; .210]	[.013; .011]
High-aggressive	.006 (.004)	.483 (.096)	.511 (.098)
	[.0004;.0001]	[.035; .005]	[.037; .005]

Note. Standard errors of estimates appear in parentheses and unconditional probability estimates in brackets with the boys' estimate presented first.

[a] These estimates were obtained from a restricted time-specific latent variables (Markov) model, wherein there is a uniform association between the two latent variables. This model represents an increase in L^2 of only 2.58, with a corresponding increase of 3 degrees of freedom from the preferred model (L^2 = 784.42 - 781.85 = 2.58; df = 1377 - 1374 = 3; p = .46), suggesting that a single odds ratio is sufficient to describe the association between the two latent variables. The value of this odds ratio was estimated at 19.5 [99% confidence interval: 9.92-38.34].