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Dual Pathways from Reactive Aggression to Depressive Symptoms in Children: Further Examination of the Failure Model

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Abstract

The failure model posits that peer rejection and poor academic performance are dual pathways in the association between early aggressive behavior and subsequent depressive symptoms. We examined this model using an accelerated longitudinal design while also incorporating proactive and reactive aggression and gender moderation. Children in 1st, 3rd, and 5th grades ($n = 912$; ages 6–12; 48% female) were rated three times annually by their primary teachers on measures of proactive and reactive aggression, peer rejection, academic performance, and depressive symptoms. Using Bayesian cross-classified estimation to account for nested and planned-missing data, path models were estimated to examine whether early reactive aggression predicted subsequent peer rejection and academic performance, and whether these, in turn, predicted subsequent depressive symptoms. From 1st to 3rd grade, reactive aggression predicted peer rejection (not academic performance), proactive aggression predicted academic performance (not peer rejection), and academic performance and peer rejection both predicted depressive symptoms. From 3rd to 5th grade, however, neither peer rejection nor academic performance predicted subsequent depressive symptoms. Results were not moderated by gender. Overall, these findings provide mixed and limited support for the failure model among school-age children. Early reactive aggression may be a key risk factor for social problems, whereas proactive aggression may be linked to improved academic functioning. The "dual pathways" of peer rejection and academic performance may operate during early but not later elementary school. Limitations and implications are discussed.

Keywords Failure model · Proactive and reactive aggression · Peer rejection · Academic performance · Depressive symptoms · Developmental pathways

Children who exhibit aggressive and antisocial behavior are at a greater risk for depressed mood in later childhood and adolescence (e.g., Panak and Garber 1992), but less is known about the mechanisms that could account for this heterotypic transition. Patterson and colleagues' "failure model" offers one possible explanation, positing that aggressive children are more likely to encounter failures in social and academic functioning, which, in turn, contribute to depressed mood over time (Patterson and Capaldi 1990). Despite its influence, the failure model as a whole has received limited direct examination. Additionally, further clarity might be gained by including the proactive and reactive functions of aggression, which bear theoretical and empirical connections to the failure model (Fite et al. 2016). The present study examines academic performance and peer rejection in the developmental pathways from reactive aggression to depressive symptoms among school-age children.

Developmental Pathways from Aggression to Depressed Mood

Aggressive behavior in childhood is associated with poorer developmental outcomes in several areas, including behavioral, academic, and social functioning. Of particular interest, children who exhibit early aggressive behavior are also more likely to experience depression and internalizing problems, both concurrently and prospectively in childhood through adulthood (Burke et al. 2005; Coie et al. 1995; Loth et al. 2014; Panak and Garber 1992). To help explain this phenomenon, Patterson and colleagues articulated and later refined a model of the

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development of antisocial behavior (Granic and Patterson 2006; Patterson and Capaldi 1990; Patterson and Stoolmiller 1991; Patterson et al. 1989; Patterson & Yoerger 1993). According to this model, aggressive children are more likely to encounter psychosocial "failure" in multiple domains, including poor academic performance and peer rejection. Over time, the cumulative wear and tear of these failures can contribute to depression and delinquency in later childhood and adolescence. Despite being theoretically influential, the model has received relatively little rigorous longitudinal examination as a whole. Most direct evaluations of the failure model have focused on outcomes related to delinquency, crime, and antisocial behavior later in development (e.g., Granic and Patterson 2006), with less attention to the social and academic pathways to depressed mood. Those studies that do address mood outcomes tend to be cross-sectional, conceptual, or focus only on component parts of the model. Consequently, much of the evidence pertaining to the failure model has accumulated with little rigorous testing of the entire model.

Among the few attempts at testing the failure model was Patterson and Capaldi's (1990) cross-sectional study of fourth-grade boys at risk for antisocial behavior. Results showed positive associations among peer rejection, academic difficulties, and depressed mood. However, better fit was obtained for a post hoc mediational model where peer rejection was the only direct predictor of depression, and peer rejection statistically accounted for the link between academic performance and depression. Replications of this model were later tested among three cross-sectional samples of boys, including two cohorts from the previous study and a third sample of youth from recently separated families (Patterson and Stoolmiller 1991). Although the link between peer relations and depressed mood was supported in all three samples, the link between academic skills and depressed mood was supported only among the two samples not from recently separated families. It seems likely that these divergent findings could be explained by sample differences (i.e., youth from separated families being at particularly pronounced risk for depression via social rejection). These generalizability issues are further limited by their all-male samples and cross-sectional design.

While the failure model explanation has persisted in the literature, it seems that most studies have cast aside the notion of dual pathways in favor of models focusing on *either* social *or* academic problems as they relate to aggression or depressive symptoms. From this perspective, evidence for the component associations within the failure model continues to emerge. For example, in a five-year longitudinal study among Chinese children, aggression had significant direct and indirect effects on subsequent social competence and academic achievement; however, the converse was not true (Chen et al. 2010). Such developmental pathways appear to emerge relatively early, robustly predicting subsequent academic and social functioning (e.g., Brennan et al. 2012; Campbell et al. 2006).

Other studies provide evidence for the later paths in the failure model, showing that peer rejection (e.g., Gooren et al. 2011; Morrow et al. 2006, 2008), academic problems (e.g., Fite et al. 2013; McCarty et al. 2008; Stoolmiller et al. 2005), or both (e.g., Nocentini et al. 2012; Obradović et al. 2010) are uniquely associated with depressive symptoms. For example, peer rejection statistically accounts for the association between aggression and depressive symptoms (Fite et al. 2013; Morrow et al. 2006, 2008). Longitudinally, aggressive and externalizing behavior predict subsequent depressive symptoms and internalizing problems, with peer rejection accounting for this association (Gooren et al. 2011; van Lier and Koot 2010; Panak and Garber 1992; Pedersen et al. 2007). With respect to academic functioning, low GPAs predicted subsequent depressive symptoms among samples comprised of school-age children (boys and girls) over the course of two years (Schwartz et al. 2008), and academic failure predicted subsequent depressive episodes for adolescent girls (McCarty et al. 2008). Of note, Nocentini et al. (2012) found that school performance and social problems both act as proximal predictors of depressive symptoms and delinquency.

Only a few studies to our knowledge have examined anything resembling most or all of the failure model (i.e., all four variables over time). In a 20-year study, Obradović et al. (2010) found that low social competence predicted internalizing symptoms from childhood into adolescence, and in turn into adulthood; however, academic competence only predicted internalizing problems from adolescence into adulthood. Further, this study found evidence for cascade effects in which early externalizing problems predict a sequence of academic, social, and internalizing problems across development. In a much shorter study, van Lier et al. (2012) followed children from 6 to 8 years of age and found that externalizing problems predicted poor academic performance and peer victimization, which both predicted later internalizing symptoms (although with bidirectional links between externalizing problems and victimization). Overall, it is difficult to draw firm conclusions from these studies because they investigated similar questions across different developmental periods and with variables measured at a broader level (e.g., internalizing and externalizing problems) than is suggested by theory. Here, more specific operationalization is needed.

The Role of Reactive Aggression

Although aggression is often considered as a monothetic construct, meaningful distinctions can be drawn according to the proactive and reactive functions of aggressive behavior (Dodge and Coie 1987; Fite et al. 2016; Little et al. 2003). Proactive aggression consists of goal-oriented, instrumental behaviors committed as a means of accomplishing a goal. By contrast, reactive aggression consists of emotionally driven, impulsive

behaviors that occur in response to a real or perceived threat or blocked goal (Fite et al. 2016). These two subtypes of aggression are theoretically distinct but empirically correlated, typically between 0.6 and 0.8 in studies utilizing questionnaires (Card and Little 2006; Polman et al. 2007). Yet, factor analytic studies support the proactive-reactive dichotomy (Fite et al. 2010; Little et al. 2003). After controlling for their shared variance, proactive and reactive aggression demonstrate differential correlates, etiologies, and outcomes, including unique relations with academic, social, and emotional constructs (Card and Little 2006; Fite et al. 2016).

These aggression subtypes are theoretically complementary to Patterson and colleagues' model, with reactive aggression likely playing a key role. Broadly, Patterson et al.'s model (Patterson et al. 1989) and the current conceptualization of proactive/reactive aggression (Fite et al. 2016) both derived in large part from social learning theory (Bandura 1973), adding more specific details about environmental processes and individual characteristics associated with aggressive behavior. In their broader models, Patterson et al. (Dishion and Patterson 1997; Patterson et al. 1989) hypothesized that both child characteristics (e.g., emotion dysregulation, ADHD, cognitive functioning) and social-interactional processes (e.g., coercive cycles, harsh and inconsistent parenting) are linked to antisocial behavior. Similarly, reactive aggression can be conceptualized in terms of individual differences in emotion reactivity and social information processing (Berkowitz 1989; Dodge and Coie 1987), with individual and environmental components. Reactive aggression is uniquely linked to neurobiological and psychophysiological correlates as well as deficits in emotion regulation, executive functions, and verbal intelligence (Fite et al. 2016). All of these characteristics align nicely with the failure model. For example, hostile attribution biases can lead to peer problems; neurocognitive deficits likely contribute to poorer academic performance; and heightened reactivity may increase risk for depression. Proactive aggression, on the other hand, is not associated with any of these neurocognitive and dysregulatory deficits after controlling for reactive aggression. Further, proactive aggression appears to emerge later in development via different learning processes (Fite et al. 2016).

In addition to this theoretical rationale, there is empirical evidence supporting the link between reactive aggression and depressed mood in youth (e.g., Day et al. 1992; Fite et al. 2009; Mathieson and Crick 2010). For example, in a large community sample, children who were classified as reactively aggressive showed significantly greater depressive symptoms at age 13 compared to those who were proactively aggressive or nonaggressive (Vitaro et al. 2002). Similarly, reactive, but not proactive, aggression in adolescent males was a risk factor for depressive symptoms 3 years later (Fite et al. 2014). There is also evidence that reactive, but not proactive, aggression is associated with peer rejection and victimization (e.g., Evans et al. 2015; Salmivalli and Helteenvuori 2007). A meta-analysis of 36 correlational studies found that, after controlling for proactive aggression, reactive aggression is associated with less favorable ratings in social preference, peer acceptance, rejection, victimization, and internalizing problems (Card and Little 2006). Similarly, some evidence suggests that reactive, not proactive, aggression is uniquely associated with poor academic performance (Fite et al. 2013; Day et al. 1992). Aggression (broadly) is linked to poor academic performance (e.g., Chen et al. 2010), and reactive aggression seems to play a major role in this association (Day et al. 1992).

Although proactive aggression shows little to no specific associations with depressive symptoms, peer functioning, and academic performance, it is more strongly linked to antisocial correlates and outcomes such as delinquency (Card and Little 2006; Fite et al. 2016). In fact, some of this evidence suggests that proactive aggression can be positively evaluated by peers and is associated with lower levels of peer victimization. These patterns might be explained by the finding that proactive aggression is not associated with deficits in behavioral, cognitive, and emotional regulation, unlike reactive aggression (Evans et al. 2016a, b; White et al. 2013).

Considering Gender

Lastly, it is important to examine the possibility of gender differences. Many of the studies reviewed above have used male-only samples (e.g., Day et al. 1992; Patterson and Stoolmiller 1991; Stoolmiller et al. 2005), but there is no obvious reason why this model would not apply to females. Among those studies that have used mixed-gender samples, many have failed to examine gender differences (e.g., Panak and Garber 1992), found no differences (e.g., van Lier et al. 2012), or found differences to varying degrees. For example, Salmivalli and Helteenvuori (2007) found that among boys, reactive aggression predicted higher levels—and proactive aggression predicted lower levels—of future peer victimization; but no temporal associations among these variables were found for girls. There is also evidence of only girls showing a significant path from academic performance to depressive symptoms (McCarty et al. 2008), and of boys exhibiting more pathways from social problems to internalizing problems (Obradović et al. 2010). More fundamentally, gender is a key consideration in examining aggression and depression developmentally. While boys tend to exhibit higher levels of aggression than girls, the manifestation and social impact of aggressive behavior may be different for girls (e.g., Smith et al. 2010). Similarly, gender differences in depressive symptoms are negligible in childhood and then become very pronounced in adolescence (Hankin et al. 1998), with certain psychological and interpersonal characteristics among girls thought to account for their increased vulnerability (Nolen-Hoeksema and Girgus 1994). Thus, previous research

justifies the exploration of gender differences, but does not indicate specific hypotheses.

Study Overview

The literature provides mixed and limited evidence for the failure model, in which peer rejection and poor academic performance are dual pathways by which aggressive children go on to develop depressive symptoms. Against this background, the present study provides a direct, longitudinal test of the failure model among school-age children. This study also advances the literature by incorporating proactive and reactive aggression and exploring the possibility of gender differences. Based on previous research, we hypothesized that (a) reactive, not proactive, aggression would predict subsequent peer rejection and poor academic performance; and (b) peer rejection and poor academic performance would both predict subsequent depressive symptoms.

Methods

Data collection took place at an elementary school in a small town in the U.S. Midwest. The primary classroom teachers of students in grades 1, 3, and 5 (ages 6–12) were asked to complete measures on each student in their class. As described in more detail below, data were collected annually over the course of three school years. In total, data were collected from 36 unique teachers reporting on 912 unique students (48% female) on at least one of the three occasions. School records from the T1 year show students' racial/ethnic backgrounds as follows (multiple responses were permitted): 21% were at least partially from a racial minority background (9% Black/African American, 6% Hawaiian/Pacific Islander, 4% Native American, 2% Asian/Asian American), and 5% identified as Hispanic ethnicity. About 35% were eligible for free or reduced-cost lunch. Census records for the town show a similar racial/ethnic composition and a median household income of $65,197 (per capita, $26,679).

The same protocol was used at all time points. Prior to each wave, teachers were informed of the nature of their participation and potential benefits to the school and to themselves, and informed consent was collected.[1] Virtually all teachers consented and participated in the study at each time point, yielding a total (grade-by-year) teacher response rate of 96%. Teachers completed a series of measures, hosted through the Qualtrics online survey platform, on each student in their classroom. Teachers received $7 per survey at T1 and $50 for full participation at T2/T3. All procedures were approved by the institutional review board at the University of Kansas and are in accordance with the 1964 Helsinki declaration and its later amendments.

This study follows an accelerated longitudinal design using transformed cross-sequential data and planned missingness (Little 2013). In such a design, a cross-section of participants of different age cohorts is followed longitudinally to examine developmental trends across both time and age. Advantages of this design include that it allows stronger inferences about change processes (compared to cross-sectional data), estimation of cohort and wave effects, larger overall sample sizes, and greater efficiency than a fully prospective design. A key disadvantage is that results do not apply to the same individuals over the entire period, as is required for true mediation.[2] Thus, accelerated designs are weaker than fully prospective designs (Little 2013). In the present study, data were collected annually from seven consecutive grade cohorts of children who were assessed at up to three time points over the course of three school years (T1, T2, and T3). Each measurement occasion fell between late October and early December of the fall semester. The transformed data structure of this design is illustrated in Table 1 along with child sample sizes by cohort and grade level. For example, 3rd grade observations were aggregated from T1, T2, and T3 for cohorts C, D, and E, respectively.

Measures

Proactive and Reactive Aggression Teachers rated students' aggressive behaviors using the Proactive and Reactive Aggression rating scale (PRA; Dodge and Coie 1987). The PRA consists of six items, with subscales measuring proactive (e.g., threatens or bullies others to get what s/he wants) and reactive aggression (e.g., when teased or threatened, s/he gets angry easily and fights back). All items are rated on a five-point Likert scale from 1 (*never*) to 5 (*almost always*). Past research has supported the validity and reliability of the PRA as a teacher-rated measure of aggressive behavior in school-age children (Dodge and Coie 1987; Dodge et al. 1997). Across all time points, internal consistency was at good for proactive aggression (αs = 0.85–0.87) and excellent for reactive aggression (αs = 0.93–0.95).

Academic Performance Teachers rated their students' overall academic performance on three items: (a) "relative to other students in your class," (b) "overall academic performance (reputation based on all their classes)," and (c) "what letter

[1] These teachers routinely evaluate and report on their students in study domains (i.e., academic performance, social-emotional functioning, behavior problems) as part of their professional duties and school procedures. Further, the data were de-identified to the researchers and only presented back to school staff in aggregate descriptive statistics. For these reasons the institutional review board and the school administration determined that teacher participation was unlikely to affect individual students. Thus, parent consent and youth assent were not required; teacher consent was sufficient.

[2] True mediation is established when variable X at Time T is associated with variable Y at Time T + 2, and both are associated with variable M at time T + 1 (Kline 2016; Little 2013). Given the accelerated design, the direct paths from first to fifth grade were not estimable because no participants were observed at both time points. Thus, only the indirect paths were estimated, and direct effects could not be examined.

Table 1 Data collection samples and occasions by cohort and grade level

Study Cohort	1st Grade		3rd Grade		5th Grade	Total
A	–		–		104 [a]	104
B	–		–		143 [b]	143
C	–		119 [a]	→	117 [c]	136
D	–		124 [b]		–	124
E	111 [a]	→	140 [c]		–	155
F	122 [b]		–		–	122
G	128 [c]		–		–	128
Total	361		383		364	912

Values represent sample sizes. Total grade level sample size (bottom row) reflects the total of the figures within each column, summing to 100%. Total cohort sample size (rightmost column) reflects the total number of unique students within each cohort measured on at least one occasion and therefore do not sum to 100%.

[a] T1 data collection

[b] T2 data collection

[c] T3 data collection

grade best reflects this student's academic performance." The first two items were rated on a five-point scale from 1 (*well below average*) to 5 (*well above average*), and the third item on a five-point scale comprised of letter grades from A to F (reverse-coded as 5 to 1). Responses were averaged for analysis, with higher scores reflecting better overall academic performance. These items have demonstrated evidence of reliability and validity in previous research (e.g., Evans et al. 2016a, b; Fite et al. 2013). In separate analyses of 3rd to 5th grade data, this measure shows evidence of criterion/predictive validity via strong associations with students' overall end-of-semester GPAs (rs = 0.55 to 0.60, ps < 0.001). It showed excellent internal consistency in the present sample (αs = 0.93–0.95).

Peer Rejection Peer rejection was measured using teachers' ratings on four items from the Teacher Report Form (TRF; Achenbach and Rescorla 2001). Ratings were provided on a three-point Likert scale (1 = *not true*, 2 = *somewhat or sometimes true*, 3 = *very or often true*) and then averaged for analyses. The peer rejection subscale includes four items that tap general aspects of poor peer relations and social difficulties, including being teased, left out, or not liked. Research supports the validity of this subscale in terms of convergent, divergent, and criterion-related validity with other measures of social functioning (e.g., Evans et al. 2016a, b; Fite et al. 2013). The peer rejection scale showed acceptable internal consistency (αs = 0.78–0.83).

Depressive Symptoms The withdrawn/depressed subscale from the TRF was used to measure students' depressive symptoms. This scale consists of eight items, rated on the same three-point Likert scale as peer rejection, measuring symptoms of depression (e.g., sadness or depressed mood, anhedonia, psychomotor retardation) as well as behaviors indicating social withdrawal (e.g., preference for being alone and for not talking to others). The withdrawn/depressed subscale is one of the original composite scales in the Achenbach assessment system, with substantial empirical support for validity and reliability (Achenbach and Rescorla 2001). This measure demonstrated good internal consistency (αs = 0.87–88).

Analytic Plan

Prior to analysis, distributional characteristics, intraclass correlation coefficients (ICCs), bivariate correlations, and missing data patterns were examined for all variables and time points. It was expected and confirmed that some variables (e.g., proactive aggression, depressive symptoms) would be positively skewed and kurtotic, and that there would be some classroom-level dependencies (see Table 2). Additionally, the accelerated design incorporates planned missing data (Table 1). As detailed below, analyses accounted for all of these data characteristics.

We used two complementary strategies to help adjust for classroom-level bias and dependencies (see ICCs in Table 2), and allow for more theoretically and statistically sound interpretation of results. First, while all variables were initially measured as mean scores (thereby retaining their scale properties for descriptive statistics; Table 2), these scores were then standardized by classroom prior to analysis ($Z = [X - M_{Classroom}] / SD_{Classroom}$). Using clustered z-scores is a common practice for standardizing the measurement of social, emotional, and academic data when it is nested within classrooms. Standardization can mitigate nonnormality, reduce nonessential multicollinearity, and aid in the interpretation of the regression coefficients (Cohen et al. 2003). More substantively, classroom standardization affords researchers a more ecological interpretation—that is, results are applicable to students relative to their classroom peers at each occasion. Second, path models were analyzed using Bayesian cross-classified estimation in Mplus Version 7 (Muthén and Muthén 2012). Cross-classified estimation is a special case of multilevel modeling appropriate for data where participants are nested in different structures (classrooms) across observations (grade levels).[3]

Bayesian models use Markov Chain Monte Carlo (MCMC) to independently estimate posterior values in sequential

[3] Because software limitations allowed no more than two cross-classified occasions, these models were specified in several ways: piecewise models containing two adjacent occasions at a time (1st to 3rd; 3rd to 5th); and whole models containing all three occasions with the cross-classified adjustments applied to one interval or the other. Because single models are more parsimonious than piecewise models, and because the 3rd and 5th grade variables were most of interest as outcomes, we treated this particular model—i.e., 1st to [3rd to 5th] (brackets denote cross-classified adjustments)—as the primary model for interpretation. The other versions were estimated as secondary evidence to assess the robustness of results. In some model variants (but not the primary/final model), model convergence required fixing means to zero due to variance restriction imposed by cross-classification adjustments.

Table 2 Descriptive statistics and correlations

	Pro1	Rea1	Aca1	Rej1	Dep1	Aca3	Rej3	Dep3	Dep5	Female
Bivariate										
Pro1	(0.77)**	0.66**	−0.15**	0.39**	−0.02	0.06	0.29**	0.17	–	0.07
Rea1	0.74**	(0.85)**	−0.21**	0.57**	−0.01	−0.10	0.34**	0.24*	–	−0.25**
Aca1	−0.16**	−0.22**	(0.97)**	−0.25**	−0.15**	0.70**	−0.09	−0.28**	–	0.01
Rej1	0.55**	0.63**	−0.18**	(0.80)**	0.23**	−0.13	0.26*	0.29**	–	−0.15**
Dep1	0.09	0.07	−0.15**	0.28**	(0.78)**	0.04	0.06	0.25*	–	−0.05
Aca3	−0.06	−0.16	0.66**	−0.11	0.00	(0.90)**	−0.20**	−0.25***	−0.10	0.08
Rej3	0.21*	0.31**	−0.05	0.21*	−0.03	−0.21**	(0.90)**	0.38**	0.19	−0.09
Dep3	0.14	0.31**	−0.24*	0.33**	−0.24*	−0.26**	0.45**	(0.83)**	0.39**	−0.05
Dep5	–	–	–	–	–	−0.03	0.27**	0.38**	(0.95)**	−0.06
Female	−0.09	−0.22**	0.00	−0.13*	−0.02	0.07	0.07	−0.02	−0.04	(1.00)**
Univariate										
N	361	361	361	361	361	381	382	382	364	364
M	1.38	2.07	3.18	1.17	1.19	3.5	1.16	1.23	1.17	–
SD	0.76	1.21	1.18	0.32	0.31	1.09	0.34	0.37	0.29	–
Range	1–4.67	1–5	1–5	1–2.75	1–2.75	1–5	1–3	1–3	1–2.38	–
Skewness	2.25	0.94	−0.10	2.31	2.27	−0.34	2.63	2.03	2.14	–
Kurtosis	4.53	−0.20	−0.98	5.27	5.31	−0.54	7.33	4.13	4.28	–
Z Skewness	2.12	0.86	−0.11	1.97	1.73	−0.47	2.16	1.63	1.93	–
Z Kurtosis	4.45	0.02	−0.91	3.60	3.05	−0.26	4.20	1.98	3.30	–
Teacher ICC	0.169	0.135	0.000	0.091	0.185	0.054	0.020	0.115	0.000	–
Cohort ICC	0.000	0.000	0.000	0.003	0.004	0.000	0.000	0.000	0.000	–
Classroom ICC	0.174	0.161	0.000	0.125	0.165	0.077	0.020	0.145	0.000	–

Correlations and descriptive statistics for untransformed data are reported below diagonal; bivariate correlations for data standardized by classroom reported above diagonal; diagonals (parenthetical) represent correlations of each variable with itself before and after standardization. Correlations are based on observed data only using pairwise deletion. Due to the planned missingness of the accelerated design, sample size and membership varies between grade levels. All univariate estimates are for raw data except where noted (Z = z-scores). Sample sizes for bivariate correlations are as follows: G1-G1 $n = 361$; G1-G3 $n = 96$; G1-G5 $n = 0$; G3-G3 $n = 383$; G3-G5 $n = 100$; G5-G5 $n = 364$.

Pro, proactive aggression; rea, reactive aggression; aca, academic performance; rej, peer rejection; dep, depressive symptoms; number suffixes indicate grade level

* Two-tailed $p < 0.05$, ** Two-tailed $p < 0.01$

iterations, each time accounting for the previous estimate, until the potential scale reduction is negligible. We specified non-informative priors, four MCMC chains, and required 5000 to 50,000 iterations. Bayesian MCMC estimation yields estimates similar to maximum likelihood (ML), and can handle non-normal data as well or better than robust ML estimation (Muthén and Asparouhov 2012; Zyphur and Oswald 2015). Also similar to ML, Bayesian uses a direct estimation technique for handling missing data, producing estimates based on all available information in the data. Bayesian performs similarly to ML and multiple imputation for handling missing data under usual assumptions (MCAR or MAR), outperforming deletion and substitution methods (Buhi et al. 2008). Planned missingness was specified using the Mplus pattern option to indicate which data was missing for which cohorts. Path models were estimated with gender as a covariate on all variables and with covariance paths among variables assessed on the same occasion. Gender differences were examined using the product-of-coefficients strategy for indirect effects (Preacher et al. 2007). Specifically, the model was re-estimated adding in each possible gender × predictor product term one at a time to test whether the strength of the original path depends on gender. All results were evaluated primarily based on path coefficients and r-squares. Directionality was tested via one-tailed *p*-values, while the presence of effects was interpreted based on whether the 95% credibility intervals (CI) of posterior estimates included zero (Marsman and Wagenmakers 2017).

Results

Descriptive Statistics and Correlations

Means, standard deviations, ICCs, and correlations are presented in Table 2. ICCs suggested that classroom-level effects (i.e., teacher × cohort groupings) accounted for significant

variance ($M = 9.6\%$, range = 0.0 to 17.4%) in some variables whereas cohort effects alone were negligible (<0.5% of the variance). These results supported the decision to standardize data by classroom. A comparison of the correlations among raw variables (Table 2, below diagonal) to those among standardized variables (above diagonal) shows that standardization generally resulted in a little to no change (mostly slight attenuation) of correlations, and the significance of bivariate correlations remained largely unchanged. Further, skewness and kurtosis were reduced.

Correlations among standardized variables showed that proactive and reactive aggression were highly correlated with one another, and with peer rejection and academic performance, in 1st grade. Academic performance and peer rejection showed small significant negative concurrent associations with one another in both 1st and 3rd grade. Depressive symptoms were unassociated with proactive and reactive aggression in 1st grade, but showed small to moderate correlations with peer rejection and academic performance in 1st and 3rd grade. Regarding the hypothesized paths, proactive and reactive aggression in 1st grade were both moderately associated with peer rejection, but not academic performance, in 3rd grade. Peer rejection and academic performance in 1st grade were both associated with depressive symptoms in 3rd grade. From 3rd to 5th grade, however, neither peer rejection nor academic performance reached significance in their associations with later depressive symptoms. Academic performance was highly stable from 1st to 3rd grade, whereas peer rejection and depressive symptoms showed lower but still significant stability across all intervals. Only two variables were significantly associated with gender: girls showed less reactive aggression and peer rejection in 1st grade than boys.

Path Model Results

Results of the initial (and ultimately final) path model are presented in Fig. 1, with all parameter estimates reported in Table 3. As shown, reactive aggression in 1st grade predicted higher levels of peer rejection in 3rd grade, but was not associated with academic performance in 3rd grade. Conversely, proactive aggression in 1st grade predicted higher levels of academic performance in 3rd grade, but was not associated with peer rejection in 3rd grade. Notably, depressive symptoms in 3rd grade were predicted by poor academic performance and greater levels of peer rejection in 1st grade; however, for peer rejection, this result confirmed the directionality of the effect (one-tailed $p = 0.026$) but fell just shy of rejecting the null hypothesis for the presence of the effect (95% CI: -0.001, 0.411). From 3rd to 5th grade, neither academic performance nor peer rejection predicted subsequent depressive symptoms.

Stability paths were significant for academic performance (1st to 3rd) and depressive symptoms (1st to 3rd and 3rd to 5th), but not for peer rejection (1st to 3rd grade). Gender was included as a covariate for all variables at all time points, but was only significantly predictive of 1st grade peer rejection and reactive aggression. All covariance paths among concurrently measured variables were significant ($|rs| = 0.14$ to 0.66, $ps < 0.01$), with the exception of the link between depressive symptoms with both aggression subtypes in 1st grade ($|rs| < 0.03$, $ps > 0.3$). This model accounted for about 17% of the variance in 5th grade depressive symptoms, 47% in 3rd grade academic performance, and 14% in 3rd grade peer rejection. Among the other 1st grade variables, gender (the only predictor) accounted for about 7% of the variance in reactive aggression, 2% of peer rejection, and < 1% for the remaining variables.

When gender was tested as a moderator, there was some suggestion of moderation via one-tailed p-values for two paths: 3rd grade to 5th grade depressive symptoms ($B = 0.321$, $p = 0.038$; 95% CI: -0.039, 0.640), and 1st grade peer rejection to 5th grade depressive symptoms ($B = -0.412$, $p = 0.047$; 95% CI: -0.867 to 0.071). However, none of these effects were significantly different from zero per 95% CIs, and therefore were not pursued further. All other interaction terms were nonsignificant (one-tailed $ps = 0.113$ to 0.491). Accordingly, the original model (Fig. 1 and Table 3) was retained as the final model. Results were robust across different specification approaches[4] and can be interpreted as applying similarly to both boys and girls.

Discussion

The failure model posits that peer rejection and academic performance constitute dual pathways through which early aggression leads to later depression (Patterson and Capaldi 1990; Patterson and Stoolmiller 1991). The present results provide mixed and limited support for this model among school-age children. Early aggression appears to be more

[4] As mentioned in the previous footnote, three alternative variants tested to overcome software limitations: 1st to 3rd piecewise model ($n = 647$); 3rd to 5th piecewise model ($n = 646$); and whole model with cross-classification adjustment applied to1st to 3rd ($n = 912$). Prior to these analyses, all path estimates from the initial model (Fig. 1, Table 3) were first classified into three mutually exclusive groups based on their significance: (a) significant effect (95% CIs ≠ 0); (b) significant direction (one-tailed $ps < .05$ but 95% CIs = 0); and (c) nonsignificant (one-tailed $ps \geq .05$). From the original model to all three alternative models, there were no meaningful changes in these significance classifications for any parameter estimates. A few negligible changes were observed in covariate paths for gender across models (e.g., from nonsignificant to significant), but these were explained by the omission of other regression path terms (as necessitated by piecewise model building), upon which the covariate effect is conditional.

strongly associated with peer rejection than with poor academic performance; however, to understand this association, it is critical to first differentiate the functions of aggression. Reactive aggression in 1st grade uniquely predicted peer rejection, but not academic performance, in 3rd grade. In contrast, proactive aggression in 1st grade was a unique and sole predictor of *higher* levels of academic performance in 3rd grade. With regard to depressed mood, evidence was found for poor academic performance and, to a lesser extent, peer rejection both independently contributing to increased levels of depressive symptoms from 1st to 3rd grade, consistent with the dual pathways hypothesis. From 3rd to 5th grade, however, results were less consistent: neither academic performance nor peer rejection predicted subsequent depressive symptoms. This overall pattern of results does not confirm or falsify the failure model in its entirety, but rather elucidates the underlying psychosocial mechanisms within specific developmental contexts. Given the classroom-standardized measurement and Bayesian cross-classified analytic approach, these results can be interpreted in relative to children's classroom peers, across classrooms over time, and controlling for classroom-level dependencies. Further, all models controlled for gender and baseline levels of each variable, and results were not altered by gender moderation or model respecifications. Findings are discussed in more detail below.

Aggression Subtypes to Social and Academic Functioning

Previous research has established associations between reactive aggression and both social (e.g., Card and Little 2006; Salmivalli and Helteenvuori 2007) and academic (e.g., Day et al. 1992; Fite et al. 2013) problems. The present results accord with and expand upon this body of evidence regarding the link with peer difficulties, but not academic difficulties. In the zero-order correlations, reactive and (to a slightly lesser extent) proactive aggression in 1st grade were both associated with peer rejection cross-sectionally and longitudinally into 3rd grade. When entered in the path model, however, only reactive aggression in 1st grade predicted higher levels of peer rejection in 3rd grade. This finding is consistent with a large body of evidence indicating that proactive aggression shows little to no specific associations with peer problems after controlling for reactive aggression (Card and Little 2006; Fite et al. 2016). It may be that reactively aggressive behaviors are viewed as bothersome by peers, interfering with social skill development and friendship formation, and leading to compounding social problems over time (Fite et al. 2016). This possibility is consistent with the larger developmental and social mechanisms hypothesized by Patterson and colleagues (e.g., Patterson et al. 1989). In contrast, the nonsignificant path from 1st grade proactive to 3rd grade peer rejection may be partly explained by evidence that proactive aggression is not uniquely associated with deficits in emotional, behavioral, and cognitive self-regulation whereas reactive aggression is (Evans et al. 2016a, b; White et al. 2013). Thus, proactively aggressive children may be better equipped to navigate social relationships in a way that does not result in peer rejection.

In predicting 3rd grade academic performance, the positive path result for 1st grade proactive aggression and the nonsignificant path result for 1st grade reactive aggression were both unexpected. These findings are inconsistent with previous research, which does show a link between reactive aggression and poor academic performance (e.g., Day et al. 1992; Fite et al. 2013), and evidence of no unique associations (e.g., Fite et al. 2013) or a negative association (e.g., Day et al. 1992) between proactive aggression and academic performance.

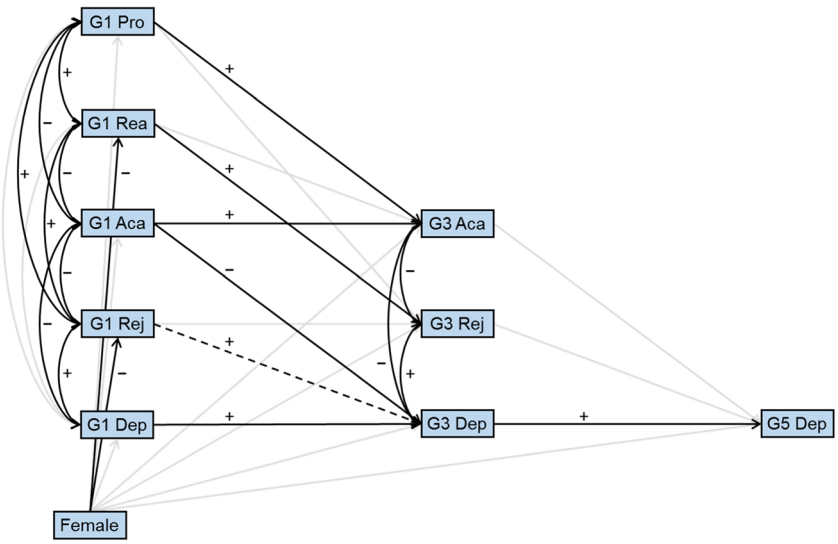

Fig. 1 Results of final model Note. Black lines denote significant effects (95% CI ≠ 0); black dashed lines denote paths that reached significance for direction but not effect (one-tailed $p < 0.05$ but 95% CI includes 0); gray paths are nonsignificant (one-tailed $p \geq 0.05$). All estimated parameters and their significance are depicted. For clarity, parameter estimates are presented in Table 3 rather than here. G#, Grade level; Pro, proactive aggression; Rea, reactive aggression; Aca, academic performance; Rej, peer rejection; Dep, depressive symptoms

Table 3 Parameter estimates from final model

			Estimate	Posterior SD	95% CI		1-Tailed P-Value	Standardized β / r
					LB	UB		
Regression: Lagged Paths								
Dep5	On	Dep3	0.342**	0.086	0.163	0.498	<0.001	0.346
Dep5	On	Aca3	0.018	0.094	−0.166	0.203	0.427	0.018
Dep5	On	Rej3	0.099	0.097	−0.093	0.286	0.156	0.097
Dep3	On	Dep1	0.256**	0.092	0.067	0.428	0.004	0.250
Dep3	On	Aca1	−0.172**	0.075	−0.320	−0.026	0.010	−0.166
Dep3	On	Rej1	0.214*	0.104	−0.001	0.411	0.026	0.209
Aca3	On	Aca1	0.670**	0.063	0.538	0.787	<0.001	0.655
Aca3	On	Pro1	0.251**	0.101	0.046	0.440	0.008	0.244
Aca3	On	Rea1	−0.157	0.105	−0.357	0.051	0.069	−0.155
Rej3	On	Rej1	0.069	0.133	−0.192	0.330	0.297	0.070
Rej3	On	Pro1	0.030	0.124	−0.212	0.275	0.406	0.029
Rej3	On	Rea1	0.266**	0.124	0.011	0.496	0.021	0.271
Regression: Fixed Covariates								
Dep5	On	Fem	−0.062	0.108	−0.273	0.150	0.283	−0.031
Dep3	On	Fem	−0.039	0.109	−0.251	0.174	0.361	−0.019
Aca3	On	Fem	0.067	0.114	−0.154	0.291	0.278	0.034
Rej3	On	Fem	−0.002	0.116	−0.227	0.229	0.494	−0.001
Dep1	On	Fem	−0.074	0.103	−0.276	0.131	0.236	−0.038
Aca1	On	Fem	0.016	0.097	−0.175	0.205	0.433	0.008
Rej1	On	Fem	−0.276**	0.102	−0.479	−0.079	0.003	−0.141
Pro1	On	Fem	−0.146	0.101	−0.345	0.051	0.074	−0.076
Rea1	On	Fem	−0.503**	0.100	−0.700	−0.308	<0.001	−0.255
Covariance: Grade 3								
Dep3	With	Aca3	−0.098**	0.051	−0.201	−0.001	0.024	−0.152
Dep3	With	Rej3	0.290**	0.057	0.183	0.408	<0.001	0.360
Aca3	With	Rej3	−0.135**	0.049	−0.234	−0.043	0.002	−0.209
Covariance: Grade 1								
Dep1	With	Aca1	−0.129**	0.051	−0.231	−0.030	0.005	−0.136
Dep1	With	Rej1	0.199**	0.052	0.101	0.305	<0.001	0.210
Dep1	With	Pro1	−0.015	0.051	−0.116	0.083	0.383	−0.016
Dep1	With	Rea1	−0.026	0.050	−0.125	0.073	0.303	−0.028
Aca1	With	Rej1	−0.234**	0.051	−0.340	−0.138	<0.001	−0.249
Aca1	With	Pro1	−0.148**	0.050	−0.250	−0.053	0.001	−0.159
Aca1	With	Rea1	−0.206**	0.050	−0.309	−0.112	<0.001	−0.223
Rej1	With	Pro1	0.357**	0.053	0.259	0.467	<0.001	0.384
Rej1	With	Rea1	0.512**	0.056	0.410	0.630	<0.001	0.554
Pro1	With	Rea1	0.604**	0.058	0.501	0.729	<0.001	0.661
R-Square								
Dep5			0.170	0.059	0.064	0.294		
Aca3			0.472	0.066	0.330	0.587		
Rej3			0.136	0.057	0.043	0.262		
Dep3			0.201	0.074	0.072	0.355		
Aca1			0.001	0.003	0.000	0.012		
Rej1			0.020	0.015	0.002	0.057		
Pro1			0.006	0.009	0.000	0.031		
Rea1			0.065	0.024	0.025	0.120		
Dep1			0.002	0.005	0.000	0.020		

Posterior standard deviations and 95% credible intervals can be interpreted similarly to standard errors and 95% confidence intervals, respectively.

Pro, proactive aggression; rea, reactive aggression; aca, academic performance; rej, peer rejection; dep, depressive symptoms; number suffixes indicate grade level

* One-tailed $p < 0.05$ (significant direction), ** 95% CI $\neq 0$ (significant effect)

Two important caveats should be made here. First, these longitudinal path results should be interpreted in terms of the amount of variance in 3rd grade academic performance explained above and beyond the 49% of the variance which is already explained by prior academic performance, a highly stable variable. Second, at the zero-order level, proactive and reactive aggression were both associated with poorer academic performance cross-sectionally in 1st grade, but neither were significantly associated with later academic performance. Thus, the path from proactive aggression to subsequently higher academic performance should be interpreted with particular caution.

With those caveats in place, we offer a few possible explanations for these paths to academic performance. Compared to reactively aggressive children (who show a range of cognitive, social-emotional, and behavioral difficulties, as noted above), proactively aggressive children are somewhat successful in certain aspects of social-emotional functioning, with greater cognitive and self-regulatory resources (Fite et al. 2016). Such abilities may equip children for both proactive aggression and for academic success. Alternatively, considering that the link between proactive aggression and better academic performance was observed only after controlling for reactive aggression, there might be a subgroup of proactively aggressive youth who show poor academic performance in 1st grade but improve by 3rd grade. This bears some consistency with the findings of studies which have delineated groups such as proactive-only, reactive-only, and mixed proactive-reactive (Dodge and Coie 1987; Day et al. 1992). It is notable that the links between 1st grade reactive aggression and poor 3rd grade academic performance approached significance in correlations and path models (one-tailed $ps < 0.10$), stronger than the corresponding links for proactive aggression. It may be that the relationship exists, but we failed to detect it due to issues related to power, measurement, or intervals between assessments. Alternatively, the link between reactive aggression and poor academic performance may be more acute than persistent in nature, as most studies reporting this association been cross-sectional (e.g., Day et al. 1992; Fite et al. 2013). In sum, when considering the two significant paths from 1st to 3rd grade, the literature and present results suggests the need for further research on the relationship between proactive aggression and academic performance, while robustly supporting the connection between reactive aggression and peer rejection.

Social and Academic Functioning to Depressive Symptoms

In this study, the failure model's dual pathways to depressive symptoms were tested across two different intervals—1st to 3rd grade, and 3rd to 5th grade. Although our theory-based hypotheses pertained more directly to the latter interval, we found support only for the former: from 1st to 3rd grade, poor academic performance (significantly) and peer rejection (significant direction, within rounding error of significant effect) both uniquely contributed to depressive symptoms. From 3rd to 5th grade, however, neither of these pathways were supported. In retrospect, there are a few possible explanations for this pattern of results. Depressive symptoms showed autoregressive stability across the entire developmental span of this study, and this stability was even stronger from 3rd to 5th grade than from 1st to 3rd. Any additional predictors would have to account for additional variance in depressive symptoms above and beyond this stability. When viewing these statistical considerations through a developmental lens, it makes sense that social-emotional characteristics would be more susceptible to change during the early elementary school years as compared to later in childhood. Between 1st and 3rd grade, children face a rapid period of developmental tasks and changes, including encounters with academic challenges and peer networks being formed. This might be a sensitive period during which academic and social failure might place children at particularly pronounced risk for depressive symptoms. In contrast, from 3rd to 5th grade, psychosocial development continues to progress along a relatively more stable trajectory (e.g., stronger autoregressive coefficients) until the next period of rapid changes and challenges—adolescence.

Indeed, it is during adolescence that depression rates increase sharply (Hankin et al. 1998). From a lifespan developmental perspective, it is possible that the social or academic pathways to depressive symptoms may emerge again during the early adolescent years.

Much of the evidence for the social and academic pathways to depressive symptoms comes during adolescence (e.g., Nocentini et al. 2012; Obradović et al. 2010; Stoolmiller et al. 2005). Although important social and academic development processes unfold during middle childhood, it is during the adolescent years (middle/high school) when peer relationships become most influential and when academic failure peaks. Children who are experiencing academic or peer difficulties during 3rd, 4th, and 5th grade may still be at risk for further impairment and possibly depression down the line. In other words, to the extent that academic or social "failure" could be a risk factor for depressive symptoms, 3rd graders may not yet have accumulated the quality and quantity of these problems to experience that risk to its fruition. These results and speculations raise intriguing questions for future research the timing of developmental risk trajectories or cascades spanning childhood into adolescence.

The failure model was originally tested among boys (Patterson and Capaldi 1990; Patterson and Stoolmiller 1991), but without any reasons why the model would not apply equally well to girls. As noted earlier, the evidence that has accumulated to support this model has been limited by significant methodological limitations, including failure to

clarify any similarities or differences across gender. We examined these questions in the present data and found no evidence for gender differences in any of the model paths. Again, this should be interpreted with caution, given that the methods of this study may have been limited to detected differential gender effects. Different results might be found among later childhood and adolescent samples given gender-related differences in in the manifestation and impact of aggression (e.g., Salmivalli and Helteenvuori 2007; Smith et al. 2010) as well as in the prevalence and vulnerability for depressed mood (e.g., Hankin et al. 1998; Nolen-Hoeksema and Girgus 1994).

Limitations and Implications

Several limitations should be noted. First, shared method variance is an important weakness given that all assessments were by teacher report. Although research supports the validity of teachers' ratings of aggression subtypes, depressive symptoms, and social and academic functioning (see measures section), the present findings are nonetheless susceptible to teacher-related measurement bias. Future research should incorporate data from multiple sources, including self-report, parent-report, and observational methods. These and other methodological differences (e.g., latent vs. manifest variables, categorical vs. dimensional approaches) may help account for some of the mixed findings in the literature and in relation to some of the present findings. Second, the accelerated panel design only allowed estimation of indirect paths pertaining to subsets of the entire sample (*n*s = 136–155 out of 912), but not direct paths or the entire sample. There is a need for true mediational models, wherein youth are followed prospectively, assessing all variables at three or more time points. Relatedly, pathways were examined from one occasion to the next without examination of the patterns of intra-individual change over time. Multilevel or growth models would be useful for better understanding trajectories aggression subtypes, peer rejection and academic performance, depressive symptoms, and their interrelations. Software limitations restricted our ability to examine the entire model simultaneously; however this led us to re-specify the model in several different ways, all of which provided robust support for these results.

For theoretical reasons, the present study focused on the proactive and reactive functions of aggression, but not the *forms* of aggressive behavior (e.g., physical vs. relational aggression). A form-by-function approach could help clarify even more precisely what kind of aggressive behavior confers risk for developmental pathways leading to social, academic, and mood problems. Finally, the present study was conducted among a predominately Caucasian sample of school-age children from a single school in a small town. Thus, results may not be generalizable to other populations or developmental periods. Future research should consider these questions across youth of diverse ethnic and socioeconomic backgrounds, developmental periods, and various risk domains. It would be particularly useful to examine outcomes involving depressive symptoms and antisocial behavior during adolescence and in targeted populations such as clinical and justice-involved samples.

In addition to the empirical and theoretical contributions described above, the present findings also help extend our knowledge of *when* and *for whom* interventions are likely to be most helpful. Given its centrality as a risk factor, reactive aggression is an important target for early screening and intervention. Children who continue to be more reactively aggressive than their peers in 1st grade or later should raise flags, not only for aggression, but also to monitor their social-emotional trajectories more generally. School-based interventions targeting anger and aggressive behavior may be beneficial in addressing reactive aggression. Importantly, this study highlights the need for intervention during the early elementary school years. During this developmental period, effective prevention and intervention strategies are less likely to involve child-focused skill-building approaches and more likely to involve behavioral interventions involving parents and teachers (Kaminski and Claussen 2017). In addition to interventions for early reactive aggression, further research is needed to help advance the assessment, prevention, and treatment of proactive aggression and depressive symptoms among school-age children.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval Ethical approval was obtained from the institutional review board at the University of Kansas (Human Subjects Committee - Lawrence #20175)

Informed Consent Informed consent was collected.

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