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A Longitudinal Examination of Gun Reporting by Middle and High-School Students

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ABSTRACT

A variety of factors are associated with the likelihood of reporting guns at school; however, mixed empirical findings hinder our ability to inform policies to reduce school violence. Additionally, many of the established factors are difficult to change over time, and limited attention has been devoted to more malleable factors such as anonymous reporting. To better understand how to improve the likelihood of gun reporting at school, we drew from three waves of survey data from 3,633 students in St. Louis, Missouri. Using a multilevel model, we find that perceived risk of victimization and the availability of anonymous reporting increase the likelihood of gun reporting, while negative peer commitment, self-reported delinquency, and victimization decrease the likelihood of reporting. Additional analyses suggest that independent of known risk factors that inhibit reporting, increases in school climate and improvements in availability of anonymous reporting can increase the likelihood of reporting guns at school.

Introduction

Although school violence has been trending downward for the last 30 years (P. J. Hirschfield, 2018; J. J. Turanovic & Siennick, 2022), recent data from the Centers for Disease Control and Prevention (CDC) show that in the past decade, approximately nine percent of U.S. high school students still missed school for safety concerns (Centers for Disease Control and Prevention, 2023). Additionally, recent incidents of school shootings demonstrate the need for continued discussion about school safety (Burton et al., 2021). School personnel, policy makers, researchers, and activists have been working toward creating policies for school safety, but these discussions are often inconclusive or full of disagreement, leaving children at continued risk of victimization (Cox & Rich, 2023).

For example, school surveillance technologies [such as security cameras (used by schools serving 79% of students) and metal detectors (used by schools serving 47% of students)] is one approach used to decrease the presence of weapons (National Center for Education Statistics, 2020). Unfortunately, empirical evidence on the effectiveness of these approaches has been mixed, with a recent meta-analysis concluding that the use of security cameras and metal detectors has a null association with reductions in violence at school, aggressive/delinquent behavior at school, violent offending at school, or even bringing a weapon to school (J. Turanovic et al., 2020). Furthermore, many scholars also suggest that these surveillance practices may serve to increase fear among students (Hankin et al., 2011; P. Hirschfield, 2010). Given this research suggesting surveillance methods do not prevent crime (Hankin et al., 2011; J. Turanovic et al., 2020), it is necessary to look toward other ways at reducing weapons in schools.

One option for keeping weapons out of schools involves creating school climates where students are willing to report the presence of guns. Indeed, research suggests that in a majority of incidents involving an attack on school campuses, at least one peer had prior knowledge the event was to occur (Vossekuil et al., 2002). Furthermore, in a study regarding shootings in schools, Langman (2015) found that when information regarding a shooting is leaked to peers and nothing is done in response, the potential shooter can interpret this as their peers providing permission for the plan to continue. Based on this evidence, increasing the likelihood that students report the presence of guns could then serve to prevent incidents of violence.

Research suggests a variety of conditions related to the likelihood that a student will report risky behavior (e.g., bullying, cheating, breaking into lockers) of peers in schools. These conditions include demographic factors (Brank et al., 2007; Slocum et al., 2017), peer relationships (Brank et al., 2007; Slocum et al., 2017), individual life experiences (Anderson, 1999; Brank et al., 2017; Morris, 2010; Perkins et al., 2020; Slocum et al., 2017), and school-level factors (Espelage et al., 2022; Pollack et al., 2008). However, most research on this topic is cross-sectional and only considers a subset of variables, thus resulting in inconsistent findings. To create school-wide interventions/policies that increase overall reporting rates, we must better understand how these conditions are independently related to the likelihood of reporting guns in school and how they impact reporting over time.

The current study draws from a longitudinal sample of middle and high school students located in six school districts in St. Louis County, Missouri. These data contain measures of multiple school, peer, and individual factors that have been identified as risk or protective factors for youth behavioral outcomes in prior research (F. A. Esbensen et al., 2020). As described below, many of these factors have also been linked with the reporting of problematic behaviors in school, although findings are mixed. The panel design contains two cohorts of students that were surveyed over the course of three years. This allows for the examination of multiple risk factors across different domains (see Slocum et al., 2017) and an examination of within-individual changes over time to determine how changes in perceptions of the school, peers, and attitudes are associated with changes in the reporting of guns at school. As such, our findings can help determine conditions that increase gun reporting independent of conditions known to inhibit students from informing adults at school.

Literature review

Estimates suggest that approximately 64–78% of students say they would report someone at school who was exhibiting antecedents to violence (Brinkley & Saarnio, 2006; Perkins et al., 2020). Though the majority of students claim to be willing to report, understanding the risk factors for the students who would not report is crucial to targeting interventions/policies that foster more open communication between students and school personnel.

Individual factors associated with weapons reporting

Individual-level factors associated with the likelihood of reporting weapons and risky behavior (e.g., bullying, breaking into a locker, cheating) include specific life experiences (Anderson, 1999; Brank et al., 2007; Morris, 2010; Perkins et al., 2020) and demographic factors such as sex, age, and race (Brank et al., 2007; Crichlow-Ball & Cornell, 2021; Slocum et al., 2017). Specific life experiences such as self-reported delinquency (Brank et al., 2007; Wylie et al., 2010), suspensions from school (Crichlow-Ball & Cornell, 2021), and poor academic performance (Brank et al., 2007; c.f.; Morris, 2010) are each linked with being less likely to report guns at school. However, having experienced victimization is more nuanced and unclear. Though theoretical evidence suggests victimization may be related to weapon reporting due to mistrust of the authoritative system (a result of not having been protected in the past and a common reason cited for not reporting in general) (Miethe & Rothschild, 1994; Skogan, 1984), some studies have found the opposite: victimization increases reporting of misbehavior incidents at school (Slocum et al., 2017) including weapons reporting at school (Perkins et al.,

2020) – perhaps due to students being acutely aware of the dangers associated with violent behavior (Slocum et al., 2017).

Regarding demographic factors, Brank et al. (2007) found that students who identify as male are less likely to report risky peer behavior and weapon carrying than students who identify as female. However, other demographic factors (including race and age) have different results depending on the study. For example, while Brank et al. (2007) found no differences in reporting between White and Black students, Slocum et al. (2017) and Crichlow-Ball and Cornell (2021) found that White students were more likely to report school misbehavior than other racial groups. As for age, Brinkley and Saarnio (2006) found that younger students were more likely to report antecedents to violence; however, Crichlow-Ball and Cornell (2021) found the opposite – students from younger grades were less likely to report antecedents to violence.

One possible explanation for mixed findings could be related to the lack of temporal ordering in studies examining how individual factors are associated with reporting behaviors. Of note, all the previously reviewed studies were cross-sectional in design. This lack of longitudinal designs means studies have largely been unable to examine changes in reporting over time, which increases the possibility of identifying spurious associations.

Peer factors associated with weapons reporting

Evidence suggests students tend to overestimate the likelihood that their peers carry guns (Hemenway et al., 2011) and underestimate whether their peers would be willing to report peer gun carrying (Perkins et al., 2020). However, who students associate with does seem to impact whether an individual is willing to report. Essentially, associating with delinquent peers is linked with decreases in reporting guns at school (Brank et al., 2007; Wylie et al., 2010). Some scholars suggest this peer influence in reporting is related to the "code of the street" [the idea that individuals should not rely on authority figures to solve problems, but rather should resolve disputes on their own (often in a violent manner)] (Anderson, 1999; Slocum et al., 2017) or anti-snitching norms (including concerns over reputations) within school settings (Morris, 2010). As a result, going to authority maycause students to lose respect among peers.

School factors associated with weapons reporting

In addition to individual and peer factors, school-level factors also play a role in the likelihood that a student will report deviant behavior at school. Evidence suggests that schools with supportive adults (Pollack et al., 2008; Wylie et al., 2010), schools with students who feel as though they can trust adults within the school (Espelage et al., 2022), and schools with high levels of school commitment (i.e., how committed students in the school are to working hard/achieving success) (Slocum et al., 2017) are all more likely to have more students who are willing to report antecedents to violence. School collective efficacy [cohesion and trust among students and adults combined with the willingness to intervene (Sampson et al., 1997)], though not directly studied, is one factor that evidence suggests may impact the likelihood that students report antecedents to violence. Collective efficacy has been linked with reductions in problematic behavior such as bullying (Olsson et al., 2017) and being suspended at school (Kirk, 2009). Although some studies have found that this impacts the willingness to report crime (e.g., Hart & Colavito, 2011), to our knowledge no evidence shows how school collective efficacy may impact reporting weapons or threats at school specifically.

The ability to report anonymously also seems to impact reporting behaviors in school (Brank et al., 2007; Messman et al., 2022; Wylie et al., 2010). For example, in a multi-state study of middle schools, Brank and colleagues (2007) found that anonymous reporting, or the ability to report an infraction to school personnel anonymously, increased the likelihood students would report weapons at school, even if it was a friend who had the weapon. Unfortunately, aside from the work of this study, there is little evidence showing the effectiveness of anonymous reporting

systems as a practical means of preventing school violence (Messman et al., 2022). Indeed, in a recent systematic literature review of 25 years of research (1995–2020) on anonymous reporting systems, Messman et al. (2022) found just four empirical articles (only one of which was peer reviewed) discussing the effectiveness of anonymous reporting systems and/or information regarding best practices for utilizing anonymous reporting systems, despite widespread implementation of these systems. Of the four studies, two reported on the number of tips received, one found that anonymous reporting was linked with the perception that bullying had decreased, and one saw a decrease in violent incidents at school after implementing an anonymous hotline. Messman and colleagues (Messman et al., 2022) therefore made a call for more research to understand how anonymous reporting systems can be utilized to prevent school violence.

The current study

When examining various factors associated with reporting guns in school, there are inconsistencies which warrant further exploration. For example, there have been mixed findings related to individual factors across race (Brank et al., Slocum et al., 2017), age (Brinkley & Saarnio 20,116; Crichlow-Ball & Cornell, 2021), grade (Brank et al., 2007; Morris, 2010), and victimization (Skogan, 1984; Slocum et al., 2017). Peer factors related to the code of the street and peer delinquency are more consistently linked with lower gun reporting (Brank et al., 2007; Slocum et al., 2017; Wylie et al., 2010), yet limited work has examined attitudes toward violence, especially within the same study. School factors such as bonds with adults and commitment to school have likewise received empirical support (Espelage et al., 2022; Pollack et al., 2008), but few studies focus on more malleable factors beyond school climate, such as anonymous reporting (Messman et al., 2022). Additionally, the few studies that incorporate longitudinal designs (e.g., Espelage et al., 2022) utilize cohorts or focus groups. Panel designs, which follow the same students over time, can better allow schools to identify amenable factors that can be targeted to change behaviors within individuals (e.g., Slocum et al., 2017).

The current study uses panel data from six school districts in St. Louis County, Missouri to examine how various individual, peer, and school factors are associated with reporting guns in school. Prior work has highlighted the need to consider high-risk samples, including those who have experience with offending and victimization, since these individuals are most likely to know others who carry guns (Brank et al., 2007). Around 28% of students in the current study lived within one mile of a homicide during the first wave of data collection (2017), with 49.5% self-reporting at least one act of delinquency. Moreover, two cohorts of students enrolled in the seventh and eighth grades were surveyed across three waves, which allows for the examination of within-individual changes during both middle and high school.

Specifically, our research seeks to answer the following research questions:

(1) What school, individual, and peer factors are associated with reporting guns at school?
(2) How are changes in these factors at different times associated with reporting guns at school?

Data and methods

Data from this study come from the University of Missouri, St. Louis Comprehensive School Safety Initiative (CSSI) Student Questionnaire. Six school districts were chosen that represent a diverse sample based on school size, racial composition, disciplinary incidents, and the percentage of students eligible for free and reduced-cost lunch. For example, the racial composition ranges from a low of six percent Black to a high of 84%, with an average of 42%. Between 16% and 95% of students within each school were eligible for free and reduced lunch and there were between 0.3 to 12.4 disciplinary incidents per 100 students in each school. This variation in schools offers a strong theoretical basis for using a multilevel model.

There are 12 middle schools within these six districts, and all were selected for participation. In the spring of 2017, two cohorts were selected, representing students from the seventh and eighth grade. Although some middle schools contained students in the sixth grade, all schools under investigation included seventh and eighth grade in their middle school. As such, these two cohorts were chosen to ensure that all students started the study as middle schoolers. All nine high schools within the six districts began in ninth grade. During the first wave, parental consent was obtained from 3,663 parents, which represents 78% of students across the 12 schools. Consent rates ranged from a low of 62% to a high of 89% between schools. Data collection occurred within the school building during school hours with research team members reading the survey to groups of students while the students independently completed the questionnaires. The research team made multiple visits to each school in order to survey students who were absent on the first day of data collection, and attempts were made to track down students who moved to different schools in nearby districts, resulting in a total of 24 schools across the three waves of data collection. During the first wave, 3,640 students completed the survey (99.4% of those eligible) with 2,753 students in ninth and tenth grade completing wave 3 (75% of those eligible). Of the 23 students who did not complete the wave 1 survey, most ($n = 19$) completed wave 2 and/ or wave 3 surveys. Various school, individual, and peer factors items are included based on validated items used in national longitudinal studies such as the National Youth Survey (Elliott & Huizinga, 1989), the Denver Youth Survey (Huizinga et al., 2003) and the evaluation of the Gang Resistance Education and Training program (F.-A. Esbensen et al., 1999). See the technical report by F. A. Esbensen et al. (2020) for additional information regarding the study design and methodology.

Missing data due to attrition is a common issue in school-based panel surveys spanning multiple years (F.-A. Esbensen et al., 1999). Those who dropped out of the study were generally at higher risk (e.g., more likely to report delinquency, victimization, and peer delinquency) compared to those who were retained across three years. This differential attrition, which is common in longitudinal panel designs, likely underestimates the effect of individual, peer, and school factors on the likelihood of reporting a gun at school. Although there are racial differences where Black students were less likely to complete all three waves, there were no statistically significant differences among male and female students. As discussed in our analysis section, we utilize a strategy that allows us to retain cases with missing information that does not violate assumptions of other techniques, which reduces the overall bias attributed to missing data due to listwise deletion. However, there is still the possibility that selective attrition could influence our findings. Fortunately, the number of cases lost due to attrition is comparable if not lower than many school-based panel designs (F. A. Esbensen et al., 2020).

Dependent variable

The key outcome variable for this study is *gun reporting*, which is measured by asking, "How likely is it that you would report the following events if you saw someone doing them?" with "bringing a gun to school" as an option. Response categories include 1 = *not at all likely*, 2 = *a little likely*, 3 = *somewhat likely*, 4 = *likely*, and 5 = *very likely*. Around 84% of all respondents answered in the extremes, either not at all likely (26%) or very likely (58%) at wave 1. Due to limited variation among the answers selected, in the analyses predicting those who are likely to report guns, this variable is recoded into a dichotomous measure where those who answered *not at all likely* = 0 and those who answered *a little likely* to *very likely* were collapsed into a single category (= 1). This allows us to more easily differentiate among those who are unwilling to report compared to the three out of four students (Brinkley & Saarnio, 2006; Perkins et al., 2020) who are at least a little willing to report someone bringing a gun to school. In models looking at changes over time within the same school, the additional variation found in our difference scores allows us to use the original five categories ranging from "not at all likely" to "very likely."

School factors

Risk of victimization at school (α = 0.78) is a three-item scale asking the likelihood (1 = *not at all likely* to 5 = *very likely*) of being attacked or threatened at school, being bullied at school, or having things stolen at school. The scale captures the average of responses across the three items, with higher values indicating greater perceived risk. *Anonymous reporting* is measured by asking how much respondents agree (1 = *strongly disagree* to 5 = *strongly agree*) with the statement, "Students have a way to report threats against school or students without giving their name."

Three variables capture bonds with the school: *supportive adults*, *school commitment*, and *school collective efficacy*. *Supportive adults* (α = 0.84) is a three-item scale that captures how supportive and caring adults are at school. Students were asked how much they agree (1 = *strongly disagree* to 5 = *strongly agree*) with questions asking about adults helping with schoolwork, adults providing advice about the future, and adults talking about life outside of school. *School commitment* combines five items that capture how much respondents agree with the following statements: homework is a waste of time, I try hard in school, in general I like school, grades are important to me, and I usually finish my homework (α = .70*). School collective efficacy* combines three items that capture how much respondents agree with the following: if there is a problem at school students get together to deal with it, people in this school care about what happens here, and people in this school can be trusted (α = .70).

Individual/peer factors

Self-reported delinquency is measured using a 13-item variety score capturing a broad range of delinquent acts including skipping class, lying about age to get into places or buy something, avoiding paying for things, destroying property, carrying a weapon, stealing something less than $50, stealing something more than $50, burglary, simple assault, aggravated assault, robbery, gang fights, and selling drugs. Prior research suggests that variety scores are the preferred criminal offending scale since they are not compromised by the high frequency of less serious delinquent acts and this approach offers higher reliability compared to other common alternatives (Sweeten, 2012). Students were asked how many times they participated in each activity over the past six months. Each item was dichotomized and then summed, creating a variety score that ranges from 0 to 13. Higher values indicate participation in more types of delinquent acts. *Self-reported victimization* is measured by asking respondents if they had experienced any of seven types of victimization during the past six months including being hit, robbed, attacked with/without a weapon, and having things stolen. A variety score was again created by dichotomizing each of the victimization items and taking the sum of all items (1–7).

Code of the Street captures agreement with the following five items: People will take advantage of you if you don't show how tough you are, people do not respect a person who is afraid to fight physically for his/her rights, sometimes you need to threaten people in order to get them to treat you fairly, it is important to show others that you cannot be intimidated, and people tend to respect a person who is tough and aggressive (α = .83). *Perceived Peer Delinquency* is a perceptual measure asking the proportion of one's friends (1 = *none of them*, 2 = *few of them*, 3 = *half of them*, 4 = *most of them*, 5 = *all of them*) that committed six different acts of delinquency over the past year. These items include theft, assault, aggravated assault, selling and using drugs, and weapon carrying at school (α = .81). *Friend brought a gun to school* is measured by asking "During the last year, how many of your friends have done the following" with "brought a gun to school" as an option. Response categories are the same as the perceived peer delinquency measure, meaning this item captures the proportion of one's peer group who has brought a gun to school.

Finally, several demographic control variables are included. *Male* is a dichotomous indicator for gender (male = 1). Race is captured by creating two mutually exclusive racial categories. *Black* is a dichotomous indicator for those who identify as non-Hispanic Black, while *other race* is a dichotomous indicator referring to those who identify as Asian, Native American, Hispanic,

multiracial, or if the respondent selected "other" as a response to the race question (with non-Hispanic White serving as the reference category). Due to limited variation in racial categories, all non-White and non-Black respondents were grouped into the other race category. *Grade Level* differentiates between those in the seventh and eighth grade at time 1 (8th = 1). *Poor grades* is a single self-reported item ranging from 1 to 5, with higher values corresponding to lower grades.

Analysis

We utilize two analytic approaches, where the first uses a binomial multilevel model with fixed effects and random intercept to test individual and school-level predictors on likelihood of reporting a gun at school over time. Multilevel modeling (MLM) analyses were conducted in R version 5.0 using *lme4* (1.1–31) package (Bates et al., 2015, *misty* (0.4.7) package (Yanagida, 2023), and *performance* (0.10.4) package (Lüdecke et al., 2021). MLM provides several advantages over other regression-based techniques. It allows for missing data at Level 1 by estimating trajectories based on available data, a more efficient estimate than mean substitution or listwise deletion (Jeličić et al., 2009). Second, repeated measures growth analyses, which we accomplish with this three-level model, provide more reliable estimates of change relative to a focus on mean differences only. Third, individual or person-level timelines can be used to more precisely and accurately depict gun reporting by taking the nested structure of the data into account.

In the present study, individual-level data were collected at three timepoints: wave 1, wave 2, and wave 3. The three waves are nested within students, which are then nested within schools. Our predictors and model account for this three-level structure where we run a mixed effects binomial regression model with random intercepts at the school level. Level 1 outcomes are time-varying repeated measures. These are nested or clustered within individuals at Level 2, where we include time-invariant measures like demographics. Changes in gun reporting (increases or decreases) are estimated for each student at Level 1. These estimated slopes then become the focal dependent variable in the Level 2 model. That is, between-student sample means and variances for reporting rates are regressed on Level 2 predictors. These estimated outcomes are then used for the Level 3, school-level model and for the 24 middle and high schools in our sample.

In the first set of models, we estimate a mixed effects binomial regression with random intercepts at the school level. The conditional mixed-effects model was compared to the fixed-effect-only model using the likelihood-ratio-test (LRT) for model comparison to confirm that the mixed effects model offered more precise estimates, despite low reported model intra-class correlation (ICC = 0.15). Additionally, noninde-pendence and autocorrelation in the multilevel data structure justify the use of multilevel modeling (design effect = 4.45; Lai & Kwok, 2015). In running the model, we find the school-level variance to be 0.04, while the individual-level variance to be 0.55, indicating that individual-level differences are likely driving variance in the model. The generalized linear mixed-effect model (GLMM) was run in R.

In order to take a closer examination into changes over time within the same school, the next set of models take a first-difference approach where within-individual changes in the likelihood of reporting guns at school is regressed on within-individual changes in school, personal, and peer factors. We use robust standard errors through clustering by school to control for the fact there are underlying similarities between students in the same school. Here we separate models focusing on each cohort, which allows us to examine the changes among respondents who stay in the same school across waves. Specifically, the first cohort of students were in seventh grade at wave 1 and were in ninth grade at wave 3. The first-difference models focusing on middle school look only at this first cohort and examine changes from wave 1 to wave 2, which corresponds with the transition from seventh to eighth grade. The second cohort started in the eighth grade at wave 1 and finished in the tenth grade at wave 3. The high school models focus on this second cohort and use the last two waves, thus capturing the transition from ninth to tenth grade. Although this approach reduces the sample size in each model, it allows for specific examination of within-individual changes among those who stay in the same middle school or high school. Due to the normal distribution of the outcome variable, ordinary least squares regression is used to estimate these models (Allison, 1990).

Results

In Table 1 we show descriptive statistics for all variables used in the analysis for wave 1 (mean, standard deviation, range), changes from wave 1 to wave 2 (for students in the middle school cohort), and changes from wave 2 to wave 3 (for students in the high school cohort). For the change scores, a value of 0 indicates there is no change between waves, a negative value indicates a decrease between waves, and a positive value indicates an increase between waves.

Table 2 shows results from the three-level multilevel mixed-effects model to understand how school, individual, and peer factors relate to the likelihood of reporting guns at school. Aligning with expectations, we find that significant predictors of being at least somewhat likely to report guns at school include risk of victimization ($b = 0.56$, $p < .001$), collective efficacy ($b = 0.16$, $p < .001$), anonymous reporting available at the school ($b = 0.19$, $p < .001$), street code ($b = 0.09$, $p = .010$), attitudes toward violence ($b = 0.08$, $p = .012$), and if a friend brought a gun to school ($b = 0.38$, $p = .028$). Among these, it appears that the risk of victimization and friends bringing a gun to school are the strongest factors predicting whether a student is likely to report a gun at school. Independent of these factors, the availability of anonymous reporting remains significant.

Additionally, having poor grades ($b = -0.44$, $p < .001$), having delinquent peers ($b = -0.34$, $p < .001$), identifying as male ($b = -0.37$, $p < .001$), identifying as Black ($b = -1.08$, $p < .001$), identifying as other race ($b = -0.75$, $p < .001$), and having supportive adults ($b = -0.23$, $p < .001$) were all negatively predictive of being at least somewhat likely to report guns at school. We did not find significant differences in reporting likelihood for delinquency, victimization, and school commitment. The rather strong racial differences stand out among these covariates where nonwhite youth are less likely to report guns at school compared to white youth when controlling for a variety of risk and protective factors. The one unexpected finding relates to the negative association between supportive adults and gun reporting at school, a point we return to in the discussion.

Table 3 uses OLS regression to examine how within-individual changes among students who stay in the same middle or high school are associated with changes in the likelihood of reporting guns at school. The most consistent finding across models is that increases in the risk of victimization are associated with increases in the likelihood of reporting in middle school ($b = 0.19$, $p < .01$) and high school ($b = 0.23$, $p < .01$). When looking at the middle school sample, which captures changes among those who moved from seventh to eighth grade, increases in reporting were significantly associated

Table 1. Descriptive statistics.

Variables	Wave 1 Variables				W1 to W2 change (Middle School)				W2 to W3 change (High School)			
	M	SD	Min	Max	M	SD	Min	Max	M	SD	Min	Max
Likelihood of Reporting Gun at School	3.70	1.73	0	5	−0.16	1.98	−4	4	−0.18	1.94	−4	4
Poor Grades	1.96	0.83	1	5	0.04	0.67	−4	3	0.07	0.71	−4	4
Risk of Victimization	2.04	0.98	1	5	−0.15	0.98	−4	4	−0.07	1.02	−4	4
Supportive Adults	3.09	0.91	1	5	0.10	1.00	−3.33	4	0.04	0.99	−4	4
Collective Efficacy	2.79	0.90	1	5	−0.20	0.97	−3.67	4	0.00	1.04	−4	4
School Commitment	3.85	0.69	1	5	−0.16	0.63	−2.8	3.2	−0.15	0.63	−3.6	3
Anonymous Reporting	3.55	1.10	1	5	−0.16	1.31	−4	4	−0.13	1.25	−4	4
Street Code	3.02	0.93	1	5	−0.04	0.96	−4	4	0.00	0.93	−4	4
Attitudes toward Violence	3.17	1.07	1	5	0.07	1.02	−4	4	−0.05	1.06	−4	3.5
Victimization	0.70	1.07	0	7	−0.15	1.09	−5	7	−0.09	1.07	−6	7
Delinquency	1.17	1.79	0	13	0.03	1.71	−9	13	−0.01	1.96	−13	13
Negative Peer Commitment	1.99	0.93	1	5	0.17	1.04	−4	4	0.13	1.14	−4	4
Friend Brought Gun to School	0.03	—	0	1	0.01	0.21	−1	1	0.02	0.23	−1	1
Male	0.46	—	0	1	—	—	—	—	—	—	—	—
Black	0.42	—	0	1	—	—	—	—	—	—	—	—
Other Race	0.10	—	0	1	—	—	—	—	—	—	—	—
N	3,433				1,480				1,143			

ABBREVIATIONS: *M* = mean; SD = standard deviation, Min = minimum; Max = maximum.

Table 2. Generalized linear mixed model fit by maximum likelihood (Laplace Approximation).

Variables	b (SE)	Odds ratio	Odds ratio CI	p-value
School Factors				
Risk of Victimization	0.56 (0.04)	1.75	1.62–1.88	<.001
Supportive Adults	−0.23 (0.04)	0.79	0.74–0.85	<.001
Collective Efficacy	0.16 (0.04)	1.18	1.10–1.27	<.001
School Commitment	0.08 (0.05)	1.08	0.98–1.19	.129
Anonymous Reporting	0.19 (0.03)	1.21	1.14–1.28	<.001
Individual and Peer Factors				
Poor Grades	−0.44 (0.04)	0.64	0.59–0.69	<.001
Street Code	0.09 (0.04)	1.10	1.02–1.18	.010
Attitudes toward Violence	0.08 (0.03)	1.08	1.02–1.15	.012
Victimization	−0.04 (0.03)	0.97	0.90–1.03	.303
Delinquency	0.00 (0.01)	1.00	0.97–1.04	.801
Peer Delinquency	−0.34 (0.08)	0.71	0.61–0.84	<.001
Friend Brought Gun to School	0.38 (0.18)	1.47	1.04–2.07	.028
Demographic Factors				
Male	−0.37 (0.06)	0.69	0.62–0.78	<.001
Black	−1.08 (0.10)	0.34	0.28–0.42	<.001
Other Race (non-White & non-Black)	−0.75 (0.09)	0.47	0.40–0.57	<.001
Intercept	1.09 (0.29)	2.98	1.68–5.29	<.001
Random Effects		σ^2	3.29	
		$\tau_{00\ id:school}$	0.55	
		$\tau_{00\ school}$	0.04	
		ICC	0.15	
		N_{id}	3571	
		N_{school}	24	
	Marginal R^2/Conditional R^2		0.192/0.314	

Table 3. OLS regression assessing the influence of change in school, peer, and individual factors on change in the likelihood of reporting guns at school.

Variables	Middle School (n = 1,465)		High School (n = 1,128)	
	b	SE	b	SE
School Factors				
Risk of Victimization	0.19 **	0.05	0.23 **	0.06
Supportive Adults	−0.05	0.05	−0.07	0.08
Collective Efficacy	0.15 *	0.06	0.07	0.08
School Commitment	0.02	0.09	0.22 *	0.10
Anonymous Reporting	0.02	0.04	0.12 *	0.05
Individual and Peer factors				
Poor Grades	−0.09	0.09	0.07	0.08
Street Code	0.10	0.08	−0.02	0.05
Attitudes toward Violence	0.04	0.03	0.12	0.08
Victimization	−0.03	0.06	0.02	0.03
Delinquency	0.02	0.04	0.01	0.02
Peer Delinquency	−0.28 †	0.14	−0.10	0.08
Friend Brought Gun to School	−0.15	0.25	−0.25	0.25
Intercept	0.01	0.10	−0.24	0.12

ABBREVIATIONS: SE = standard error.
Estimated using robust standard errors.
† p < .10; * p < .05; ** p < .01; *** p < .001.

with increases in collective efficacy ($b = 0.15$, $p < .05$). However, this factor is not associated with changes in reporting guns in high school. Among those who moved from ninth to tenth grade, increases in the likelihood of reporting were associated with increases in school commitment ($b = 0.22$, $p < .05$) and increases in anonymous reporting ($b = 0.12$, $p < .05$). Although the association between changes in anonymous reporting and the likelihood of reporting is among the weakest in this model, it represents one of the more amenable significant factors. However, this association was only observed among high school students.

Discussion

A variety of school safety measures have the goal of keeping guns out of school. Although the use of approaches such as metal detectors and security cameras has increased over the years, research suggests they are not effective in keeping schools safe (J. Turanovic et al., 2020) and can increase fear among students (P. Hirschfield, 2010). We aim to explore alternative strategies that rely less on physical security and more on individual, peer, and school climate factors that might improve the reporting of guns at school. Focusing on these factors may ultimately contribute to a less disrupted learning environment.

Our analyses were in two parts. First, we used the multilevel model to examine what factors contribute to the likelihood that a student will report seeing a gun at school. Several school, individual, peer, and demographic factors contribute to this. Next, we used OLS regression to examine what factors influence a students' change in likelihood of reporting from one year to the next. We ran this separately for students who stayed in middle school for both years compared to students who stayed in high school for both years. This allows us to identify factors that can be changed within a school to increase gun reporting while eliminating the confounding variables that may come into play when students move from middle to high school. Since this approach examines differences between waves, it may mask the influence of variables that remain relatively stable over time. Thus, interpreting both sets of results together helps to identify key areas to guide interventions.

Similar to prior literature (Brank et al., 2007; Pollack et al., 2008), we found that the availability of anonymous reporting increases the likelihood students will report guns in school. However, there is some indication this has more of an impact in high school compared to middle school – especially when predicting whether a student becomes more likely to report from one year to the next. Importantly, since the first-difference models account for changes within the same school, this suggests high schools can have a positive impact in reporting over time by implementing an anonymous reporting strategy. In other words, schools with anonymous reporting systems create an environment where youth (overall) are more likely to report, *and* they also create an environment for high schoolers where youth may *become* more likely to report. Our models control for a variety of factors that decrease the likelihood of reporting, such as peer delinquency and having poor grades in school, which suggests that anonymous reporting has a unique impact on reporting behaviors beyond those other individual factors. Given the ease with which this can be implemented in schools compared to altering school climate, anonymous reporting is one useful and simple strategy that can help reduce the number of guns in school.

We find that a variety of school climate factors impact the likelihood of reporting of guns at school. Though there has been prior theoretical and adjacent literature pointing to the importance of factors such as school commitment and collective efficacy (see Kirk, 2009; Olsson et al., 2017; Slocum et al., 2017), our study is among the first to specifically examine how much these factors matter for students' likelihood of reporting *guns* at school. Regarding collective efficacy, our multilevel model demonstrates that when students think people in the school can be trusted, will get together to solve problems, and care about what happens, this increases the likelihood of reporting guns across schools. When assessing whether a student became more or less likely to report from one year to the next, collective efficacy was an important predictor for helping middle school students become more likely to report. This was not the case among high school students. It is important to note that the lack of significance within high school could reflect the fact there is no change between waves 2 and 3 (see Table 1). Regarding school commitment, our multilevel model did not show that liking school, believing grades are important, finishing homework, or trying hard is associated with reporting guns at school. However, when predicting whether students change their likelihood of reporting from one year to the next, having high levels of school commitment for high schoolers was important but not for middle schoolers. Although school commitment did decline between waves 1 and 2, this change was unrelated to changes in the likelihood of reporting guns.

These findings suggest that collective efficacy may matter more than school commitment when it comes to identifying school characteristics that increase the likelihood of reporting. Traditionally, collective efficacy is examined within neighborhoods and less attention has been devoted to understanding how trust, cohesion, and the willingness to intervene impact behaviors within school. If schools wish to increase the reporting of guns, this may be one factor to target; however, school climate is difficult to change in a short amount of time. When looking at those in middle school, we found that both collective efficacy and school commitment decline over time. The same was found for school commitment among high schools, but collective efficacy remained stable. These changes over time reveal how reporting behaviors can be altered when climate changes, where improvements in collective efficacy increase the reporting of guns among middle schoolers, and school climate increases reporting among high schoolers. Increasing school collective efficacy can be accomplished through creating opportunities for collaboration, providing actionable feedback, and involving everyone in school decision making (Brinson & Steiner, 2007). Increasing programs to work with youth who have disrupted family dynamics is one way to improve school commitment. Jenkins (1995) finds that youth who come from families with higher education combined with parents who are involved in their youth's academic pursuits will yield the most school commitment from a student.

The one factor most consistently associated with reporting guns is the perceived risk of victimization. Students who believe it is likely they will be victimized at school are more likely to report guns at school. This was found when accounting for school-level differences and when examining changes within the same middle and high school. Importantly, self-reported victimization was not significant in any of the models. Prior research has disentangled how perceptions differ from reality, where actual victimization is distinct from perceived risk of victimization, which is different from fear of victimization (Ferraro, 1995). Ferraro's risk assessment model explains how risk is a cognitive assessment of the probability of victimization. Both direct and indirect experiences with victimization impact risk, as do ecological forces such as signs of physical and social disorder. Moreover, perceptions of risk have a stronger impact than actual risk (Brunton-Smith et al., 2014). As such, schools should look beyond the rate of victimization to better understand how students perceive their risk of victimization.

Surprisingly, and contrary to prior literature (Pollack et al., 2008; Wylie et al., 2010), the multilevel analysis found that having supportive adults at school decreased the likelihood of reporting. These findings might indicate students are more dismissive of threats in schools where everyone is supportive and they feel safe, especially given the various reasons students bring guns to school. Although there is the possibility that students may bring guns to campus with the intent of causing violence in a single shooting incident (e.g., Bonanno & Levenson, 2014; Burton et al., 2021), such incidents are statistically rare when looking at the broad scope of school violence (Fridel, 2021). Alternatively, students may bring guns to school to avoid victimization (Wilcox et al., 2006), as part of a delinquent lifestyle (Melde et al., 2009), or even to gain status among their peers (Esselmont, 2014). There could be some possible moderation where the presence of supportive adults increases the likelihood of dismissing threats if students feel safe and think their peers carry guns for protective reasons. However, the first-difference models did not find evidence that changes in supportive adults were associated with changes in the likelihood of reporting.

Also contrary to expectations (e.g., Anderson, 1999; Morris, 2010; Slocum et al., 2017), our study found that when students scored high on having a code of the street (the idea that individuals should resolve disputes on their own), they were actually more likely to say that they would report seeing a gun than those students who had low code of the street scores. Perhaps this is related to our specific outcome of interest. Whereas Slocum and colleagues (2017) applied code of the street to the reporting of different risky behaviors, we exclusively focus on the reporting of guns. Perkins and colleagues (2020) found that students are willing to report guns at school even though they thought their peers would not report. Previous studies looking at less serious outcomes highlighted how the code is associated with anti-snitching norms (Morris, 2010), which suggests students would lose respect among their peers if they reported information to authority figures. It is possible the presence of a gun may overpower the adherence to the code, or the availability of anonymous reporting may

enable youth to circumvent concerns about lost respect if peers are unaware that the report took place. Since the code of the street reflects demonstrating toughness and the willingness to threaten other people to maintain respect, those who adhere to this code may think the presence of a gun at school is more likely to lead to violence compared to those who do not adhere to the code. Our survey data is limited in its ability to understand the nuance of this association, and future qualitative research may better unpack how street code is associated with gun reporting.

It is important to note other individual and demographic level factors that are risk/protective factors for reporting. Unsurprisingly, students with poor grades and delinquent peers are less likely to report guns in school. These findings indicate a need to especially support students who are struggling both behaviorally and academically. Aligning with prior literature (e.g., Brank et al., 2007), we find that youth are still likely to report a gun even if a friend brought it to school. Furthermore, students who identify as male (compared to female), Black (compared to White) or other race (compared to White) are all less likely to report guns at school. This may be due to the ample literature suggesting that male youth (and especially male youth of color) are more likely to be judged harshly by teachers (Gilliam et al., 2016; Welsh & Little, 2018). Perhaps, then, these students do not feel comfortable reporting for fear that they may face adverse consequences. Anonymous reporting systems could be one way to help these students feel more comfortable reporting.

Limitations

These analyses are not without limitations. As is, it is difficult to use this dataset to generalize findings beyond the St. Louis County context. The missing values in this dataset are not missing completely at random, with attrition and other factors contributing to gaps in data. Additionally, with these measures relying solely on student self-report, other factors related to school climate and culture that influence gun reporting may not be captured. For example, in the demographics we include, we find White students to be over twice as likely to report guns than any peers of color, and male-identifying students are less likely. Other factors associated with these variables – such as gun familiarity – are not captured in this survey. Though beyond the scope of this study, future studies should go on to examine how these factors and demographics interact, in addition to replicating these analyses on a larger scale.

Our primary dependent variable only captures the likelihood of reporting and does not measure actual reporting behavior. The act of reporting is likely nuanced and influenced by situational factors not included in the study (e.g., degree to which student knows the carrier, how they know of the gun, and/or location of the gun on campus). Furthermore, it is also possible that middle schools are driving the outcomes we observed in the multilevel model. Due to attrition, the sample size is almost 28% larger in wave 1 ($N = 3,640$) compared to wave 3 ($N = 2,753$). We are also limited in that we only look at ninth and tenth grades in high school, thus are missing older students. Future work should aim to examine changes over longer periods of time across different age groups.

Our secondary goal in this study was to examine changes over time within the same school, with the hope of identifying factors that could be targeted to increase the reporting of guns as students advance grades within the same environment. Future research should aim to look at how changes across schools impact the likelihood of reporting. We previously noted how difficult it may be to change climate over time, which highlights the utility of focusing on strategies such as anonymous reporting. However, if students transition between schools, they may find themselves in an entirely new environment with a different culture that will impact factors such as collective efficacy and school commitment. Using a more diverse sample, it will be useful for future research to compare within and between school differences.

Conclusion

Independent of known risk factors that inhibit reporting of guns at school, improvements in school climate and improvements in availability of anonymous reporting can increase the likelihood that students will tell school personnel if they are aware that a gun is on campus. Moreover, when students are worried about their victimization, this heightened awareness contributes to their willingness to report guns. While some school factors were shown to increase reporting, such as collective efficacy, other factors were shown to decrease reporting, such as having supportive adults at schools. It is imperative that future research disentangle various school climate and culture factors that impact the reporting of guns. Based on these findings, we suggest that anonymous reporting is a key strategy and that it should be implemented widely to reduce the number of guns on campus. Not only does this reporting mechanism generally increase the likelihood students will disclose guns on campus, but we find that among high school students, increases in the awareness of anonymous reporting are associated with increases in the likelihood of reporting guns. We recommend that schools adopt this strategy as part of their school safety measures.

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