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School functioning and violent behavior among young adolescents: a contextual analysis

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Abstract

This paper examines associations between overall school functioning and frequency of violent behaviors among young adolescents (ages 10–14). The sample included 16 middle schools participating in an unrelated intervention study (on nutrition) in Minneapolis, Minnesota. A School Functioning Index, developed to characterize schools' overall stability, performance and demographics, was constructed using data from public archives and school administrator surveys. Data on violent behaviors and other variables were collected in student surveys in fall 1998 and spring 1999. We used multilevel modeling to assess the effect of school functioning on violent behavior after adjusting for known individual-level covariates of violent behaviors. We found an interaction between school functioning (group-level variable) and expectations for future education (individual-level variable). Among students who reported expectations of completing a college degree (71% of the sample), positive school functioning was negatively associated with violent behaviors. Among students that reported expectations of completing less than a college degree, no association was found between school functioning and violent behaviors. These results support earlier work suggesting that objectively measured school characteristics are associated with students' violent behaviors even after accounting for individual-level factors and also identify a subgroup of students for whom school detachment may be an issue.

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Introduction

Despite recent decreases in rates of violent behavior among US high school students (Brener *et al.*, 1999), violence remains one of the greatest public health threats to youth in the US. Intentional injuries comprise the second and third leading causes of death of US adolescents (Singh *et al.*, 1996), as well as a substantial proportion of morbidity (Annest *et al.*, 1995). The rate of violent victimization among 12–24 year olds is nearly twice as high as that among adults 25 and over (Bureau of Justice Statistics, 1996). Levels of exposure to violence are also high (Bain and Brown, 1996; Campbell and Schwarz, 1996) and appear to have serious negative sequelae, including elevated depressive symptoms (DuRant *et al.*, 1995) and post-traumatic stress disorder (Campbell and Schwarz, 1996).

There are strong indications that violence has significant social, structural and environmental causes (Wilson and Daly, 1997; Cohen, 1998; Kennedy *et al.*, 1998; Kawachi *et al.*, 1999), many of which are not well understood. Recent calls have been made for more social and environmental approaches to understanding and preventing violence in the whole population (Stanistreet, 1999; American Public Health Association Governing Council, 2000). Because youth differ from adults not only cognitively and developmentally, but also in terms of their primary social environments,

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there is a need to explore unique social and environmental influences on youth violence. This need is made more urgent in light of the mixed findings of evaluations of several popular youth violence prevention programs (Orpinas *et al.*, 1995; Macgowan, 1997; Kellermann *et al.*, 1998).

Schools are a logical place to begin to examine the social environment of youth. Over 95% of youth spend up to 6 h per weekday in school (Department of Education, 1998). Furthermore, a substantial proportion of youth violence takes place at school (Kann *et al.*, 1998; Brener *et al.*, 1999) and recent multiple-victim school shootings have elevated public concerns about school safety. Middle and junior high schools (typically any combination of Grades 6–9) may be particularly important, because these grades span the transition from childhood into adolescence. This transition is often marked by an acceleration in the prevalence of risky behaviors (Dryfoos, 1998), and there is some evidence that weapon carrying and violent behaviors both on and off school grounds increase over the middle school grades (DuRant *et al.*, 1996, 1999), although there is a paucity of violence-related surveillance data for this age group.

A social-environmental approach to understanding youth violent behavior suggests that schools, as a major context for adolescent development, may influence individuals' acquisition and enactment of violent behaviors, both positively and negatively. Investigations of the relationships between school bonding (McBride *et al.*, 1995; Simons-Morton *et al.*, 1999), school connectedness (Resnick *et al.*, 1997) and school deterioration (Williams *et al.*, 1998) with self-reported violence and other problem behaviors support this hypothesis. To what extent are these associations explained by characteristics that are endogenous to individual students (e.g. personality and psychosocial characteristics) versus characteristics of the schools and their respective institutional and social environments? This is a question that remains largely unanswered, but warrants careful exploration to inform intervention and policy development. A recently advanced macro-level model of school disorder (Welsh *et al.*, 2000) further supports investigations along these lines.

One of the challenges in investigating the effects of school-level characteristics is measurement. From a social-environmental perspective, measurement of both objective characteristics and subjective impressions of schools is important, because both affect individuals' motivations and behaviors (Jessor and Jessor, 1973). To help guide policies and other interventions, it is particularly important to investigate which objective characteristics exert the greatest influence on behavior (whether mediated by individual perceptions or not) and which are most amenable to change. However, probably due to the state of measurement science, existing instruments generally focus on subjective impressions rather than objective aspects of schools. In most of the studies cited above, the school context was measured primarily at the student level and sometimes aggregated to the school level. Although this approach is valuable, it leaves open the question of how much the observed associations are driven by institutional-level characteristics versus characteristics of the students that influence their perceptions of the school. It is plausible that, in addition to individuals' characteristics, some objectively measured indicator of the overall 'well-being' or functioning of a school may also exert an influence on students' behavior, just as there is evidence that overall family functioning influences adolescents' behaviors (Cashwell and Vacc, 1997; Dakof 2000). In an effort to explore the effects of institutional characteristics on adolescents' behaviors, McBride *et al*. (McBride *et al*., 1995) used a combination of school-level demographics and aggregated student measures of school attachment, commitment and involvement to operationalize the school bonding environment. Their results were suggestive of a causal relationship between school environment and risky behaviors. Before recommending school-level interventions or policy recommendations, however, they identified the need for replication and extension of their work using more objective measures of the school environment.

The present study uses a set of school-level

characteristics as the main independent variables in predicting young adolescents' self-reported violent behavior over the past year. The primary hypothesis was that positive school functioning would be negatively associated with the prevalence of violent behavior. Using contextual analysis (also called multilevel modeling or hierarchical linear modeling) (Bryk and Raudenbush, 1992; Diez-Roux, 1998), we examined the relationship of overall school functioning—an institutional-level variable—with individual-level violent behavior (not restricted to school violence). The analytic techniques allowed adjustment for known individual-level correlates and predictors of violent behavior, enabling us to make inferences regarding both individual and institutional level effects.

Method

Study design and population

Data for the analyses reported here are from the 16 schools in the Teens Eating for Energy and Nutrition at School (TEENS) study, a group randomized intervention trial in 16 middle and junior high schools to reduce cancer-related dietary risk among young adolescents (Lytle and Perry, 2001). All data pertain to the 1998–1999 school year. Individual-level data are from student surveys administered during the fall (TEENS baseline) and the subsequent spring of Grade 7. Survey development and administration methods are described in detail elsewhere (Birnbaum *et al.*, 2002). School-level data were collected from both public archives and TEENS school administrators during the winter of 1999. All research was approved by the University of Minnesota Committee on the Use of Human Subjects in Research and its counterpart at the University of Memphis.

Eligibility for participation in TEENS was based on district and school criteria. TEENS was designed to be implemented with a lower-income population and only districts with a minimum of 20% of students approved for free or reduced-price meals were eligible. Schools were also required to have Grade 7 and 8 students in the same building and enroll at least 30 students per grade. Thirty-three schools representing 14 districts were eligible and 20 schools representing nine districts agreed to participate. The main reasons cited for not participating were time constraints, personnel changes and lack of interest in a component of the intervention that focused on the school food environment. One of the schools was chosen as a pilot school and three others were judged ineligible due to scheduling conflicts. The remaining 16 schools were randomly assigned to intervention or comparison (delayed intervention) conditions after all baseline measures were taken. As the intervention was focused entirely on nutrition, the analyses reported here do not take condition into account. The sample size of students in the 16 schools used in the analyses reported here was 2941.

Measures

The measures described below were used to examine the relationship between positive school functioning and violent behavior among young adolescents.

Past-year violent behavior

The dependent variable was past-year fighting/violent behavior reported in the spring 1999 survey (i.e. end of Grade 7). Based on pilot testing, questions from three existing instruments were combined to create a five-item scale. Students were asked, 'During the past 12 months, how often did you <ITEM>?'. The items were: 'Carry a weapon such as a gun, knife or club' (Kann *et al.*, 1998; Centers for Disease Control and Prevention, 1999), 'Hit or beat up someone' (Minnesota Department of Education, 1989), 'Take part in a fight where a group of your friends fought another group', 'Hurt someone badly enough to need bandages or a doctor' and 'Use a knife, gun, or other weapon to get something from a person' (Carolina Population Center, 1999). Response categories were: 0 = never, 1 = 1–3 times, 2 = 4–7 times, 3 = 8–11 times and 4 = 12 or more times. The scale was computed by assigning each response category the midpoint value (0 = 0; 1 = 2; 2 = 5.5; 3 = 9.5; 4 = 14) and summing the values. Scores were not

computed if data were missing for any of the five items. In a pilot study with approximately 65 students (Birnbaum *et al.*, 2002) the test–retest Spearman correlation was 0.76. Cronbach's α was 0.73–0.76 in the pilot, fall and spring surveys.

School Functioning Index (SFI)

The main independent variable was a SFI, an original measure developed to characterize the overall functioning and stability of schools. A review of the public health and education literature did not yield any existing measures of overall school-level characteristics. In the public health and adolescent health literature, most school-level composite measures are school health indices focused on particular health behaviors rather than overall school functioning (Stevens and Davis, 1988; Centers for Disease Control and Prevention, 2000). In the education literature, school climate scales generally focus on individuals' school-related attitudes rather than on measurable institutional characteristics (Epstein and McPartland, 1976; Moos, 1979; Johnson *et al.* 1987; Johnson and Johnson, 1993). For example, one study that used such a school climate index in 50 schools reported intraschool correlations of only 0.02–0.03 (Mok and McDonald, 1994), suggesting the index yielded more information about individual respondents than about the institution itself. When institutional characteristics are studied, questions generally focus on a single administrative or organizational variable (e.g. school size) rather than theoretical constructs such as functioning and stability (Pittman and Haughwout, 1987; Lee and Smith, 1995).

The SFI comprises nine school-level variables pertaining to the 1998–1999 school year: average attendance, student mobility (number of students who moved into or out of the school after classes began in fall 1998, divided by fall enrollment), proportion of key school staff working in the present school less than 3 years, proportion of key staff that left midyear, proportion of students in Grade 8 that passed the state-mandated Basic Standards Reading Test, proportion that passed the Basic Standards Math Test, total student enrollment, proportion of students that received free or reduced price lunches and proportion with limited English proficiency. These nine items are a subset of a larger set of variables initially conceived using Social Ecological Theory (McLeroy *et al.*, 1988; Stokols, 1992), Social Cognitive Theory (Bandura, 1986) and Social Disorganization Theory (Shaw and McKay, 1942; Sampson and Groves, 1989) as conceptual guides. The full complement of variables also included items more specifically related to violence, including the presence and types of policies on student aggressive behavior, frequency of disciplinary actions, etc. After data collection was completed, however, serious concerns about the validity of these items led us to exclude them from the index. The remaining items are conceptualized to reflect school stability, performance and demographics; whether these were distinct constructs is unknown, because factor analysis was not possible due to the small number of schools ($n = 16$). Cronbach's α for the nine-item index was 0.88, suggesting a stable measure whose variables are driven by a common factor. Because the α for the full set was high and all the measures were already available, we did not eliminate any items.

It is important to note that no assumptions of causality are implied by including sociodemographic variables in the SFI. For example, having a high proportion of students receiving free and reduced price meals is not hypothesized to cause low school functioning. Rather, the demographic variables are indicators of social conditions (e.g. poverty, the status of immigrants) that may affect school functioning in multiple ways, such as the availability and distribution of resources within and outside schools, experiences of discrimination, cultural barriers, and relative inequities. If these expectations were unsubstantiated, these variables would be uncorrelated with the other school-level variables, which would reflect a state of equity in schools with respect to sociodemographic characteristics. The high Cronbach's α indicates that this is not the case, although it does not provide information about the pathways or mechanisms of the inter-relationships.

Some data for the SFI were available in public datafiles from the Minnesota Department of Children, Families and Learning. The remaining data were collected directly from the 16 schools, using questionnaires completed by school principals or their staff. The index was computed by standardizing all of the variables and summing the values. Scores ranged from –11.11 to 6.47; based on visual inspection, cutpoints were set at ±4.45 to create a roughly balanced distribution of schools across three categories: low ($n = 4$), moderate ($n = 6$) and high ($n = 6$).

Covariates and potential confounders

Covariates and potential confounders were taken from the fall 1998 (baseline) student survey. Substance use, which was expected to be highly predictive of violent behavior, was measured with standard questions from Monitoring the Future (Johnston *et al.*, 1998) concerning use of alcohol, marijuana and inhalants in the past 30 days, and mean number of cigarettes smoked weekly. Test–retest correlations for past-30-day use were 0.67, 0.52 and 0.30 for alcohol, marijuana and inhalants, respectively; test–retest for tobacco use was 0.70. Three psychosocial measures were also included. The first was level of depressive symptoms, measured using the Center for Epidemiologic Studies–Depression (CES-D) scale (Radloff, 1977; Garrison *et al.*, 1991) (Cronbach's $\alpha = 0.86$, test–retest Spearman correlation = 0.83). The second was educational expectations, measured using a single item from the Voice of Connecticut Youth survey (test–retest Spearman correlation = 0.70) (State Department of Public Health of Connecticut, 1996). Finally, future outlook was measured using an adapted version of a Voice of Connecticut Youth scale concerning students' perceptions of the chances that they will: live to age 35, get HIV or AIDS, be a parent by age 18 and ever get in trouble with the police (Cronbach's $\alpha = 0.52$, test–retest Spearman correlation = 0.62). Despite the lower than desirable Cronbach's α, we retained this scale because it has been used previously and has been well correlated with other health behaviors in our sample (Schmitz *et al.*, 2002).

Individual-level sociodemographic covariates were also included. A trichotomous index of socioeconomic status (SES) was created by combining four variables from the student surveys: receipt of free or reduced-price lunch, parents' educational attainment, number of parents the student reported living with and number of parents working full-time. A scoring algorithm was developed to estimate SES even in cases where some data were missing. The algorithm was structured such that various combinations of the four variables were used, but not every variable was needed in any single case. The pilot test–retest Spearman correlation was 0.80; the algorithm is available from the authors upon request. Race/ethnicity was collected using a single item that gave respondents a choice of identifying themselves as 'African-American', 'Asian or Pacific Islander', 'Hispanic/Latino', 'multiracial', 'Native American', 'white' or 'other'. Test–retest Spearman correlation was 0.86.

Analysis

A scatterplot of school mean violence scores and SFI scores ($n = 16$) was examined to confirm that no single school overly influenced the regression models. All analyses were performed using mixed-model Poisson regression, a form of the Generalized Linear Mixed Model. Mixed modeling was appropriate because cluster sampling was used and the multilevel research question focused explicitly on the hierarchical nature of the data (Bryk and Raudenbush, 1992; Murray, 1998). Students within a school share some characteristics and are more likely to be similar to one another than to students in other schools. This positive intraclass correlation reflects an additional component of variance attributable to school and violates the assumption of independence required in ordinary regression models. If ignored, this additional component of variance would inflate the type I error, and cause standard error estimates that are too small and confidence intervals that are too narrow (Murray, 1998).

Mixed-model regression analysis addresses this problem by correctly modeling the components of variance. In the present analysis, however, the

Table I. *Characteristics of full baseline sample and study cohort*

Variable	Full baseline sample, fall 1998 (n = 3878)		Cohort at fall 1998 (n = 2941)		Cohort at spring 1999 (n = 2941)		Differences between cohort and excluded respondents on fall 1998 variables (test statistic)
	Frequency	%	Frequency	%	Frequency	%	
Sex							χ^2 = 10.84
male	1983	51.1	1460	49.7	(baseline values used)		d.f. = 1
female	1895	48.9	1481	50.3			$P < 0.01$
Race/ethnicity							χ^2 = 1338.12
African-American	439	11.3	279	9.5	(baseline values used)		d.f. = 6
Asian or Pacific Islander	271	7.0	221	7.5			$P < 0.01$
multiracial	238	6.2	173	5.9			
white	2579	66.6	2268	77.1			
Hispanic/Latino	107	2.8	–[a]				
Native American	67	1.7	–[a]				
other	172	4.4	–[a]				
Family structure							χ^2 = 68.91
lives with two parents	2660	68.6	2120	72.1	2112	71.8	d.f. = 1
other	1218	31.4	821	27.9	829	28.2	$P < 0.01$
Free or reduced-price lunch							χ^2 = 41.20
no	2962	76.4	2319	78.8	2356	80.1	d.f. = 1
yes	916	23.6	622	21.2	585	19.9	$P < 0.01$
Expected educational attainment							χ^2 = 43.51
⩾4-year college degree	2559	68.7	2097	71.3	2111	73.3	d.f. = 1
<4-year college degree	1165	31.3	844	28.7	768	26.7	$P < 0.01$
SFI							χ^2 = 146.84
low	789	20.4	475	16.2	(baseline values used)		d.f. = 2
moderate	1299	33.5	992	33.7			$P < 0.01$
high	1790	46.2	1474	50.1			
Past-30-day use of alcohol							χ^2 = 24.39
none	3269	85.2	2547	86.6	2333	80.1	d.f. = 2
once	434	11.3	308	10.5	415	14.2	$P < 0.01$
two or more times	136	3.5	86	2.9	166	5.7	
Past-30-day use of marijuana							χ^2 = 56.20
none	3657	95.5	2843	96.9	2748	94.6	d.f. = 2
once	107	2.8	60	2.0	85	2.9	$P < 0.01$
two or more times	64	1.7	31	1.1	73	2.5	
Past-30-day use of inhalants							χ^2 = 17.35
none	3689	96.0	2838	96.7	2811	96.3	d.f. = 2
once	116	3.0	75	2.6	74	2.5	$P < 0.01$
two or more times	37	1.0	21	0.7	35	1.2	
Mean weekly tobacco use (number of cigarettes smoked)							
	mean 1.13		mean 0.81		mean 1.58		t = –3.47
	SD 7.97		SD 6.71		SD 10.68		d.f. = 1062
	range 0–167		range 0–127		range 0–180		$P < 0.01$
Age	mean 12.76		mean 12.75		mean 13.25		t = –2.37
	SD 0.38		SD 0.36		SD 0.36		d.f. = 1336
	range 10–14		range 10–14		range 11–14		P = 0.02
Past-year violent behavior score	mean 3.35		mean 2.70		mean 3.40		t = –7.52
	SD 7.55		SD 6.20		SD 7.78		d.f. = 1077
	range 0–70		range 0–70		range 0–70		$P < 0.01$

Table I. *continued*

Variable	Full baseline sample, fall 1998 (n = 3878)	Cohort at fall 1998 (n = 2941)	Cohort at spring 1999 (n = 2941)	Differences between cohort and excluded respondents on fall 1998 variables (test statistic)
	Frequency %	Frequency %	Frequency %	
CES-D[b] score	mean 13.74	mean 13.00	mean 13.28	t = –8.63
	SD 9.74	SD 9.39	SD 10.05	d.f. = 1109
	range 0–57	range 0–55	range 0–57	$P < 0.01$
Outlook for future scale	mean 17.42	mean 17.68	mean 17.50	t = 11.11
	SD 2.41	SD 2.17	SD 2.44	d.f. = 1046
	range 4–20	range 6–20	range 4–20	$P < 0.01$

[a]Excluded from cohort due to small cell sizes (<5% sample).

dependent variable was highly skewed and the assumption of Gaussian distribution of the residual errors was violated. Poisson regression assumes a Poisson model for the residual errors and is appropriate for count data such as the past-year violent behavior score (Allison, 1999). The modeling procedures used also corrected for extra dispersion in the data, as is common in Poisson regression analyses (Allison, 1999). All models were fit using the GLIMMIX macro in SAS (Littell *et al.*, 1996), specifying the error distribution as Poisson, the link as log, school as a random effect and all other variables as fixed effects.

Modeling was done in stages: first a crude model was fit to obtain estimates of variance components for computing the crude intraclass correlation coefficient (ICC), and then models were fit separately to test for interactions between SFI and each of the covariates. These models included only the SFI and the covariate of interest, without adjusting for additional covariates. A borderline significant interaction with race/ethnicity was detected (P = 0.07), but an examination of the SFI stratum-specific mean violence scores by race/ethnicity indicated similar patterns across all three levels of SFI, so the interaction was eliminated. An interaction between SFI and expectations for future education (4-year college degree versus less) was highly statistically significant ($P < 0.01$), and an examination of stratum-specific mean violence scores suggested conceptually meaningful differences. This interaction term was retained in all additional models.

Subsequent models were fit in stages to assess potential confounding. Variables were retained as confounders if their presence in the model caused the parameter estimate for any level of the SFI×college expectations interaction term to change by 10% or more. Adjusted event rate ratios (ERRs) and associated 95% confidence intervals (CIs) were computed for all comparisons of SFI×college expectations, and for covariates. The ERR is the ratio that has as its numerator the past-year violent behavior rate in the group with the characteristic of interest, and in its denominator, the past-year violent behavior rate in the comparison group; adjusted ERRs are adjusted for all other terms in the model.

Results

Participation and sample characteristics

At baseline, 3878 of the 4050 eligible Grade 7 students (95.8%) completed the survey. Of those, 3503 (90.3%) were surveyed again at the end of their Grade 7 year; the remaining 375 were lost to follow-up. During data analysis, exclusion criteria were applied to this cohort of 3503 students. Respondents whose self-reported racial/ethnic group had less than 5% representation in the sample were excluded to avoid reporting based on small samples; this resulted in the exclusion of 348 students who self-identified as Hispanic (n = 107), Native American (n = 67) or other (n = 172), or did not respond to this question (n = 2). An

additional 214 students were excluded due to missing data on one or more variables used in the models. The resulting final sample comprised 2941 students (75.8% of the original baseline sample).

In the final sample, respondents were approximately 12 years old at baseline, were split evenly across genders and the majority were white (77%). Just over 10% reported having used alcohol in the past 30 days; in the spring this was closer to 20%. Past-30-day use of tobacco, marijuana and inhalants were each consistently lower than alcohol use at both surveys. The mean past-year violent behavior score was 2.70 in the fall and 3.40 in the spring. Table I presents selected characteristics of the final sample, including data from both surveys. Small changes from fall to spring suggest slight increases in risk behaviors and slight decreases in psychosocial well-being over the course of Grade 7.

The students who were lost to follow-up or excluded from analyses differed from the final sample on nearly all variables compared (Table I). Overall, risk behaviors were more prevalent, psychosocial factors less favorable and SES indicators lower among the excluded students. As compared with students in the final sample, those excluded were more likely to be male, to attend a low functioning school, to receive free or reduced-price lunch at school, to have used one or more substances in the 30 days prior to the fall survey, and to have higher mean CES-D and past-year violent behavior scores.

Variance components

In a crude model with school as the only independent variable, specified as a random effect, the variance attributable to schools was 1.109 and the variance attributable to individuals was 59.621, based on 15 d.f. Adding the SFI as a fixed effect reduced the school component of variance to 0.347, while the variance attributable to individuals was essentially unchanged at 59.613. This suggests that the SFI explained a substantial proportion of the school component of variance. In the final model with covariate adjustment, the school and individual components of variance were further reduced to 0.283 and 51.985, respectively.

SFI and past-year violent behavior

The primary hypothesis was that the mean past-year violent behavior score was lower in schools with higher SFI scores. We found that the effect of SFI on past-year violent behavior depended on students' expectations for educational attainment (Table II). Evidence of this interaction was attenuated somewhat after covariate adjustment, but the interaction term remained borderline significant (type III $F = 2.37$; d.f. = 2,2919; $P = 0.094$) and patterns in the ERRs support the presence of the interaction. Among students who reported in the fall of Grade 7 that they expected to complete a 4-year college degree or more (over two-thirds of the sample), there was a significant negative relationship between SFI and past-year violent behavior for low versus high school functioning and a trend toward a negative relationship for low versus moderate school functioning. The adjusted ERRs and associated 95% CIs, presented in Table II, suggest a dose–response pattern. Among students planning to complete a college degree, those in low functioning schools reported adjusted rates of past-year violent behavior that were 66% higher than those in high functioning schools and 33% higher than those in moderate functioning schools, although the 95% CI around the latter estimate does include one. The adjusted ERR for moderate versus high SFI was also elevated (1.25), but the 95% CI also included the null value. We also found evidence supporting a negative linear trend (i.e. higher SFI associated with lower violence scores) in the students planning to complete a college degree (estimate = –0.51, $P < 0.01$).

In contrast, among students who reported in the fall of Grade 7 that the most education they expected to complete was less than a 4-year college degree, there were no significant differences in the rates of past-year violent behavior across any levels of SFI. However, stratum-specific adjusted ERRs at each level of SFI, also presented in Table II, suggest that in low functioning schools, the students planning to complete a 4-year college degree in fact reported 28% higher rates of past-year violent behavior than those not planning to complete a 4-

Table II. *Adjusted ERRs and 95% CIs for self-reported past-year violent behavior by school functioning×college expectations, Grade 7, 1998–1999,* n = *2941*

	Adjusted ERR[a]	95% lower CI	95% upper CI
Students expecting to complete a 4-year college degree (n = 2076)			
low versus moderate SFI	1.33	0.95	1.87
low versus high SFI	1.66	1.19	2.32
moderate versus high SFI	1.25	0.94	1.66
Students not expecting to complete a 4-year college degree (n = 840)			
low versus moderate SFI	0.87	0.58	1.30
low versus high SFI	1.16	0.77	1.75
moderate versus high SFI	1.34	0.97	1.85
SFI stratum-specific comparisons			
low SFI (expecting 4-year college degree versus less)	1.28	0.93	1.76
moderate SFI (expecting 4-year college degree versus less)	0.84	0.65	1.07
high SFI (expecting 4-year college degree versus less)	0.90	0.71	1.13

[a]Ratio with its numerator as the past-year violent behavior rate in the group with the characteristic of interest and its denominator as the past-year violent behavior rate in the comparison group. Adjusted for sex, age, SES, race/ethnicity, future outlook, depressive symptoms, past-30-day alcohol use and mean number of cigarettes smoked weekly.

year college degree (borderline significant). This pattern did not hold at higher levels of school functioning: the moderate and high SFI stratum-specific adjusted ERRs for those with expectations of completing a college degree versus less than college were both actually lower than 1.0, but the 95% CIs for both included the null value and P values were >0.20.

Other predictors of past year violent behavior

Table III presents adjusted ERRs and 95% CIs for selected levels of the covariates. Male sex, poor future outlook, mean number of cigarettes smoked weekly (including a quadratic term), past-30-day alcohol use and elevated depressive symptoms were all strong predictors of past-year violent behavior. Sociodeomgraphic factors including low SES and white, African-American or multiracial identity (as compared with Asian/Pacific Islander identity) were also associated with elevated levels of past-year violent behavior. Age greater than 12 years was not a significant predictor in the adjusted interaction model.

Discussion

We found that overall school functioning was negatively related to violent behavior in the majority of students in this large sample of Grade 7 students. These results were generally supportive of the main hypothesis; however, a significant interaction was detected. The negative relationship was evident among the large group of students (71%) who reported at the beginning of Grade 7 that the most education they expect to complete is a 4-year college degree or more. For a sizeable minority who reported expecting to complete less than a 4-year college degree in the future (29%), school functioning was not similarly related to violent behaviors.

The interaction is intriguing and warrants further research for clarification. From a methodological perspective, although covariate adjustment attenuated the statistical significance of the interaction term, the pattern in the parameter estimates suggests that the interaction was present and might have been better detected with a larger number of schools in the sample. From a substantive perspective, it is not clear what college expectations mean to a Grade 7 student. At the time they reported these expectations, the students were still over 5 years away from high school graduation and, at a mean age of 12, were still newly acquiring the abstract reasoning skills needed to think critically about their futures (Crockett and Petersen, 1993). Rather than measuring college plans, this

Table III. *Adjusted ERRs and 95% CIs for self-reported past-year violent behavior, Grade 7, 1998–1999,* n = *2941*

	Adjusted ERR[a]	95% lower CI	95% upper CI
Sex			
male versus female	2.29	1.95	2.68
Future outlook			
poorest versus highest	3.99	2.91	5.48
poorest versus median	1.88	1.50	2.35
Past-30-day alcohol use			
one time versus none	1.36	1.23	1.66
two or more times versus none	1.65	1.24	2.20
Past 7-day tobacco use			
one cigarette versus none	1.03	1.02	1.05
7.75 cigarettes (1 SD) versus none	1.27	1.13	1.43
15.5 cigarettes (2 SD) versus none	1.61	1.27	2.05
CES-D			
75th versus 25th percentile (12-point range)	1.23	1.14	1.32
Race/ethnicity (self-identified)			
White versus Asian/Pacific Islander	1.49	1.06	2.08
African-American versus Asian/Pacific Islander	2.00	1.41	2.86
multiracial versus Asian/Pacific Islander	1.83	1.22	2.73
SES			
low versus moderate	1.17	0.99	1.39
low versus high	1.22	1.01	1.47
moderate versus high	1.03	0.85	1.25
Age			
13+ versus 12 and under	1.07	0.91	1.27

[a]Ratio with its numerator as the past-year violent behavior rate in the group with the characteristic of interest and its denominator as the past-year violent behavior rate in the comparison group. Adjusted for all other variables in table, SFI, college expectations and SFI×college expectations interaction.

variable may instead be a proxy for a more immediate construct, such as parental educational attainment, school bonding, current academic performance or normative expectations and messages. Qualitative methods would be useful to learn more about the processes that drive college expectations in young adolescents. Given the inextricable links between education and SES (Krieger *et al.*, 1997), it is likely that social-environmental factors are important. It seems particularly important to learn more about the meaning of this variable in the 29% of students who reported expectations less than a 4-year college degree. The finding that the overall SFI was not associated with violent behavior in this subgroup may signal that as early as age 12, these students may be sufficiently disengaged or alienated from school that even a high-functioning school confers limited benefits or protection from engaging in risk behaviors.

The effect of educational expectations in low functioning schools also warrants further research attention. Speculation about why the students in low functioning schools who were planning to complete a 4-year college degree reported more past-year violent behavior than students not planning to complete college covers a wide range of possibilities. For example, the behavior could reflect displaced frustration with school functioning among school-oriented students, it may be an attempt to fit in or 'be cool' in schools where social norms may devalue education and rule-following, it may be the result of students with higher educational expectations being bullied more in low functioning schools (the violence questions asked only about participation and did not distinguish between instigating fights and victimization) or it may reflect defensive posturing if these students perceive themselves as vulnerable targets

and do not trust that school personnel will protect them (Astor *et al.*, 1999).

In this sample, school-level factors accounted for approximately 2% of the total unadjusted variance in past-year violent behavior, which is comparable with findings from other studies (Resnick *et al.*, 1997; Williams *et al.*, 1998). Measurement error from multiple sources may contribute to this ICC being an underestimate of the true variance attributable to schools. The patterns in the data as well as our experiences in the various schools suggest that this may be the case. The SFI explained a substantial proportion of the school-level component of variance, suggesting that the index successfully captured the construct driving between-school differences.

Our results support and extend the work of McBride *et al*. (McBride *et al*., 1995), providing evidence that objectively measured school characteristics are associated with students' violent behaviors even after adjusting for known individual-level predictors and correlates of violence. In the present US climate of educational reform as well as sustained demand for violence prevention interventions, this line of inquiry holds promise for informing institutional organizational decisions. However, several important questions and considerations remain. First, it is difficult to determine cause and effect. Compared to the primary hypothesis, it seems equally plausible that the prevalence of violent behaviors among students may affect components of the SFI (e.g. staff turnover, attendance, standardized test performance and student mobility) or that both school functioning and student violence covary together as a function of another related construct. In addition, though our data indicated that larger school size was associated with greater school functioning and stability, research findings on this question have been mixed and remain inconclusive (Pittman and Haughwout, 1987; Lee and Smith, 1995; Welsh *et al.*, 2000). Cautious interpretation of the SFI is therefore warranted. Although our results suggest that school policy or other institutional interventions may be effective in reducing violence, further investigations are needed to guide the content of such interventions. In-depth interviews with school stakeholders may be an appropriate next step to help identify which components of the SFI seem most likely to have a causal role and to be amenable to intervention, and to identify additional school-level characteristics for further study. Explorations of the relationship between the SFI and student school bonding, as well as replications and additional testing of the SFI in larger and more diverse samples, would also be desirable.

The findings reported here must also be considered in light of limitations of the study in three areas: sampling, measurement and design. Differences between the final sample and the students lost to follow-up or otherwise excluded were troubling. Some of these could be anticipated, e.g. student mobility was a component of the SFI, so it was not surprising that more of the missing students were from low functioning schools. Some of the observations were excluded because the students identified with racial/ethnic groups that had small representation in the sample. To assess potential bias from this exclusion, we re-ran the final model including these students in the sample. The resulting estimates varied only slightly from those reported above and did not change any of the reported associations or interpretations (data not shown).

Bias may have been introduced by other missing data. As indicated in Table I, students lost to follow-up had higher baseline violence scores than did students in the final sample. Violence scores at both time points were negatively correlated with SFI. If, as this suggests is possible, there was proportionally more past-year violent behavior among students lost to follow-up in low SFI schools than in other schools, the estimates reported here may be conservative. Students with missing data were less likely than those in the final sample to expect to complete a 4-year college degree. Depending on the distribution of spring violence scores among these students, the interaction with SFI could be over- or underestimated. However, bivariate associations in the baseline data and the patterns reported here suggest that although our estimates are probably either smaller or larger than

the absolute truth, it is unlikely that the negative relationship between SFI and violent behavior in students planning to finish college would disappear given complete data.

Generalizability is another sample-related concern. While the baseline sample was fairly representative of students in the Twin Cities area, the final sample was less so. Our sample may be representative of urban areas in the midwestern US, but may not be generalizable to other areas, particularly rural areas and those even more highly urbanized than the Twin Cities.

Measurement may also be a limitation. The chief concern is that our surveys were not anonymous; because they were part of a larger trial using a cohort design, it was necessary to use unique identifiers to track individuals. Although we assured students of confidentiality, there is evidence that violent behavior is reported more honestly in anonymous surveys (Kingery *et al.*, 1998). The prevalence of violent behaviors reported by students in our sample was comparable to other reports (Brener *et al.*, 1999; DuRant *et al.*, 1999), which may alleviate concerns. Furthermore, the aim of this study was to identify factors related to violent behaviors rather than study prevalences, therefore under-reporting may not be a great threat to the validity of our findings in that regard.

Interpretations should be limited to behaviors represented in our violence measure. We did not distinguish between violence on and off school grounds, and the time frame for the questions was the past 12 months, which may be too long for young adolescents to recall. Other studies have used both 12-month and 30-day time periods (Carolina Population Center, 1999; Centers for Disease Control and Prevention 1999); we chose 12 months based on expectations that among young adolescents, 30 days may be too short to capture sufficient variability. There is evidence that violent behavior among youth is associated with both victimization (DuRant *et al.*, 1997) and exposure to violence (Singer *et al.*, 1999), and our measure did not explicitly tap either of these.

The validity of the SFI is not fully established, although the psychometric properties in this sample were good. Although the scaling used to construct the index gave each component equal weight, this assumption may not be valid. Three of the indicators in the SFI (both teacher-related variables and overall attendance), as well as other variables that were excluded due to highly suspect validity, were not available from public datafiles and had to be collected from the school principals. Extensive follow-up was needed to obtain complete responses and it is unknown how accurate the school reports were. Given the difficulties in obtaining these measures from schools, a goal of future work may be to identify alternate data sources for these indicators.

A strength of the study is that it used data from two time points, and was able to account for temporality by using covariates from the fall survey and the dependent variable from the subsequent spring survey. However, the main independent variable of interest, SFI, reflects the entire 1998–1999 school year and therefore is not strictly a baseline measure. While all of the publicly available data used to compute the SFI were similar to values for the preceding year, this comparison was not possible with the three variables collected from the schools. The high Cronbach's α suggests that the measure is stable, but monitoring schools' SFI scores over several years would be a stronger indicator of stability. The extent to which schools' functioning actually varies annually is not known.

A final consideration relates to the analytic approach. The multilevel models used were of the type Bryk and Raudenbush (Bryk and Raudenbush, 1992) describe as 'Means as Outcomes' models, adapted for the skewed distribution of the data. The outcomes of interest (in this case, ERRs) were the differences in the frequency of violent behavior reported by students across different levels of the SFI$\times$college expectations interaction. SFI was modeled as a fixed effect, which requires two assumptions. Specifying an effect as fixed assumes that the condition is reproducible, which in this case is a strong but defensible assumption. It also requires an assumption that the coefficient of interest is homogeneous within the specified levels (e.g. that the effect of SFI is homogeneous across

schools in a given stratum, at the reference level of college expectations). An alternate approach, random coefficients modeling, would allow for variation in the coefficient of interest both within and between strata, by fitting both a random intercept (which the 'Means as Outcomes' model also does) and a random slope for each group level unit (in this case, school). The random coefficients model requires fewer assumptions, but is less powerful than the 'Means as Outcomes' model. Given the small number of schools available in this study, we chose the more powerful approach, but acknowledge that the stronger assumptions are a limitation. Future work using random coefficients modeling would strengthen the findings reported here.

Conclusion

In summary, we found that in a large sample of Grade 7 students in a metropolitan area in the midwestern US, school functioning was negatively related to violent behaviors in the majority of students. These findings warrant further investigation, to learn more about the nature of the relationships of school functioning, educational expectations and violent behavior. Further investigation, with particular attention paid to addressing the limitations described above, may provide additional insights into promising intervention strategies.

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