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A Longitudinal Confirmatory Factor Analysis of Indirect and Physical Aggression: Evidence of Two Factors Over Time?

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The purpose of the present study was to examine whether indirect aggression was distinct from physical aggression across developmental periods. Participants were 3,089 Canadian children aged 4 to 7 years (Time 1), 6 to 9 years (Time 2), and 8 to 11 years (Time 3). Confirmatory factor analysis using an accelerated longitudinal design confirmed a 2-factor model that was stable across cohorts, time, and sex. The longitudinal predictive links between indirect and physical aggression were also examined in a path analysis. Findings did not support the notion that maturation is associated with changes in the ways children aggress but rather suggest that children are consistent in the type of aggression they use over time, whether it be indirect or physical.

The study of aggression has been and continues to be a popular topic of research given the negative price it carries to the individual as well as to society (Tremblay, 1999, 2000). Because of its inherent appeal, there have been many advances made concerning this issue. One notable progression has been the realization that aggression must not only be quantified in terms of high levels versus low levels but that it must also be qualified in terms of the many forms it can take (e.g., Buss, 1961; Gladue, 1991; Pitkanen, 1969). Indeed, by attending to the idea that aggression can take many forms, investigators have succeeded in disconfirming the long-held belief that males are more aggressive than females (Buss, 1961; Maccoby & Jacklin, 1974). For example, following nonhuman primate studies (Hrdy, 1981; Hrdy & Williams, 1983), recent studies of humans have shown that males and females aggress in different ways with males using physical aggression more than females, and females using indirect or relational aggression more than males (e.g., Crick & Grotpeter, 1995; Lagerspetz, Bjorkqvist, & Peltonen, 1988).

Before reviewing the literature on some of the different forms aggression can take, it is worthwhile to note that there is some confusion regarding which term should be used to describe the type of aggression primarily employed by females (see Bjorkqvist, 2001). For example, *indirect aggression* is the term used by Bjorkqvist and colleagues (e.g., Lagerspetz et al., 1988; Bjorkqvist, Lagerspetz, & Kaukiainen, 1992; Bjorkqvist, Osterman, & Kaukiainen, 1992) to describe behaviors that are socially manipulative such as spreading invidious remarks about a person, becoming friends with another person as a form of revenge, getting others to dislike a person, and the like. Indirect aggression is similar to what Crick and colleagues (e.g., Crick, 1995, 1996; Crick & Grotpeter, 1995) have termed *relational aggression* in that both involve the manipulation of peer relations. However, indirect aggression and relational aggression differ on one important factor—indirect aggression is covert in nature whereas relational aggression can be both covert, as in spreading rumors, and overt, as in threatening to withdraw friendship as a retaliatory method. Still, others (e.g., Bjorkqvist, 2001; Vaillancourt, in press) have argued, that these different names essentially capture a similar phenomenon. In our review of the literature, we consider findings from studies of both indirect aggression and relational aggression although we employ the term *indirect aggression* in recognition of the pioneer work conducted by

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Feshbach (1969, 1971) and Lagerspetz et al. (1988) in this area.

The last decade has produced an explosion of studies in which sex differences as well as the links and correlates of indirect and physical aggression at different developmental periods have been investigated (e.g., Crick, 1995; Hart, Nelson, Robinson, Olsen, & McNeilly-Choque, 1998; Kaukiainen et al., 1999; McNeilly-Choque, Hart, Robinson, Nelson, & Olsen, 1996; Moretti, Holland, & McKay, 2001; Osterman et al., 1999; Rys & Bear, 1997; Tapper & Boulton, 2000; Tomada & Schneider, 1997). Through this work another important discovery has been made, namely, that in addition to sex differences there are also age-related changes associated with the type of aggression used. For example, recent cross-sectional studies have shown that the use of indirect aggression is more common in older children than in younger children (e.g., Bjorkqvist, Lagerspetz, & Kaukiainen, 1992; Bjorkqvist, Osterman, & Kaukiainen, 1992; Osterman et al., 1998; Tremblay et al., 1996). Conversely, the use of physical aggression has been found to be more common in younger children than in older children (e.g., see Bjorkqvist, Lagerspetz, & Kaukiainen, 1992; Tremblay et al., 1996). These cross-sectional results have been confirmed in longitudinal studies of indirect aggression (Vaillancourt et al., 2003) and physical aggression (Brame, Nagin, & Tremblay, 2001; Cairns, Cairns, Neckerman, Ferguson, & Gariepy, 1989; Cote et al., 2003). However, most of these studies have used small samples, and no study has considered the developmental course of indirect and physical aggression concurrently using a longitudinal design.

It is clear from this review that there have been advances made in recent years concerning our understanding of indirect and physical aggression in humans. This point notwithstanding, one potential hindrance to further growth in this field of research is the assumption that indirect and physical aggression, although related constructs, represent distinct indexes of aggression (which are discrete across sex and age). This supposition is based primarily on two sources of evidence: (a) the consistently moderate correlation obtained between the two types of aggression (i.e., $r = .4 - .8$), and (b) exploratory factor analytic results that have yielded two interpretable factors (e.g., Bjorkqvist, Lagerspetz, & Kaukiainen, 1992; Crick, Casas, & Mosher, 1997; Crick & Grotpeter, 1995; Lagerspetz et al., 1988; see also Crick, et al., 1999; Richardson & Green, 1997, for reviews).

Although in the beginning of an emerging area of study correlational and exploratory factor analyses are appropriate, there are several potential problems associated with the reliance on these types of analyses as proof of discreteness. Dealing with correlational results first, it is important to bear in mind that in sample-based studies, correlations tend to be lower than in population-based studies because of the restricted range in cases (Tabachnick & Fidell, 1996). Thus, moderate correlations obtained from studies with few participants may not accurately depict the degree of overlap actually present.

The issue with using exploratory factor analytic results as evidence for two distinct types of aggression is that, because there is an ''infinite number of rotations available, all accounting for the same amount of variance in the original data, but with factors defined slightly differently'' there are a plethora of ways investigators can interpret the findings (Tabachnick & Fidell, 1996, p. 636). For example, assuming the factors are not correlated, researchers can use an orthogonal rotation (e.g., Bjorkqvist, Lagerspetz, & Kaukiainen, 1992; Crick, 1996; Crick & Grotpeter, 1995; Lagerspetz et al., 1988). Conversely, assuming the factors are correlated, researchers can employ an oblique rotation (e.g., Hart et al., 1998). Clearly, these two types of factor rotations can produce different results, thus calling into question the validity of the findings. Another issue with the use of exploratory factor analysis as a method to examine the distinctiveness of two constructs is that it does not permit a clear test of the uniqueness over time or across sex. Given that researchers have shown the existence of sex- and age-related differences in the use of indirect and physical aggression, it becomes important to determine not only if they are in effect distinct but also whether the measurement structure and the correlation between the factors are stable over development and across sex. This type of examination can only be accomplished using a longitudinal confirmatory factor analysis (CFA).

Accordingly, the purpose of the present study was to test empirically the distinctiveness of maternal reports of indirect and physical aggression over time using CFA. Using a large national representative sample of Canadian children aged 4 to 11 years, we employed a multigroup modeling procedure with an accelerated longitudinal design in which we tested a two-factor model. We hypothesized that two interpretable factors would be found and that their measurement structure (i.e., the pattern of factor loadings) would be stable across time and sex.

Contingent on our hypothesis being confirmed, an additional aim of the present study was to investigate the predictive links between indirect

and physical aggression over time using path analysis. As previously mentioned, recent cross-sectional studies, as well as independent longitudinal investigations of indirect and physical aggression, suggest that a developmental shift occurs with respect to the use of indirect and physical aggression. These findings are consistent with Bjorkqvist and colleagues' developmental hypothesis (Bjorkqvist, Osterman, & Kaukiainen, 1992; Bjorkqvist, Osterman, & Lagerspetz, 1994), which proposes that the nature of aggression changes from physical to verbal to indirect and that these changes correspond with linguistic, social, and cognitive maturation. Specifically, Bjorkqvist and colleagues argued that with increased verbal competence comes decreased use of physical aggression and increased use of verbal aggression. Correspondingly, with increased social-cognitive skills comes decreased use of verbal (and physical) aggression and increased use of indirect aggression. Said differently, as children develop so does their method of aggressing develop, with indirect aggression representing the more sophisticated form.

Although it appears there is converging evidence (reviewed previously) supporting Bjorkqvist and colleagues' (Bjorkqvist, Osterman, et al., 1992; Bjorkqvist et al., 1994) developmental theory, no study has examined simultaneously the longitudinal relations between indirect and physical aggression using path analysis. Such a statistical approach is required to examine questions concerning heterotopic continuity in the development of aggression (see Nagin & Tremblay, 2001). Examining whether some individuals switch forms of aggression from physical to indirect as they age requires a longitudinal design in which different forms of aggression are considered concurrently. Toward this end, in addition to examining the factor structure of indirect and physical aggression across age and sex, we also examined the predictive links between these two types of aggression over 4 years using path analysis.

Method

Participants

Participants were drawn from the National Longitudinal Survey of Children and Youth (NLSCY), which comprises approximately 23,000 Canadian children ranging in age from birth to 11. Since the inception of this project in 1994 to 1995, data have been collected from children, their parents, and teachers biannually. At the time of this study, maternal reports of children's levels of indirect and physical aggression were available from the first three cycles. Specific to this study, a sample of 1,549 girls and 1,540 boys aged 4 to 11 were included in the analyses ($N = 3{,}089$). The study employed an accelerated longitudinal design in which four cohorts (age groups) were used. The criteria for inclusion in the analyses were that participants had to be between the ages of 4 and 7 at Time 1, and these children needed to have data points at Time 1 (1994–1995), Time 2 (1996–1997), and Time 3 (1998–1999) for both indirect and physical aggression. This age criterion for selection was based on the fact that complete data on indirect and physical aggression across the three periods were only available for children who were aged 4 to 7 at Time 1. Table 1 depicts the breakdown of participants by cohort, age, and sex.

Instruments and Procedures

Data regarding children's level of indirect and physical aggression were obtained through a face-to-face interview with the person most knowledgeable (PMK) about the target child, who was the mother in 93% of the cases. Specifically, the PMK (mother) was asked by a trained Statistics Canada interviewer to rate her child on five indirect aggression items and three physical aggression items using a 3-point Likert scale (often/very true, sometimes/somewhat true, never/not true). The five indirect aggression items taken from Lagerspetz et al. (1988) are as follows: "How often would you say that ____ when mad at someone, gets others to dislike him/her," "…becomes friends with another as revenge," "…says bad things behind the other's back," "…says to others: let's not be with him/her," and "…tells the other one's secrets to a third person?" The three physical aggression items taken from Statistics Canada and Human Resources Development Canada (1995) are as follows: "How often would you say that ____ kicks, bites, hits other children," "…gets into many fights," and "…physically attacks people?" For girls, the means for the composite physical aggression score ranged from $M = 1.16$ ($SD = 0.28$) to $M = 1.30$ ($SD = 0.39$) and for the composite indirect aggression score, from $M = 1.14$ ($SD = 0.23$) to $M = 1.30$ ($SD = 0.40$). For boys, the means for the composite physical aggression score ranged from $M = 1.23$ ($SD = 0.35$) to $M = 1.35$ ($SD = 0.41$) and for the composite indirect aggression score, from $M = 1.11$ ($SD = 0.22$) to $M = 1.27$ ($SD = 0.35$). Internal consistencies of the composite scores ranged from $\alpha = .68$ to $\alpha = .70$ for

Table 1
Setup of the Accelerated Longitudinal Design of the Study

	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11
Cohort 1								
Girls	T1 $n = 429$		T2		T3			
Boys	T1 $N = 419$		T2		T3			
Cohort 2								
Girls		T1 $n = 394$		T2		T3		
Boys		T1 $n = 387$		T2		T3		
Cohort 3								
Girls			T1 $n = 363$		T2		T3	
Boys			T1 $n = 402$		T2		T3	
Cohort 4								
Girls				T1 $n = 363$		T2		T3
Boys				T1 $n = 332$		T2		T3

physical aggression and from $\alpha = .75$ to $\alpha = .80$ for indirect aggression.

Results

Analyses were conducted in two blocks. In the first block, we examined the measurement structure of the three items referring to physical aggression and the five items referring to indirect aggression. Specifically, we tested: (a) whether the hypothesized two-factor model could be found in the data, and (b) if found, whether the two-factor measurement structure (i.e., the specific factor loadings) would be invariant across age and sex. In the second block, we examined whether the latent factor structure (i.e., the relations among the latent physical and indirect aggression factors) would vary across age, or sex, or both. These analyses were conducted with the LISREL8 software package (Jöreskog & Sörbom, 1996) using a multigroup modeling procedure with eight groups, based on the 2 (sex) $\times$ 4 (cohort) group design of the study. Through the use of within-group and cross-group comparisons (see the following detailed description), the accelerated longitudinal design of the study allowed us to examine potential age-related changes from age 4 to 11 years.

Because the χ^2 becomes increasingly sensitive with growing sample size (Marsh, Balla, & McDonald, 1988), it was not considered for evaluation of model fit given the large sample in our study ($N = 3{,}089$). Instead, we used practical fit indexes to test invariance of the measurement structure (i.e., the factor loadings) and of the latent factor structure (i.e., the relations among the latent factors). Little (1997) suggested that model invariance can be assumed (a) if the overall model fit is acceptable, as indicated by relative fit indexes (e.g., if the nonnormed fit index [NNFI] or a similar standard such as the comparative fit index [CFI] or incremental fit index [IFI] is approximately .90 or greater; Bentler & Bonett, 1980; Marsh, et al., 1988; and if the root mean square error [RMSEA] is less than .05; Browne & Cudeck, 1993); (b) if the difference in model fit is negligible (e.g., $\leq .05$ for the NNFI, IFI, or similar indexes) after introduction of the equality constraints; and (c) if the justification for the accepted model is substantively more meaningful and the interpretation more parsimonious than the alternative model. In addition, we followed recommendations by MacCallum, Browne, and Sugawara (1996) and used the 95% confidence interval (CI) around the RMSEA to evaluate model fit and for nested model comparisons. Specifically, if the upper bound of the CI is equal to or lower than .05, a close fit of the model to the data can be assumed. Moreover, if the CIs of subsequent nested models overlap with those of preceding, less constrained models, the more parsimonious model is deemed acceptable.

Testing the Measurement Structure

In the first step of the analyses, we examined whether the hypothesized two-factor model could be found in the data. To do so, we specified an initial model where, at each of the assessed three time points, the three physical aggression items loaded on one factor and the five indirect aggression items loaded on another. Expressly, an eight-group model (4 cohorts $\times$ 2 sex groups) was specified with a total of six factors (physical aggression and indirect aggression at T1, physical aggression and indirect aggression at T2, and physical aggression and indirect aggression at T3) (see Table 1). Residual variances of the same indicator were allowed to correlate across the three time points. In addition, all latent factors were free to correlate, both concurrently and across the three time points. Instead of fixing one factor loading in each factor to 1.0 to identify the model, the latent variances of the six factors were fixed to 1.0 so that all factor loadings could be freely estimated (Jöreskog & Sörbom, 1996). All factor loadings, residual variances, and correlations among the latent factors were freely estimated because no equality constraints were imposed in this initial model across the three time points. Similarly, no cross-group equality constraints were imposed in this initial model (i.e., across cohorts or sex).

This initial model showed acceptable fit to the data, $\chi^2(1703) = 3441.58$, CFI = .97, IFI = .97, RMSEA = .048 (95% CI = .046–.050), suggesting that a two-factor structure of physical and indirect aggression represented well the relations among the observed aggression items. To test further the hypothesis of a two-factor structure in the data, we then specified a second model where, at each of the three time points, the concurrent latent correlations between direct and indirect aggression were fixed to 1.0, so that both latent factors would reflect a single overarching factor. This second model showed a poorer fit to the data than the previous model, $\chi^2(1727) = 6627.56$, CFI = .91, IFI = .91, RMSEA = .088 (95% CI = .085–.090), $\Delta\chi^2(24) = 3185.98$, $p < .001$. Given that the respective CIs associated with the RMSEA also did not overlap in these two models, this finding indicated that a two-factor structure was indeed a better representation of the data than a one-factor model. Notably, because the factor loading of the ''gets into many fights'' item on the physical aggression factor was markedly lower (.59) than the factor loadings of the other two physical aggression items ''kicks, bites, hits'' (.75) and ''physically attacks'' (.70), we also examined the possibility of a cross-loading of this item on the indirect aggression factor. The maximum likelihood estimates of this cross-loading loading mostly ranged between –.08 and .11 across groups and across the three time points, with a higher loading (.27) at T2 for girls aged 11 years. Even this latter value, however, was too small to indicate the presence of a cross-loading of the ''gets into many fights'' item on the indirect aggression factor.

Next, we tested whether the specific factor loadings on the latent physical and indirect aggression constructs would be invariant across age (i.e., ages 4–11) and across sex. These model tests were conducted following the practical modeling rationale described earlier. Before testing potential age and sex differences, however, we examined potential cohort effects by estimating a model where corresponding factor loadings were constrained to be equal across the four cohorts. For example, to test whether cohorts had equivalent factor loadings on physical aggression at age 6 years, the factor loadings on physical aggression at T2 for the first female cohort were constrained to be equal to the factor loadings on physical aggression at T1 for the third female cohort. Based on the practical fit indexes, the new constrained model did not differ from the initial unconstrained model, $\chi^2(1767) = 3525.18$, CFI = .97, IFI = .97, RMSEA = .048 (95% CI = .045–.050), indicating that there were no cohort effects on corresponding factor loadings.

The absence of cohort differences allowed us to proceed with the next model, where we tested whether all comparable factor loadings could be equated across age. To do so, we imposed (a) within-group equality constraints of corresponding factor loadings across the three assessed time points, and (b) cross-cohort (but not cross-sex) equality constraints of all corresponding factor loadings. The observed loss in practical model fit was negligible, $\chi^2(1879) = 3745.01$, CFI = .96, IFI = .96, RMSEA = .047 (95% CI = .045–.050), indicating that the measurement structure of physical and indirect aggression stayed stable from ages 4 through 11 years. Finally, cross-sex equality of the factor loadings was examined. In this last model, all corresponding factor loadings were constrained to be equal not only across age but also across sex groups. Again, the newly constrained model did not differ meaningfully from the previous one with regard to practical model fit, $\chi^2(1887) = 3770.52$, CFI = .96, IFI = .96, RMSEA = .048 (95% CI = .045–.050), suggesting that the respective factor loadings of physical and indirect aggression were invariant not only across age but also across sex. The item factor loadings on physical and indirect aggression of the

final measurement model based on the LISREL maximum likelihood estimation procedure are presented in Table 2.

Testing the Latent Correlational Structure

The results from the first block of analyses showed that the assumption of a two-factor model of physical and indirect aggression was justified and that the measurement structure of these two factors remained stable across age and sex. As such, it was possible to test in the second block of analyses whether the correlations among the latent physical and indirect aggression factors would remain stable or vary across age, sex, or both. The general model testing sequence followed the same pattern as before. Specifically, we first tested invariance of the latent correlational structure across cohorts before examining potential age or sex effects. A summary of the model testing steps is provided in Table 3.

Table 2
LISREL Maximum Likelihood Estimates of the Factor Loadings on Physical and Indirect Aggression

Item descriptor	Physical aggression	Indirect aggression
Fights	.59	
Attacks	.75	
Kicks	.70	
Dislike		.65
Revenge		.64
Behind		.64
Avoids		.67
Secret		.61

Note. Factor loadings are equal across time and sex. All factor loadings are significant at $p < .001$.

As can be seen in Table 3, the first set of comparisons revealed no differences across cohorts with respect to the correlations among the latent physical and indirect aggression constructs, and further nested model comparisons showed that these correlations did not vary significantly across age or sex. The latent correlation matrix obtained from the final parsimony model for physical and indirect aggression from T1 through T3 is presented in Table 4. As can be seen, the concurrent correlation between physical and indirect aggression was moderate, $r = .45$. This finding further supports the distinctiveness of the two constructs, which were already indicated by the results of the measurement model tests. Both physical aggression and indirect aggression were moderately stable, with stability coefficients ranging between $r = .63$ for physical aggression and $r = .54$ for indirect aggression over a 2-year period, and between $r = .55$ for physical aggression and $r = .45$ for indirect aggression over a 4-year period. The cross-correlations between the two constructs over 2 or 4 years were generally lower, around .30, but remained moderately consistent.

Predictive Relations Between Physical and Indirect Aggression Over 4 Years

In the final set of model tests, we examined the predictive relations between physical and indirect aggression over the three assessment times (i.e., over 2 years and 4 years, respectively) and whether these relations were invariant across time or sex. For this purpose, we specified a saturated model with predictive links from physical and indirect aggression at T1 to physical and indirect aggression at T2 and T3, and with predictive links from physical and

Table 3
Summary of Nested Model Tests Regarding the Latent Correlational Structure

Nested model step	Description	IFI	CFI	RMSEA	CI 95%RMSEA	ΔDF	χ^2
Invariance across cohorts	Concurrent correlations, 2-year auto- and cross-correlations equal across cohorts	.96	.96	.047	.045 – .050	1911	3815.00
Invariance across age	Concurrent correlations, 2-year auto- and cross-correlations, and 4-year auto-and cross-correlations equal across age	.96	.96	.047	.045 – .050	1989	3974.38
Invariance across sex	Concurrent correlations, 2-year auto- and cross-correlations, and 4-year auto-and cross-correlations equal across sex	.96	.96	.047	.045 – .050	1998	3978.81

Note. Practical fit indexes are compared. Subsequent nested models are tested against their respective accepted previous model. IFI = incremental fit index; CFI = comparative fit index; RMSEA = root mean square error of approximation; ΔDF = degrees of freedom.

Table 4
Correlations Among Latent Physical and Indirect Aggression Constructs Over 4 Years

	A	B	C	D	E	F
A. Physical T1		.45	.63	.31	.55	.32
B. Indirect T1			.27	.54	.16	.45
C. Physical T2				.45	.63	.31
D. Indirect T2					.27	.54
E. Physical T3						.45
F. Indirect T3						

Note. There is a 2-year interval between each time of measurement. Correlations are based on LISREL maximum-likelihood estimates and are equal across cohorts and sex. All correlations are significant at $p < .001$.

indirect aggression at T2 to physical and indirect aggression at T3. In addition, concurrent correlations were estimated between physical and indirect aggression at each time. All latent correlations and paths were freely estimated across time and no cross-group equality constraints were imposed in this initial model, $\chi^2(1855) = 3770.52$, CFI = .96, IFI = .96, RMSEA = .048 (95% CI = .045 – .050). We then tested whether the latent path structure was invariant across cohort, time, or sex. A summary of the model testing steps is provided in Table 5.

The results from this model are depicted in Figure 1. As can be seen, stability coefficients were high from one period to the next (2 years) for both physical and indirect aggression, ranging between $\beta = .55$ to .58 for physical aggression and $\beta = .45$ to .46 for indirect aggression, and these coefficients remained significant over 4 years, $\beta = .26$ for physical aggression and $\beta = .18$ for indirect aggression. Despite the relatively strong autocorrelations, significant residual concurrent correlations ranging between $r = .21$ and $r = .29$ among physical and indirect aggression could still be observed. No noteworthy cross-lagged effects between the two constructs were observed, however, over a 2- or 4-year time frame. Notably, because 2- and 4-year stability seemed to be stronger for physical aggression than for indirect aggression, we tested in an additional model whether these stability coefficients were indeed significantly different for the two constructs, using a probability level of $p < .001$. For this purpose, we constrained the corresponding stability coefficients to be equal across physical and indirect aggression. This constrained model showed a significant drop in fit compared with the previous model, $\Delta\chi^2(\Delta 2) = 16{,}77$, $p < .001$. As such, stability over 2 and 4 years was significantly higher for physical aggression than for indirect aggression in the study sample.

Discussion

Results of the present study provide support for the distinction between maternal reports of indirect and physical aggression. Using a CFA with an accelerated longitudinal design, a two-factor measurement structure was found, which was invariant from ages 4 through 11 years and across sex. This result supports the hypothesis of the distinctiveness of indirect and physical aggression. Moreover, the temporal stability of the measurement structure of indirect and physical aggression suggests that children's specific expressions of these two forms of aggression (e.g., kicking, biting, and hitting as expressions of physical aggression and becoming friends with another as revenge or telling bad things behind a person's back as expressions of indirect aggression) become established relatively early and seem to be used, albeit not necessarily to the same degree, throughout middle childhood by girls and

Table 5
Summary of Nested Model Tests Regarding the Latent Path Structure

Nested model step	Description	IFI	CFI	RMSEA	CI 95% RMSEA	DF	χ^2
Invariance across cohorts	All concurrent correlations, stability coefficients, and cross-paths equal across cohorts	.96	.96	.047	.045 – .049	1969	3885.28
Invariance across time	Two-year stability coefficients and 2-year cross-paths equal across time (i.e., from T1 to T2 and from T2 to T3)	.96	.96	.047	.045 – .050	1977	3912.93
Invariance across sex	All concurrent correlations, stability coefficients, and cross-paths equal across sex	.96	.96	.047	.045 – .049	1992	3934.39

Note. Practical fit indexes are compared. Subsequent nested models are tested against their respective accepted previous model. IFI = incremental fit index; CFI = comparative fit index; RMSEA = root mean square error of approximation; DF = degrees of freedom.

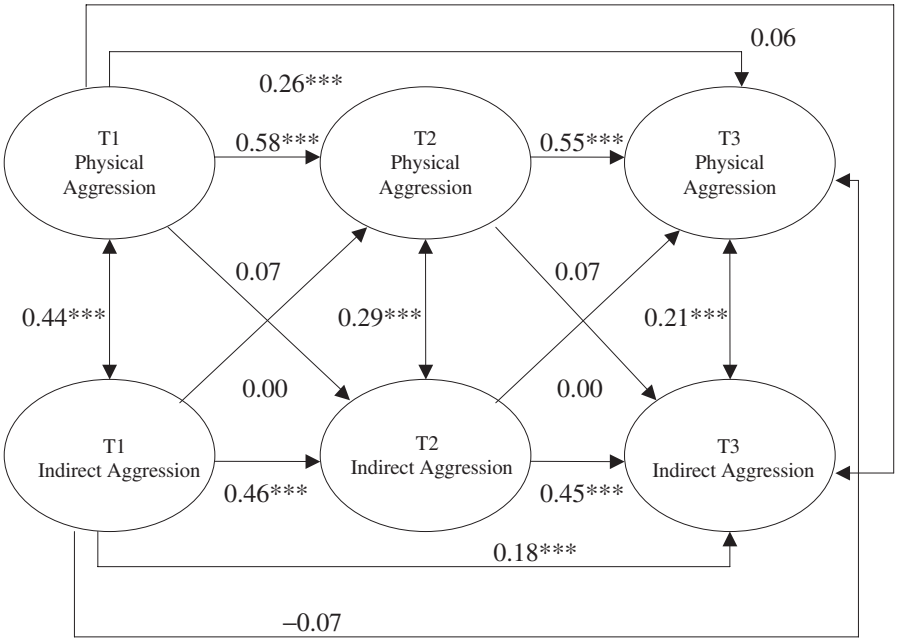

Fig. 1. Results from the latent path analysis to assess the predictive links between physical and indirect aggression over 4 years based on LISREL maximum likelihood estimates from the final model in Table 5. Common metric standardized coefficients are provided. ***$p < .001$.

boys. The finding of a stable measurement structure of physical and indirect aggression over time and across sex is important because without such invariance a meaningful examination of sex differences or age-related changes in the mean levels of these different types of aggression would not be possible.

In addition to examining the measurement structure of indirect and physical aggression, we tested the latent factor structure of the two-factor model across time and sex. Results from these analyses provided additional support for the discreteness of indirect and physical aggression. The correlation obtained between the latent indirect and physical aggression constructs was a moderate .45. Moreover, we found that individual levels of physical aggression and indirect aggression were relatively stable over a 2-year period ($r = .63$ and .54, respectively) and a 4-year period ($r = .55$ and .45, respectively), with physical aggression showing greater stability. The stability coefficients obtained for physical aggression are consistent with previous work (see Coie & Dodge, 1998; Tremblay, 2000, for reviews), whereas the stability coefficients obtained for indirect aggression are the first to be reported across this length of time. These stability rates suggest that despite maturational changes such as increased social cognitive skills, some girls and boys persist in their use of aggression. However, caution should be heeded in this statement in that correlations depict relations and do not deal with the absolute levels of these behaviors.

Finally, given the robustness of the factor structure, the predictive links between indirect aggression and physical aggression were also examined. Findings from the path analysis revealed that children's mode of aggressing was consistent over development for both physical and indirect aggression. That is, over the 4-year period assessed in the present study, physically aggressive children tended to remain physically aggressive whereas indirectly aggressive children tended to remain indirectly aggressive. These findings are incongruent with Bjorkqvist and colleagues' developmental hypothesis (Bjorkqvist, Osterman, & Kaukiainen, 1992; Bjorkqvist et al., 1994), which postulates that as children mature, their mode of aggressing switches form from physical to indirect. To support this idea of heterotopic continuity, a developmental shift in the use of aggression needs to be shown. Specifically, a predictive link from physical aggression to indirect aggression should be present (e.g., Time 1 physical aggression associated with Time 2 indirect aggression). In the current study, no cross-lag effects were found between physical and indirect aggression.

Perhaps one reason such patterns were not found is that mothers reported on their children's use of aggression. The reliance on maternal reports may be

problematic insofar as the intimate structure of peer groups is believed to promote the use of indirect aggression (e.g., Crick & Grotpeter, 1995; Lagerspetz et al., 1988). If so, it is likely that peers would be more privy to displays of indirect aggression than mothers, given that (a) it is often the social ties that are attacked, and (b) indirect aggression is often circuitous. Furthermore, considering that as children age their contact with peers increases while their contact with parents decreases (Harris, 1995, 1998), it is again likely that peers would be more cognizant than mothers regarding who uses indirect aggression.

Another reason Bjorkqvist and colleagues' (Bjorkqvist, Lagespetz, et al., 1992; Bjorkqvist, Osterman, & Kaukiainen, 1992; Bjorkqvist et al., 1994) developmental hypothesis was not supported in the present study might be that the participants were too young. Based on their cross-sectional studies of children aged 8, 11, and 15 years, Bjorkqvist and colleagues (Bjorkqvist, Lagespetz, & Kaukiainen, 1992; Bjorkqvist, Osterman, & Kaukiainen, 1992) have argued that indirect aggression may not be ''fully developed'' in 8-year-olds and that a certain level of social maturation is needed for successful use of indirect aggression. It is certainly possible that we did not find support for the idea of heterotopic continuity with respect to the form aggression takes because the children in our study were too young. The use of a more extended longitudinal design involving older (i.e., adolescent) participants may reveal clearer support for a cross-lagged relation between physical and indirect aggression, according to the developmental theory proposed by Bjorkqvist and colleagues. At this time there are no published longitudinal studies that can, in effect, support this hypothesis. However, in this context it should be considered that development is rarely (if ever) incremental, and that the development of aggression is probably more complex than is suggested by traditional stage theories of development (e.g., Piaget, 1952). For example, it is likely that (a) some children begin on a high trajectory of physical aggression and continue along this path (high stable physical); (b) some children begin on a high trajectory of indirect aggression and continue along this path (high stable indirect); (c) some children begin on a high trajectory of physical aggression and over time also start using indirect aggression (combined type); and (d) some children begin on a high trajectory of physical aggression, abandon this mode of aggressing, and begin to use indirect aggression (according to the developmental hypothesis of Bjorkqvist, Lagerspetz, & Kaukiainen, 1992, and Bjorkqvist, Osterman, & Kaukiainen, 1992). These different possible aggression profiles highlight the complexity of human development and illustrate the need to consider longitudinal designs in future research.

When interpreting the present findings, some limitations have to be considered. For example, as previously mentioned, our findings are based exclusively on mothers' reports of their children's aggressive behavior, and children's age range was restricted to 4 through 11 years. It will be important to replicate these findings using different reporting sources, especially peers' reports, as peers may be more likely than mothers to witness and experience children's aggressive behavior. Another issue is whether the distinctiveness between indirect aggression and physical aggression is not really reflective of a distinction between overt and covert aggression. In the current study, the items used to measure indirect aggression were covert whereas the items used to measure physical aggression were overt. It will be interesting to see in future studies whether the distinction found between indirect aggression and physical aggression remains when items that measure overt indirect aggression (e.g., threatening to withdraw friendship as a retaliatory method) are considered.

Furthermore, considering the suggestion that indirect aggression represents the more sophisticated form of aggression (Lagerspetz et al., 1988), which may not be fully developed until the age of 8 years and may peak in midadolescence (see Bjorkqvist, Lagerspetz, & Kaukiainen, 1992; Bjorkqvist, Osterman, & Kaukiainen, 1992), it will also be important to replicate the present study with older children. This need for replication with an older sample is highlighted further when we consider that in our study the stability of physical aggression was greater than that of indirect aggression. Perhaps the reason for the lower stability of indirect aggression is that at the relatively young age of 4 to 11 years, indirect aggression is still very much in the developing phase (Bjorkqvist, Lagespetz, & Kaukiainen, 1992; Bjorkqvist, Osterman, & Kaukiainen, 1992) and a large proportion of children may be trying it out for the first time. In contrast, physical aggression has consistently been shown to be used by toddlers (e.g., Brame et al., 2001; Broidy et al., 2003; Cote et al., 2003; Tremblay et al., 1991). It is likely, then, that those who use physical aggression in later life are the same children who used it during early childhood, thus contributing to the higher stability rates of physical aggression in the present study.

The limitations of the present study notwithstanding, our results provide clear support for the distinction between indirect and physical aggression between 4 and 11 years of age. Indeed, the CFA confirmed a two-factor model for indirect and physical aggression, which was stable across cohorts, time, and sex. These findings provide a necessary basis for future longitudinal studies examining the development of the different types of aggression across the life span (starting in infancy and proceeding into adulthood). Such studies could help determine, for example, when the use of indirect aggression is at its highest and the use of physical aggression at its lowest. They could also help map the suggested (Bjorkqvist, Lagespetz, & Kaukiainen, 1992; Bjorkqvist, Osterman, & Kaukiainen, 1992) transition from high physical aggression at the end of infancy to the start of indirect aggression, thus providing us with a better understanding of the complexities of aggression across development.

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