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Preparing Teens to Stay Safe and Healthy on the Job: a Multilevel Evaluation of the *Talking Safety* Curriculum for Middle Schools and High Schools

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Abstract
US adolescents experience a higher rate of largely preventable job-related injuries compared with adults. Safety education is considered critical to the prevention of these incidents. This study evaluates the effectiveness of a foundational curriculum from the National Institute for Occupational Safety and Health (NIOSH), *Talking Safety*, to change adolescents' workplace safety and health knowledge, attitude, subjective norm, self-efficacy, and behavioral intention to engage in workplace safety actions. The study also examines the impact of teacher fidelity of curriculum implementation on student outcomes. A multilevel evaluation, based on a modified theory of planned behavior, was conducted in 2016 with 1748 eighth-graders in Miami-Dade, Florida. Post-intervention, students had statistically significant increases ($p < .05$) in mean scores across outcomes: workplace safety knowledge (34%), attitude (5%), subjective norm (7%), self-efficacy (7%), and behavioral intention (7%). Consistent with theory, gains in attitude ($b = 0.25$, $p < .001$), subjective norm ($b = 0.07$, $p < .01$), and self-efficacy ($b = 0.55$, $p < .001$) were associated with gains in behavioral intention. Higher levels of implementation fidelity were associated with significant gains across outcome measures: knowledge ($b = 0.60$, $p < .001$), attitude ($b = 0.08$, $p < .01$), subjective norm ($b = 0.04$, $p < .001$), self-efficacy ($b = 0.07$, $p < .01$) and behavioral intention ($b = 0.07$, $p < .01$). Findings demonstrate the effectiveness of *Talking Safety*, delivered with fidelity, at positively changing measured outcomes, and provide support for using this curriculum as an essential component of any school-based, injury prevention program for young workers.

Keywords Young worker · Occupational safety and health · Injury prevention · Middle school · Theory of planned behavior · Fidelity of implementation · Multilevel modeling

In the USA, more than 80% of youth work for pay while in high school (Bureau of Labor Statistics 2005). While work has many benefits and is a formative experience for adolescents (Mortimer 2010), youth between the ages of 15 and 19 are over two times more likely than adults over the age of 25 to be injured seriously enough at work to require treatment in a hospital emergency department (NIOSH 2018a). For working youth under the age of 18, job-related injuries occur despite special protections offered by state and federal child labor laws[1] (Rauscher et al. 2008). The reasons why these injuries happen are numerous, including working in jobs with exposure to physical hazards (Mardis and Pratt 2003), and lack of experience, supervision, and training (Runyan et al. 2007; Zierold and Anderson 2006). Evidence suggests that serious, job-related injuries may have a cumulative morbidity burden on young people over their lives (Koehoorn et al. 2008).

The disproportionate toll of injuries on working youth and the total, long-term impact of these injuries calls for an

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[1] The child labor provisions of the 1938 federal Fair Labor Standards Act (FLSA) prohibit the employment of minors in jobs and under conditions harmful to their health or well-being. These provisions restrict work hours for youth under age 16 and define hazardous occupations that the Secretary of Labor has determined to be too dangerous for minors under age 18 to perform. Certain businesses are exempt from the FLSA, and varying standards apply to agricultural and nonagricultural industries (Department of Labor, Wage, and Hour Division 2016).

integrated strategy for protecting adolescent workers through changes to work environments, legislation/enforcement, and education/training (Runyan et al. 2012). Employers are responsible for providing employees with job-specific training, but schools could help prepare all young people early in life with the foundational knowledge and skills needed to respond to risks encountered in the workplace (Okun et al. 2016; Pisaniello et al. 2013). A study in France found that students who received occupational safety and health education while in school reported two times fewer workplace injuries than those who did not get this preparation (Boini et al. 2017).

A National Young Worker Curriculum

To prepare teens for safe and healthy employment, the National Institute for Occupational Safety and Health (NIOSH) and its partners developed *Youth@Work—Talking Safety* (*Talking Safety*), a free curriculum for middle- and high-school students (Miara et al. 2003; NIOSH 2018b). The *Talking Safety* curriculum is aligned with the National Health Education Standards (Centers for Disease Control and Prevention 2016) and is designed to fit with academic, health, career readiness, or career and technical education (CTE) programs in schools. Behaviors and social patterns are established during early adolescence (Brener et al. 2013). Thus, intervening early in development is an opportunity to target attitudes, beliefs, and actions related to risk before they are well-established (Houck et al. 2016). *Talking Safety* is designed to reach youth during the critical developmental stage of early adolescence, before they enter the formal labor market.

The NIOSH curriculum is built on a theoretical framework of foundational workplace safety and health competencies that are fundamental and portable to all jobs. These competencies pertain to hazard recognition and control in the workplace; employer responsibilities and worker rights and roles; actions to take in a work-related emergency; and communication with others when feeling unsafe or threatened (Okun et al. 2016). The NIOSH competencies are delivered through six 45-min, interactive lessons (and five supplemental lessons for more in-depth exploration of topics) that contain detailed lesson plans, student handouts, and PowerPoint slides. A 4-min video testimonial from a young worker seriously injured at a summer job is provided to engender favorable attitudes (Ajzen 1991) about the importance of safety on the job. Each lesson contains key learning objectives, an introductory discussion of the main lesson topic, and a summary of key points. Interactive activities, such as games or role-playing, are also provided for each lesson to enable students to practice key skills and enhance self-efficacy (Bandura 1997). Case studies and discussion prompts encourage exploration of common misconceptions and beliefs about workplace safety and health—both the students' own and their perceptions of the beliefs of others (Ajzen 1991).

Lesson 1, *Young Worker Injuries*, assesses students' current knowledge of job safety and legal rights. It also emphasizes the impact a job injury can have on a young person's life and introduces students to the idea that work-related injuries and illnesses are largely predictable and can be prevented. Lesson 2, *Finding Hazards*, helps students develop an understanding of the common health and safety hazards that workers may face on the job. Lesson 3, *Making the Job Safer*, explains methods to reduce or eliminate hazards on the job. It also shows students how to get more information about specific hazards they may encounter. Lesson 4, *Emergencies at Work*, introduces students to the types of emergencies that may occur in a workplace and how the employer and workers should respond to them. Lesson 5, *Know Your Rights and Responsibilities*, focuses on the legal rights all workers have under health and safety laws, explains the special rights young workers have under child labor laws, and introduces the government agencies and other resources that promote worker safety and health. Lesson 5 also helps students gain an understanding of their responsibilities on the job. Lesson 6, *Taking Action*, helps students develop skills to communicate effectively if a problem arises at work. The lessons incorporate a variety of teaching strategies and interactive activities tailored for teens (Herbert and Lohrmann 2011) to reinforce the learning objectives, increase self-efficacy, and enhance knowledge gain and retention.

The theory of planned behavior (Ajzen 1991), one of the most widely used health behavior theories that has been shown to explain a large proportion of the variance in intention to enact a number of health behaviors (Montaño and Kasprzyk 2015), may have utility to evaluate and measure the effects of school-based interventions, such as the *Talking Safety* program. Adolescent health researchers have used the theory of planned behavior extensively in recent years in areas such as substance use (Marsiglia et al. 2016) and injury prevention (Buckley et al. 2010).

Theory of Planned Behavior

The theory of planned behavior posits that attitude, subjective norm, and perceived behavioral control influence a person's intention to engage in a behavior (Ajzen 1991). Attitude is determined by a person's beliefs about and favorable/unfavorable assessment of outcomes of a behavior (Montaño and Kasprzyk 2015). Subjective norm is determined by normative beliefs—a person's perceptions of other important people's approval or disapproval of the behavior—and whether they wish to comply with others' views. Perceived behavioral control is the perceived ease or difficulty, assessed against perceived power, of carrying out the behavior (Ajzen 1991; Montaño and Kasprzyk 2015). Self-efficacy, confidence in one's ability to take action and successfully execute

a behavior (Bandura 1997), may be assessed as synonymous with perceived behavioral control (Montaño and Kasprzyk 2015). Behavioral intention is the most proximal predictor of behavior in Ajzen's model (1991). Meta-analyses (Webb and Sheeran 2006) provide support for the value of designing interventions to target intention to change behavior.

Although not explicitly included in the theory, knowledge is an important construct in the design of risk reduction interventions for young workers (Smith et al. 2018). Previous research indicates that knowledge acts indirectly on behavioral intention through other model constructs (Guerin et al. 2018). For adolescents, workplace safety knowledge may be increased through school-based programs (Linker et al. 2005), but knowledge alone cannot be translated to injury prevention (Pisaniello et al. 2013; Smith et al. 2018).

Current Study

A one-group, pretest-posttest design was used to evaluate the effectiveness of the *Talking Safety* curriculum to change adolescents' workplace safety knowledge, attitude, subjective norm, self-efficacy, and behavioral intention. The study population was eighth-grade students in comprehensive science classrooms in the Miami-Dade County (Florida) Public Schools (M-DCPS), the fourth largest US school district. The study was guided by previous research (Guerin et al. 2018) and a modified theory of planned behavior (Ajzen 1991) that includes a knowledge construct and assesses self-efficacy as the perceived behavioral control variable. Because of the young age of study participants (~ 13 years old) and given that the majority are not yet integrated into the formal labor force, actual behavior change was not assessed as part of the current intervention. A review of young worker training interventions by Smith et al. (2018) reported that objectively measuring behavior in a real-world setting is extremely challenging and expensive, and thus, it is more common for researchers to measure behavioral intention or self-reported safety behaviors. Moreover, meta-analytic evidence from experimental studies of the intention-behavior association (Webb and Sheeran 2006) provides support for designing interventions to target intention, as was the case with the current study.

The present study also explores outcomes among students by sex, race/ethncity, and, as a proxy for socioeconomic status (SES), the average percentage of students within the school receiving free and reduced-price lunch (FRL; Nicholson et al. 2014), which has been demonstrated as an important predictor of average student achievement (Flay et al. 2001) and of adolescent health, including workplace safety and health outcomes (Rauscher and Myers 2008). The current research also investigates the relationship between fidelity of implementation—the extent to which *Talking Safety* was delivered as designed and intended (Durlak and DuPre 2008)—and student outcomes, an area where more research is needed (O'Donnell 2008). Additional teacher-level variables (years of experience in the profession and with *Talking Safety*) were examined for direct, indirect, and interaction effects on student outcomes.

Method

Participants

During the 2015–2016 school year, the district enrolled approximately 354,000 students in grades preK–12 with approximately 27,000 in Grade 8. District-wide, roughly 70% of students self-identified as Hispanic, with an average of 71% of students receiving FRL (M-DCPS 2017). For the current study, 42 eighth-grade science teachers delivered the *Talking Safety* curriculum to 131 classes in 33 middle schools in Miami-Dade County. Approximately 10% (2833) of the eighth-grade science students in M-DCPS participated in the training and completed some portion of the pretest; of these, 2424 completed some portion of the posttest. From the 2424 students, 676 participants were removed for the following reasons: because their teacher administered the pretest after beginning instruction on the *Talking Safety* curriculum and having completion errors (such as answering at least three questions beyond the range of the questionnaire). The final study sample included 1748 students (with a linked pretest and posttest, described below) from across the county.

In the sample, and consistent with the district average, the mean percentage of students within study schools receiving FRL was 68% (range 6% to 97%). The 42 teacher participants had an average of 17 years (range: 2 to 32 years) of teaching experience. Roughly, a third of teachers ($n = 16$) held a Bachelor's degree, a third ($n = 15$) had a Master's degree, and a third held specialist ($n = 6$) or other degrees. The mean number of classes per teacher receiving *Talking Safety* was 3.1. About half ($n = 20$) of teachers participated in the first year of the study (2014–2015).

Among the 1748 students in the sample, the slight majority self-reported their sex as female (54%). Approximately 69% of respondents self-identified as Hispanic. For race (more than one category could be selected), 65% self-identified as White, 24% as Black, 5% American Indian/Alaska Native, 5% Native Hawaiian/other Pacific Islander, and 4% Asian. Approximately 29% ($n = 494$) of students indicated having worked for pay.

Intervention Materials

School district leaders requested that the NIOSH *Talking Safety* curriculum be tailored to (1) align with the Florida educational standards, (2) be delivered by teachers in one

school week, and (3) accommodate longer class blocks. The research team thus created a custom curriculum with four 55-min (versus six 45-min) lessons aligned with the Florida teaching standards: (1) *Young Worker Injuries; Know your Rights and Responsibilities*; (2) *Finding Hazards*; (3) *Making the Job Safer*; (4) *Emergencies at Work*; *Taking Action*. Overall, 50 min of teaching material, which the research team deemed not to be essential to teaching the core intervention components, were excluded.

Student Measures

To evaluate intervention outcomes, pretest and posttest questionnaires with 52 items were developed and pilot-tested with two focus groups of adolescents ($n = 16$) from the school district. The instruments are described in detail elsewhere (Guerin et al. 2018) and are summarized briefly below.

Knowledge A 20-item, multiple-choice knowledge test on workplace safety concepts was drawn from a previously developed, summative assessment (Guerin et al. 2016), and included questions related to fact-based and applied information contained within the *Talking Safety* curriculum. Cronbach's alpha (α) based on standardized items for the sample of students was 0.70 at pretest and 0.83 at posttest.

Attitude The attitude measure assessed the perceived importance of performing eight specific workplace safety skills, such as to identify hazards/risks on the job site (1 = *not important at all*; 5 = *extremely important*; $\alpha_{pre} = 0.87$ and $\alpha_{post} = 0.91$).

Subjective Norm The subjective norm items measured students' self-reported perceived importance of workplace safety to others, including friends and parents (1 = *not important at all*; 5 = *extremely important*; $\alpha_{pre} = 0.74$ and $\alpha_{post} = 0.73$).

Self-Efficacy The self-efficacy measure examined students' perceived confidence in their ability to successfully carry out eight specific workplace safety skills, such as to evaluate work hazards that could injure someone (1 = *not confident at all*; 5 = *extremely confident*; $\alpha_{pre} = 0.88$ and $\alpha_{post} = 0.92$).

Behavioral Intention The measure of behavioral intention (to enact workplace safety skills) assessed students' perceived likelihood to perform eight specific skills, such as to report problems to people in charge when the workplace is unsafe (1 = *not likely at all*; 5 = *extremely likely*; $\alpha_{pre} = 0.88$ and $\alpha_{post} = 0.91$).

Four demographic items were also included: sex (male or female), race (American Indian/Alaska Native, Asian, Black, Native Hawaiian or Other Pacific Islander, White), ethnicity (Hispanic or non-Hispanic), and ever had a paying job (yes or no). The percentage of students within each study school receiving FRL was used as an SES proxy variable (Nicholson et al. 2014). Finally, at posttest only, six items assessed students' recall of having received lesson content. These were used to establish convergent validity with teacher's self-reported fidelity of curriculum implementation.

Teacher Fidelity Measures Implementation fidelity was operationalized by assessing the amount of time dedicated to and the level of completeness of the *Talking Safety* lessons. Teachers delivered the curriculum to between one and six eighth-grade science classes, and they were asked to complete a fidelity checklist for each of those classes. Teachers were provided a stopwatch to record the number of minutes spent on each of the 19 steps within the four lessons. Teachers were also asked to provide their individual ratings of how much of each step was completed (0 = none, 1 = some, 2 = all). On average, teachers each submitted three fidelity checklists (131 total were completed). Other teacher variables collected were teacher years of experience (Ringwalt et al. 2003) in the profession (years teaching, < 5, 6–10, 11–15, 16–20, > 20) and with *Talking Safety* (years in the program, 1 or 2). Data related to teachers' education level (1 = Bachelor's; 2 = Master's; 3 = Specialist; 4 = Doctorate; 5 = Other) were also collected and analyzed.

Procedure

In 2014, officials from Miami-Dade County Public Schools adopted *Talking Safety* and implemented it in eighth-grade science, as part of the Human Growth and Development unit under the area *Personal Health and Safety in the Workplace.* This topic was also included in the district pacing guide for eighth-grade science, with *Talking Safety* suggested as the primary teaching resource. NIOSH researchers made a 1-h presentation to the middle school science chairs to familiarize them with the curriculum.

The district requested NIOSH to train teachers on the *Talking Safety* curriculum during scheduled professional development days. Department administrators recruited a total of 94 eighth-grade science teachers (approximately 25% of teachers in this subject/grade level), to participate in the 4-h sessions. Teachers who attended the trainings (64 during the spring of first year of the intervention, 2014–2015, described elsewhere [Guerin et al. 2018]; and 30 in spring of the 2015–2016 academic year) were eligible but not required to enroll in the second year of the NIOSH evaluation; 42 teachers agreed to participate in the second year of the study. Because *Talking Safety* was adopted at the district-level as part of the eighth-grade science pacing guide, all students in the classrooms of participating teachers received the curriculum.

The intervention took place over 2-to-3 weeks at the end of the 2015–2016 school year, with most of the teachers

delivering the *Talking Safety* curriculum and testing over six consecutive school days (pretest, four 55-min sessions, and posttest). Teachers in the study received instructions to follow strict adherence to the intended program design and self-reported their actual fidelity to each lesson using the provided checklists. Teacher participants received an incentive of $200 and a packet of teaching tools (dice, bingo chips, markers, and a stopwatch). Teachers collected the student data (using bubble sheets) and provided them to the M-DCPS administration for scanning. To allow for linking pretests with posttests, the school district generated unique identifiers tied to each student's M-DCPS identification number and only available to the school district administrators. The M-DCPS administration shared the de-identified student data, and the teachers provided their fidelity checklists with the research team for analyses.

Analyses

Missing Data Missing data in the final sample, the rate of which was largest for the race indicator (8.2%) and sex (6.4%), were addressed using multiple imputation with 1000 replications (Graham et al. 2007). Pretest data for each construct was included as a covariate for each of the corresponding posttest measures (a two-wave autoregressive approach; MacKinnon 2008).

Outcome Analyses Multilevel models were used to account for the nested data structure and to analyze student data on the *Talking Safety* questionnaires. Analyses were conducted in *Mplus* 8 and estimated with full maximum likelihood with robust standard errors and random intercepts for endogenous variables (Muthén and Muthén 2017). Design effects (all greater than three) were found for the posttest endogenous variables of knowledge (intraclass correlation [ICC] = 0.32), attitude (ICC = 0.19), subjective norm (ICC = 0.05), self-efficacy (ICC = 0.18), and behavioral intention (ICC = 0.17), indicating the need for a multilevel modeling approach (Lai and Kwok 2015).

Based on previous evidence with this population (Guerin et al. 2018), the student-level indirect effects of knowledge on intentions via attitude, self-efficacy, and subjective norm were assessed following recommendations by Preacher et al. (2010, 2011). Due to limited variability between schools and classrooms within schools, the percent of students receiving FRL was modeled at the highest level (i.e., the teacher level). Centering guidelines recommend by Enders and Tofighi (2007) were followed: pretest scores were group-mean centered; the covariates of sex, job status, and race (dummy coded) were left in their raw, dichotomous form; and teacher-level data were grand-mean centered. A fidelity score was created for each teacher by calculating the self-reported time in minutes spent on each step (19 total) of the four lessons of the modified curriculum multiplied by teachers' individual ratings of how much of the step was completed (0 = none, 1 = some, 2 = all). Scores were averaged across each teacher's classes, divided by 100, and then rescored (with a mean of 4.70, standard deviation = 1.81). Good model fit was evaluated using the chi-square (χ^2) statistic and the following benchmarks: root mean square error of approximation (RMSEA $\leq$ 0.06), standard root mean square residual (SRMR < 0.08), and comparative fit index (CFI $\geq$ 0.95; Hu and Bentler 1999). Figure 1 provides a graphical depiction of the final model.

Results

Student-Level Findings

After receiving *Talking Safety*, students had statistically significant increases ($p < .05$) in their scores on all outcome measures of workplace safety knowledge (34%), attitude (5%), subjective norm (7%), self-efficacy (7%), and behavioral intention (7%). Means for pretest and posttest scores (accounting for the nested data structure) are reported in Table 1.

Findings from the multilevel path analyses suggested an adequately fitting model: CFI = 0.972, RMSEA = 0.051, SRMR student-level = 0.047, SRMR teacher-level = 0.002, and overall $\chi^2(48) = 262.79$. Assessments of direct paths suggested that, after receiving the *Talking Safety* curriculum, gains in workplace safety and health attitude ($b = 0.25$, $p < .001$), subjective norm ($b = 0.07$, $p < .01$), and self-efficacy ($b = 0.55$, $p < .001$) were associated with gains in students' intention to engage in workplace safety behaviors. No statistically significant direct effects were found between gains in knowledge and behavioral intention ($b = 0.01$, $p = .097$). Significant indirect effects of knowledge on intention via attitude ($b = 0.01$, $p < .001$) and self-efficacy ($b = 0.03$, $p < .001$) were revealed, with no indirect effect of knowledge on intention via subjective norm detected ($b = 0.001$, $p = .102$).

Students who reported they ever had a paying job and those who self-identified as Hispanic or Latino had fewer gains in knowledge ($b = -0.43$, $p < .05$ and $b = -0.40$, $p < .05$, respectively). Students who reported being male showed fewer gains in subjective norm for workplace safety after the intervention ($b = -0.09$, $p < .001$). No other student variables were statistically significant.

Teacher-Level Findings

Teacher experience (years teaching) was positively associated with gains in students' attitude toward workplace safety and health ($b = 0.01$, $p < .05$), self-efficacy ($b = 0.02$, $p < .05$), and intention to engage in workplace safety behaviors ($b = 0.01$, $p < .05$), but not with gains in student knowledge. Teacher years in the study had no significant effects on student

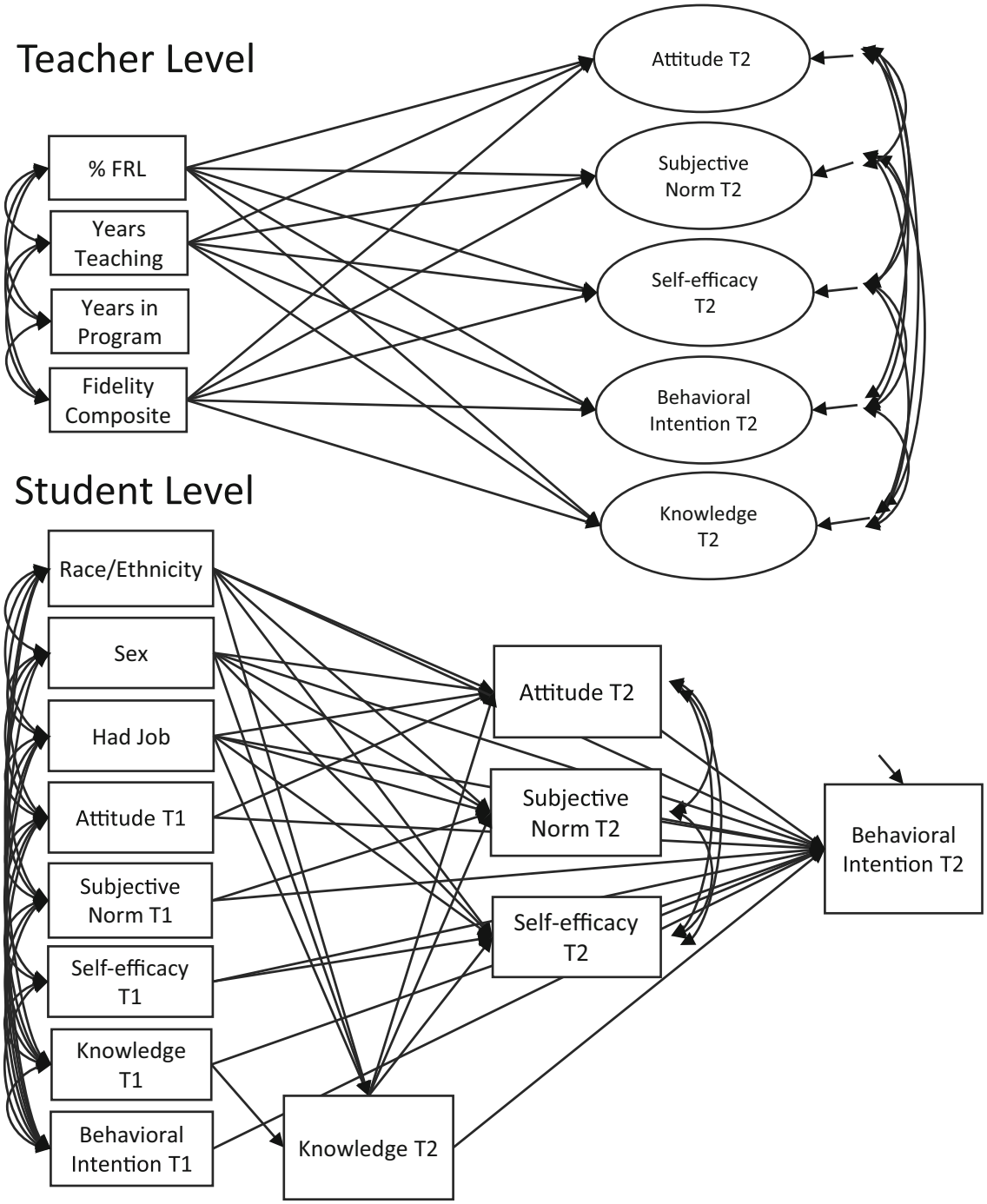

Fig. 1 A graphic representation of the multilevel estimation of student- and teacher-level predictors and outcomes. *Note.* FRL free and reduced-price lunch, T1 time 1 (pretest), T2 time 2 (posttest). Oval shapes represent random intercepts predicted by teacher-level variables. Curved, double-headed arrows represent estimated correlations; straight, single-headed arrows represent estimated associations; and short, single-headed arrows represent residual variability

outcomes. The percentage of students receiving FRL (assessed at the teacher-level) was positively associated with students' gains in subjective norm ($b = 0.25$, $p < .001$) but negatively associated with attitude ($b = -0.50$, $p < .05$), self-efficacy ($b = -0.46$, $p < .05$), behavioral intention ($b = -0.41$, $p < .05$), and gains in knowledge (approaching significance, $b = -2.79$, $p = .054$).

Fidelity of Implementation Linked to Student Outcomes

Higher levels of fidelity to the *Talking Safety* curriculum were associated with significant gains in all outcome measures: workplace safety knowledge ($b = 0.60$, $p < .001$), attitude ($b = 0.08$, $p < .01$), subjective norm ($b = 0.04$, $p < .001$), self-efficacy ($b = 0.07$, $p < .01$), and intention to engage in workplace safety behaviors ($b = 0.07$, $p < .01$). Bivariate

Table 1 Descriptive and reliability statistics for outcome variables of the modified theory of planned behavior model

	Pretest				Posttest				Change
			95% CI				95% CI		
Outcome variables	α	Mean	Lower	Upper	α	Mean	Lower	Upper	%
Knowledge	0.70	11.41	10.90	11.91	0.83	15.33	14.65	16.02	34%
Attitude	0.87	3.96	3.88	4.05	0.91	4.17	4.07	4.28	5%
Subjective Norm	0.74	2.36	2.32	2.39	0.73	2.52	2.48	2.56	7%
Self-efficacy	0.88	3.72	3.65	3.79	0.92	3.98	3.87	4.09	7%
Behavioral Intention	0.88	3.70	3.63	3.77	0.91	3.97	3.86	4.08	7%

α Cronbach's alpha (internal consistency reliability of the measure)

correlations appear in Table 2, and a complete representation of all associations in the multilevel path model is reported in Table 3. We tested but found no support for teacher fidelity and student outcomes being moderated by teacher experience (p values ranged from .246 to .497), and our final model excludes these interactions. Finally, we found a statistically significant correlation (overall) between teachers' reported fidelity of curriculum implementation and students' summed and averaged responses on the six, "What were you taught" questions at posttest ($r = .48$, $p < .001$), which provided evidence of convergent validity for the fidelity results.

Discussion

Eighth-grade students in Miami-Dade Public Schools who received instruction on the *Talking Safety* curriculum achieved statistically significant increases in workplace safety and health knowledge, attitude, norms, self-efficacy, and behavioral intention, a proximal predictor of health behavior change (Ajzen 1991), to engage in workplace safety actions. Previous research supports the premise that effective, school-based education may contribute to preventing work-related injuries among this vulnerable group (Boini et al. 2017) and that workplace safety education for adolescents is an important component of any occupational injury prevention strategy (Smith et al. 2018).

Although students demonstrated increases across all outcome measures as assessed using a modified theory of planned behavior model that included a knowledge construct, the results highlighted some important differences. Students with work experience scored lower on the knowledge measure at both pretest and posttest compared to students who had never worked. The finding that Hispanic/Latino students had fewer gains on knowledge and male students had fewer gains in subjective norm merits further examination to understand

Table 2 Bivariate correlations for a modified theory of planned behavior outcomes for the NIOSH Talking Safety curriculum intervention

		1	2	3	4	5	6	7	8	9	10
Student level											
1	Knowledge T1	–									
2	Attitude T1	0.42***	–								
3	Subjective norm T1	− 0.04	0.13***	–							
4	Self-efficacy T1	0.31***	0.22***	0.67***	–						
5	Behavioral intention T1	0.31***	0.22***	0.65***	0.75***	–					
6	Knowledge T2	0.44***	− 0.02	0.30***	0.23***	0.24***	–				
7	Attitude T2	0.25***	0.09***	0.50***	0.43***	0.42***	0.41***	–			
8	Subjective norm T2	0.04	0.41***	0.14***	0.18***	0.16***	0.05*	0.21***	–		
9	Self-efficacy T2	0.21***	0.11***	0.41***	0.48***	0.45***	0.35***	0.24***	0.72***	–	
10	Behavioral intention T2	0.21***	0.13***	0.40***	0.45***	0.46***	0.35***	0.25***	0.69***	0.79***	–
Teacher level											
1	Years teaching	–									
2	% FRL in 2013	− 0.13***	–								
3	Fidelity	− 0.03	−0.11*	–							

T1 time 1 (pretest), *T2* time 2 (posttest), *FRL* free and reduced-price lunch

*$p < .05$; **$p < .01$; ***$p < .001$

Table 3 Summary of a multilevel path model for modified theory of planned behavior outcomes for the NIOSH Talking Safety curriculum intervention

	Knowledge T2			Attitude T2			Subjective norm T2			Self-efficacy T2			Behavioral intention T2		
	b	*SE*	*p*	*b*	*SE*	*p*	*b*	*SE*	*p*	*b*	*SE*	*p*	*b*	*SE*	*p*
Job (0/1)	−0.43*	0.19	.022	0.00	0.04	.910	0.04	0.03	.103	0.01	0.05	.830	−0.03	0.03	.209
Male (0/1)	−0.24	0.16	.131	−0.03	0.03	.429	−0.09*	0.02	< .001	−0.01	0.03	.731	−0.05	0.03	.071
Black (0/1)	−0.33	0.26	.193	0.00	0.05	.940	−0.08	0.04	.055	0.01	0.05	.856	0.01	0.05	.831
AI/AN (0/1)	−0.69	0.44	.114	−0.05	0.09	.537	−0.02	0.05	.763	−0.02	0.08	.847	0.08	0.05	.081
Asian (0/1)	0.08	0.44	.866	0.07	0.07	.347	−0.08	0.06	.188	0.02	0.09	.803	−0.05	0.06	.399
Hawaiian/PI (0/1)	−0.36	0.34	.292	−0.12	0.08	.138	−0.08	0.06	.142	−0.01	0.07	.864	−0.04	0.05	.457
Hispanic/Latino (0/1)	−0.40*	0.20	.047	−0.03	0.05	.551	−0.05	0.03	.141	0.01	0.04	.912	0.00	0.04	.960
Knowledge T2				0.05*	0.01	< .001	0.02*	0.01	.021	0.06*	0.01	< .001	0.01	0.01	.097
Attitude T2													0.25*	0.03	< .001
Self-efficacy T2													0.55*	0.03	< .001
Subjective norm T2													0.07*	0.02	.003
Student level R^2	.19*	0.03	< .001	.28*	0.03	< .001	.172*	0.02	< .001	.17*	0.02	< .001	0.63*	0.02	< .001
Years teaching	0.04	0.04	.397	0.01*	0.01	.044	0.00	0.00	.252	0.02*	0.01	.012	0.01*	0.01	.031
Years in program	−0.89	0.67	.184	−0.14	0.11	.191	−0.02	0.04	.569	−0.13	0.11	.232	−0.14	0.11	.200
Fidelity[a]	0.60*	0.16	< .001	0.08*	0.03	.002	0.04*	0.01	< .001	0.07*	0.03	.008	0.07*	0.03	.007
% FRL in 2013[b]	−2.79	1.45	.054	−0.50*	0.19	.009	0.25*	0.07	< .001	−0.46*	0.20	.026	−0.41*	0.21	.050
Teacher level R^2	0.32*	0.14	.021	0.35*	0.14	.010	0.59*	0.18	.001	0.33*	0.13	.011	0.03*	0.13	.014

Association between T1 (time 1) scores and T2 (time 2) scores was estimated but not presented

AI/AN American Indian or Alaskan Native, *PI* Pacific Islander, *FRL* free and reduced-price lunch

*Statistically significant

[a] The fidelity score was divided by 100 to create a meaningful unit for analysis

[b] The school average percentage of students receiving free and reduced-price lunch, modeled at Level 2 (teacher level) due to a lack of variability at the school level

the differential outcomes of the intervention among diverse and potentially high-risk groups. Evidence suggests that adolescent males (compared to females) aged 15–17 experience higher rates of work-related injuries and fatalities, and Hispanics (versus non-Hispanics) in this age group have higher rates of work-related fatalities (Centers for Disease Control 2010). Students in schools with a high percentage of students receiving FRL demonstrated fewer gains across all outcomes, with the exception of workplace safety norms, compared to those students in schools with fewer students receiving FRL, perhaps indicating resource constraints (whether personal, organizational, or both) faced by students in high FRL schools. More work is needed to explore these disparities and to identify the unique needs of the most vulnerable youth populations and how best to tailor the curriculum materials to meet these needs.

Teacher-level findings indicate that more experienced instructors achieved better student scores across the study measures, when controlling for other factors. Prior research reports that years of experience is related to teacher self-efficacy and job satisfaction, which may have an indirect, positive impact on student engagement (Klassen and Chiu 2010) and by extension, on student outcomes. Previous experience delivering *Talking Safety* (in year one) had no significant effects on student scores.

Findings from the current study suggest that teachers who demonstrated higher levels of implementation fidelity of the *Talking Safety* curriculum had students who scored higher (on average) across all study measures. In other words, implementation fidelity made a consistent and meaningful contribution to students' success on intervention outcomes regardless of the teacher's experience level. These results are consistent with findings from a review of K–12 curriculum interventions conducted by O'Donnell (2008) that demonstrated statistically significantly higher outcomes when programs were implemented with greater fidelity. However, at equal levels of fidelity, the more experienced teachers were able to achieve better student outcomes. Analyses that considered years teaching as a moderator of fidelity did not suggest any significant relationships among the variables. Previous research (Rauscher et al. 2015) explored factors affecting teachers' implementation fidelity of a prior version of *Talking Safety*, but this investigation was retrospective and did not link fidelity to student outcomes, which is considered critical to the translation of evidence-based programs and curricula to sustained practice (Durlak and DuPre 2008; O'Donnell 2008).

Finally, the significant, indirect effects of knowledge on intention via attitude and self-efficacy is a finding that is consistent with prior research with this population (Guerin et al. 2018), providing support for the inclusion of knowledge in theory of planned behavior research with adolescents. The causal pathways between knowledge and behavior are not clearly understood (Rimal 2000), but knowledge may be an antecedent of behavior mediated by other variables (Kaiser and Fuhrer 2003), such as attitude and self-efficacy. More research is needed to explore these theoretical relationships, and to probe the null finding of the indirect effects of knowledge on intention via subjective norm.

Despite encouraging results, there are limitations. First, behavior change, the distal terminus of the theory of planned behavior, was not measured because of the young age of participants (~ 13 years old). While difficult to establish a direct link between school-based, workplace safety, and health programs and a reduction in injuries (Linker et al. 2005), there is "little doubt that some education or training is invariably better than none at all" (Smith et al. 2018, p. 193). Teaching young workers how to be safe on the job is, therefore, an essential component of any injury prevention strategy for young workers (Smith et al. 2018). The ability to achieve intermediate outcomes, such as changes in behavioral intention, should be considered as measures of success as it often takes years for changes in work-related morbidity and mortality resulting from occupational safety and health interventions to be in evidence (Downes et al. 2018). Moreover, numerous factors, such as increased enforcement of or changes to child labor regulations and enhanced outreach to employers, influence young worker injury trends, making it difficult to isolate the long-term effects of workplace safety and health education (Linker et al. 2005).

Another question is whether providing students in the eighth grade with workplace safety education (which was the decision of the school district) before most are formally integrated into the labor force is the appropriate strategy and whether these youth retain the knowledge and skills they learn to apply to later job situations. Given that behaviors are being established during early adolescence (Brener et al. 2013), prevention education, including in the area of workplace safety and health, should occur at this critical developmental phase. The competencies learned through the *Talking Safety* curriculum may be considered life skills that apply to other contexts in which risk-based decisions are made. Evidence suggests that even the youngest adolescents are transitioning into the labor force and work in informal employment situations, such as babysitting and mowing lawns, or for family-owned businesses (Zierold et al. 2004). Thus, there is need for these youth to gain workplace safety competencies earlier than expected. However, there are currently no known studies that assess long-term retention related to young worker education (Smith et al. 2018), and more research is needed in this area.

Due to time constraints and the young age of participants, only direct measures of the theory of planned behavior constructs were used (Montaño and Kasprzyk 2015). For the teacher fidelity measures, individual teacher observations were not feasible due to the vast size of the district (M-DCPS 2017). Self-report checklists are an acknowledged method for assessing implementation fidelity (Mowbray et al. 2003) and were therefore used in this study. However, to account for potential inconsistencies in the self-report data, convergent validity was established with the fidelity items on the student posttests, which were statistically significantly correlated with teachers' reported fidelity. Most importantly, fidelity was positively associated with student scores (Mowbray et al. 2003). This suggests that the intervention was responsible for the observed outcomes and that teachers should implement the *Talking Safety* program with fidelity to achieve the desired results.

The findings of this study may not be generalizable because roughly two-thirds of students in the sample self-identified as Hispanic, which may not reflect the demographics of other school districts. Additionally, although the non-experimental design limits generalizability and casual inferences, the research team took steps to minimize validity threats. Maturation was addressed by having teachers deliver the intervention to students within a 2-to-3-week timeframe when no other safety or health materials were being taught. Testing effects were examined by identifying participants who had received a low dose of the intervention and assessing their outcomes from pretest to posttest. No significant changes were detected for this low-fidelity group, which would not have been the case had a testing effect been present. Subsequent data collection in 2017 involved parallel test forms.

A condensed format of the full, six-lesson version of *Talking Safety* was designed for this study—a multisite, randomized controlled trial is being conducted in a large, urban, school district in the central USA to evaluate the full curriculum. In addition, the high degree of local control by school districts when implementing new curricula suggests that lessons learned from this research may not be generalizable to all US school districts, or internationally. That said, encouraging efforts are underway in southern Brazil to adapt the *Talking Safety* for delivery in schools.

Due to privacy concerns, information on student participants' employment arrangements could not be collected. Finally, although SES is an important predictor of adolescent health outcomes, including in workplace safety and health (Rauscher and Myers 2008), it was not possible to collect this variable at the individual, student level. Despite well-documented challenges (Domina et al. 2017; Nicholson et al. 2014), school-level measures of FRL may provide important clues as to the resource constraints faced by students (Flay et al. 2001). More research is needed to investigate how economic disparities and job status affect program outcomes.

Implications for Prevention Science

Work, a defining feature of adolescence in the USA, has benefits. Work also has serious risks, as adolescents experience a higher rate of largely preventable job-related injuries compared with adults. *Talking Safety*, a free curriculum from NIOSH, is a tool that school districts may adopt to provide teens with essential workplace safety and health education. Teaching young workers how to be safe on the job is an essential component of any occupational injury prevention strategy (Smith et al. 2018). The present study provides empirical support for the effectiveness of a foundational workplace safety and health curriculum, *Talking Safety*, to change adolescents' workplace safety and health knowledge, attitude, norms, self-efficacy, and behavioral intention to engage in workplace safety actions. Behavioral intention is a proximal predictor of behavior change under the theory of planned behavior (Ajzen 1991), which was used to evaluate the intervention. The current study also contributes to prevention and implementation science by providing evidence that teacher implementation fidelity made a consistent and meaningful contribution to students' success on intervention outcomes. Building a robust evidence-base for the NIOSH *Talking Safety* program, through this research and future efforts, may ensure that, 1 day, all young people are equipped with knowledge and skills to prepare them for a lifetime of safe and healthy at work—a critical public health challenge.

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Compliance with Ethical Standards

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

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent The NIOSH Institutional Review Board (IRB) waived the documentation of informed consent because the project occurred within a regularly established educational setting, used a publically available curriculum adopted by the school district as part of established and ongoing classroom studies, presented no risk of harm to participants, and involved no procedures for which written consent is normally required outside of the research context.

Disclaimer The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health. This manuscript's data will not be deposited.

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