


EMPIRICAL ARTICLE

Applying the PROSPER prevention delivery system with middle schools: Emerging adulthood effects on substance misuse and conduct problem behaviors through 14 years past baseline

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Abstract

This study evaluated emerging adult effects of the PROMoting School-Community-University Partnerships to Enhance Resilience (PROSPER) universal prevention delivery system implemented in middle schools. Twenty-eight rural school districts were randomized to intervention and control conditions, with 1985 nineteen-year-old participants (90.6% White, 54.1% female) evaluated through age 25. Intent-to-treat, multi-level, point-in-time analyses of covariance and growth analyses were conducted. Outcomes were assessed with self-report measures of substance misuse (lifetime, current, frequency) and conduct problem behaviors. Analyses showed very limited point-in-time effects; there were growth pattern effects on measures of illicit drugs, non-prescribed drugs, cigarettes, and drug problems. When risk moderation was observed, it favored higher-risk participants. These emerging adult effects concerning slower growth of lifetime misuse combine with more robust adolescent stage findings to support PROSPER's public health value.

INTRODUCTION

Current epidemiological data show that substance misuse and other health-risking behaviors are prevalent in emerging adulthood. For example, in 2018, the U.S. annual prevalence estimate for any illicit drug use was highest among emerging adults ages 19–28 (42.8%, see Schulenberg et al., 2019). Further, misuse of prescription drugs was highest among emerging adults ages 18–25, with 14.4% reporting nonmedical use in the past year (National Institute on Drug Abuse [NIDA], 2020a).

Illicit drug use has been trending higher for emerging adults (ages 19–28) since 2010, although alcohol and cigarette use has trended slightly downward (Schulenberg et al., 2019). However, with high annual prevalence rates for alcohol use (82%) and drunkenness (63%), emerging adult substance misuse still produces significant public health consequences (Schulenberg et al., 2019).

Developmental studies have established a reciprocal, longitudinal relation between substance misuse and conduct problem behaviors in adolescents and young adults. Adolescents who display high rates of conduct problem

Abbreviations: CES, Cooperative Extension System; CTC, Communities That Care; ICC, intra-class correlation; LST, LifeSkills Training; PC, Prevention Coordinator; PROSPER, PROMoting School-Community-University Partnerships to Enhance Resilience; RRR, relative reduction rate; SFP 10-14, Strengthening Families Program: For Parents and Youth 10-14.

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[Correction added on May 13, 2022, after first online publication: IOWA funding statement has been added.]

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behaviors are particularly at risk for later substance misuse, and vice versa (McAdams et al., 2014; Sullivan & Hamilton, 2007). Despite the overall decline in conduct problem behaviors across adolescence, there is significant persistence with comorbid substance misuse (Assink et al., 2015). Importantly, studies have found that 25% of female and 46% of male adolescent offenders persist into adulthood (Cauffman et al., 2017). Costs associated with offending are high. Although the precise costs of offending to the public in general, and to crime victims in particular, are difficult to measure, estimates range between 2% and 6% of annual GDP in the United States, or between \$310 billion and \$1 trillion (Chalfin, 2016).

Even beyond those associated with crime, the financial and human costs of substance misuse and related problem behaviors are substantial. Alcohol misuse is associated with multiple disease and injury conditions (Rehm & Imtiaz, 2016). Misuse of prescription drugs can lead to addiction, overdose, withdrawal symptoms, confusion, mood swings, memory problems, sleep problems, and social and work-related difficulties (Mayo Clinic, 2020; NIDA, 2020a). Socially, emerging adults who exhibit substance misuse may not transition into positive adult roles and are at risk for interpersonal difficulties, school dropout, early parenthood, and employment difficulties (Sussman, 2013). The financial costs of tobacco, alcohol, and illicit drug use are estimated at over \$740 billion annually (NIDA, 2020b). These enormous human and economic costs justify greater investment in evidence-based prevention approaches (U.S. Department of Health & Human Services [HHS], Office of the Surgeon General, 2016).

Malleable risk and protective factors originating in both family and school environments play a significant role in the development of substance misuse and other problem behaviors (Ennett et al., 2008; National Academies of Sciences, Engineering, and Medicine (NASEM), 2019). For that reason, universal preventive interventions implemented during early adolescence focus on building protective factors in family, school, and peer environments. Protective factors include family relationship quality, monitoring, parent-child warmth and affection, positive peer relationships distinguished by trust and affection, and school engagement (Murray & Farrington, 2010; Stone et al., 2012). Rigorous research has identified a number of effective preventive interventions designed to influence family-, school-, and peer-related risk and protective factors (U.S. Department of Health & Human Services [HHS], Office of the Surgeon General, 2016). The literature emphasizes the importance of providing preventive interventions in school and family environments during the developmental window when adolescents are beginning to use substances and conduct problem behaviors are escalating (Catalano & Kellogg, 2020; Das et al., 2016; McGorry et al., 2011; Spoth, Gyll, et al., 2009).

A small but growing number of studies has examined the long-term impacts of such programs, with some

following their participants into emerging adulthood (Botvin & Griffin, 2014; Kellam et al., 2014; Oesterle et al., 2018; Poduska et al., 2008; Riggs et al., 2009; Spoth, Trudeau, et al., 2009, 2013; Spoth et al., 2014, 2017). These studies suggest that interventions targeting multiple risk and protective factors involving substance misuse also impact additional emerging adult problem behaviors, despite a lack of explicit intervention focus on these outcomes. For example, several studies of substance misuse preventive interventions have shown positive impacts on conduct problem behaviors (Kellam et al., 2014; Oesterle et al., 2015; Trudeau et al., 2012).

A small number of these studies entail community-based delivery of universal interventions, including the PROSPER study presented in this report. PROSPER utilizes the Cooperative Extension System (CES), the outreach arm of the land grant university system, to oversee community teams that deliver school-based and family-focused interventions targeting middle school students. The PROSPER delivery system consists of: (1) local teams of community stakeholders led by local CES staff and linked with public schools; (2) Prevention Coordinators (PCs) who provide technical assistance to teams; and (3) university researchers and CES faculty who support the initiative within their institutions. PCs serve as liaisons between the community and university teams, providing ongoing, proactive technical assistance to community teams to optimize team functioning and program delivery. The local PROSPER teams selected the family-focused and school-based programs from a menu of three evidence-based universal prevention programs. Teams were responsible for all aspects of program implementation and oversight, including communicating with participants, scheduling, managing logistics for the family-focused program (e.g., meals, on-site childcare, materials preparation), and training and supervision of intervention facilitators. The school-based and family-focused interventions target the two primary socializing environments associated with multiple risk and protective factors. This community-based approach led to high levels of implementation quality (Spoth, Gyll, et al., 2007).

A systematic review of the literature (Flanagan et al., 2018) identified two "Tier 1" comprehensive community initiatives with long-term positive outcomes, namely, Communities That Care (CTC; see Oesterle et al., 2018) and PROSPER. Both of these have been characterized as delivery systems for evidence-based preventive interventions, although they differ in the types of evidence-based interventions implemented and the targeted populations. PROSPER focuses exclusively on universal interventions with young adolescents and their families, whereas CTC delivers a broader range of interventions targeting a wider range of populations. Importantly, both have been tested through longitudinal randomized controlled trials and report follow-up assessments through the emerging adult stage. Both

also examine a combination of incidence (lifetime substance use) and prevalence (current or recent use) outcome measures. Reports of CTC emerging adult outcomes (Kuklinski et al., 2021; Oesterle et al., 2018) underscore the importance of addressing sustained effects of community-based prevention delivery systems.

Feasibility and effectiveness of PROSPER throughout middle and high school has been documented in earlier reports. Findings demonstrated effective participant recruitment (Spoth, Clair, et al., 2007), maintenance of high-quality implementation (Spoth, Gyll, et al., 2007), and sustainability of intervention delivery (Welsh et al., 2016). Analyses of program impact have shown significant effects on a range of outcomes including parenting and family functioning (e.g., general child management, parent-child affective quality), youth skills and competencies (e.g., problem solving, assertiveness, perceived substance use norms; see Redmond et al., 2009), and peer networks (Osgood et al., 2013). In addition, findings indicated lower levels of substance misuse for the intervention group, relative to controls (e.g., past month, past year, and growth trajectory slopes), especially for more serious illicit misuse (e.g., marijuana, methamphetamine, prescription drug misuse), at both 4.5 (grade 10) and 6.5 years (grade 12) past baseline (Spoth, Redmond, et al., 2013; Spoth et al., 2011). Further, risk-related moderation analyses showed greater intervention effects for higher-risk youth, or those who reported having several risk factors on the baseline survey (fall of grade 6), including the initiation of one or more of three substances (alcohol, tobacco or marijuana, see Spoth, Redmond, et al., 2013). Finally, interventions positively impacted conduct problem behaviors through grade 12, despite a lack of specific programmatic focus on those behaviors (Spoth et al., 2015).

Prior intervention research has identified three potential patterns of long-term intervention effects: sustained effects, which are consistently maintained over time; fade-out effects, which diminish over time; and sleeper effects, which initially are small or non-detectable, but emerge or strengthen over time (Van Aar et al., 2017). The longitudinal findings described earlier show both sustained and sleeper effects on multiple outcomes; these results indicate the value of longitudinal follow-up for interventions implemented during young adolescence.

That same body of research highlights the importance of examining risk-related moderation of effects, which has consistently occurred with PROSPER at all data points. These analyses assessed the impact of the PROSPER interventions in the presence of both malleable (e.g., parent-child relationship quality) and non-malleable risk factors (socio-demographic factors). Of special interest has been examination of “compensatory effects,” or those that suggest greater intervention benefit for higher-risk participants. Along with randomized trials in the mental health literature demonstrating these

effects (Emsley et al., 2010), previous research on the programs implemented in the current study frequently have either shown that benefits were universal across higher- and lower-risk subgroups, or that there were compensatory intervention effects favoring the higher-risk group (Spoth, Redmond, et al., 2013; Spoth et al., 2011).

To date, one report examined the effects of PROSPER after high school, at age 19 (Spoth et al., 2017). Intervention participants continued to show lower levels of substance misuse across a range of outcomes, including lifetime use of illicit drugs (marijuana, cocaine, ecstasy, methamphetamine, LSD, non-prescription narcotics), prescription drug misuse, cigarette use, and an index of drug-related problems. However, no significant effects emerged for measures of current substance use and there were no effects on the use of alcohol. Risk moderation analyses showed a trend suggesting larger effects for higher-risk participants but moderation effects were statistically significant in only one instance (i.e., drug-related problems). Although effects for conduct problem behaviors were significant in high school, there were no significant intervention effects at age 19.

Based on the previous PROSPER findings, we hypothesized that effects on substance misuse, associated conduct problem behaviors, and their negative consequences would be observed during participants’ mid-twenties, up to 14 years past baseline. We took a confirmatory approach to addressing questions focusing on different aspects of long-term outcomes, as described in the primary research aims of the grant proposal funding this study. The first question concerned whether long-term outcomes would be observed at each of two time points in emerging adulthood, at age 23 and at age 25, that had not been previously assessed. The second question was whether differences in emerging adult stage outcome growth trajectories would be observed, using data collected at all three emerging adult time points (ages 19, 23, and 25), to better assess intervention-control differences in intraindividual change over the emerging adult period. The third question concerned whether there would be growth differences across developmental stages through the emerging adulthood end point, including the two prior stages in the study period (young adolescence, adolescence). Finally, as discussed above and also described in the secondary aim of the funded study proposal, we examined risk-related moderation of all point-in-time and growth effects. To address these questions, we first applied multi-level modeling to assess both main intervention effects and risk-related moderation of point-in-time effects at ages 23 and 25. Second, we examined growth patterns and risk-related modification across young adulthood, from age 19 through 25. Third, for measures available across all waves of data collection (10 waves from pretest to age 25), we examined longitudinal growth and growth moderation effects across all stages.

METHOD

Site selection and assignment

The PROSPER study involved 28 rural community school districts from Iowa and Pennsylvania (14 in each state). Eligibility criteria entailed school district enrollment of 1300 to 5200 students, local CES and school district agreement to random assignment, and a willingness and capacity to support PROSPER implementation if assigned to the intervention condition. Following their recruitment and enrollment, the 28 school districts were blocked (matched) on size and geographic location, randomized to experimental condition (intervention or control), and then informed of their condition assignment. Participating universities' Institutional Review Boards approved study procedures. Additional details related to recruitment procedures are available in Spoth, Clair, et al. (2007).

Sample and data collection

The study began with two successive cohorts of sixth graders. Figure 1 summarizes sample tracking across waves of data collection. All enrolled sixth graders from the two cohorts were recruited for participation and 90% of the eligible sample provided baseline data. Consistent with the characteristics of rural Iowa and Pennsylvania communities in 2002, most students were White (85%), 51% were female, 64% lived with both biological parents, and 31% received free or reduced-cost school lunches. The average age of participants was 11.8 years in the fall of sixth grade and 24.6 years at the last wave of data collection.

From the 6th through the 12th grades, data were collected via machine-scored written questionnaires administered in students' classrooms. Pretest assessments were conducted in the fall of 2002 (for Cohort 1) and 2003 (for Cohort 2). Beginning in the spring of 6th grade, follow-up assessments were conducted annually through the 12th grade (from 0.5 to 6.5 years past baseline). On average, 88% of all eligible students completed questionnaires across the eight in-school survey waves, with slightly higher rates of participation in earlier waves.

Because of the high cost of following the entire sample into adulthood, a randomly selected and stratified subsample was recruited for continued follow-up beyond 12th grade, with the intention of recruiting approximately 2000 participants. Students who were still enrolled in the same school district in the ninth grade were eligible for participation in the emerging adult follow-up assessments. Selection for the emerging adult follow-up was stratified by school district, gender, and risk status. Risk status was based on five dichotomous factors reported by participants at baseline: lifetime gateway substance use (use of alcohol, cigarettes, or marijuana);

conduct problem behaviors (at least 2 of 12 possible behaviors during the past year); eligibility for the free and reduced cost school lunch program; lower family cohesion (dichotomized); and living with one or no biological parents (vs. two biological parents). Students were classified as being at higher risk if they reported (a) any three or more of the five risk factors or (b) two risk factors, if gateway substance use or conduct problems were among the two. To enhance statistical power to investigate risk-related moderation effects in multilevel models (see Montgomery, 2020), higher-risk participants were oversampled and comprised 37.4% of the participating subsample, versus 29.2% of the eligible sample. At age 23, 1628 (82.0%) of this emerging adult subsample participated in the study, and at age 25, 1595 (80.4%) participated. Details of sample participation at different points in the study are provided in Figure 1. Randomly selected, stratified subsamples were selected in the two participating states and prospective participants were sent an invitation to continue with the study, until 1985 of those who agreed completed the survey. At age 19, participants were 90.6% White and 54.1% female. At ages 23 and 25, as was the case at age 19, participants completed assessments through a computer-assisted telephone interview or a web-based survey (9% and 91%, respectively, at age 23, and 6% and 94% at age 25).

PROSPER partnership delivery system

In the intervention communities, local stakeholder teams of 8–12 individuals were formed, consisting of the local CES-based team leader, a public-school co-leader, representatives of local human service agencies (e.g., mental health, substance abuse), and parent and youth representatives. Teams selected a sequence of two interventions from a menu of evidence-based programs, beginning with a family-focused intervention for sixth graders and their parents, followed by a school-based intervention implemented for the same cohort in seventh grade. Communities administered these programs for two successive cohorts of students. For their family-focused intervention, all 14 teams selected the *Strengthening Families Program: For Parents and Youth 10–14* (SFP 10–14). For their school-based intervention, four teams selected *LifeSkills Training (LST)*, four selected *Project Alert*, and six selected *All Stars* curriculum. (For a detailed description of the content of these programs, see Spoth, Redmond, et al., 2007; an appendix with descriptive detail is available upon request from the authors.)

Across the two cohorts of families of sixth graders, there were 142 SFP 10–14 program groups offered in the 14 communities. The school-based program was implemented with Cohort 1 seventh grade students in the second year and with the Cohort 2 seventh grade students the following year. Each school-based program

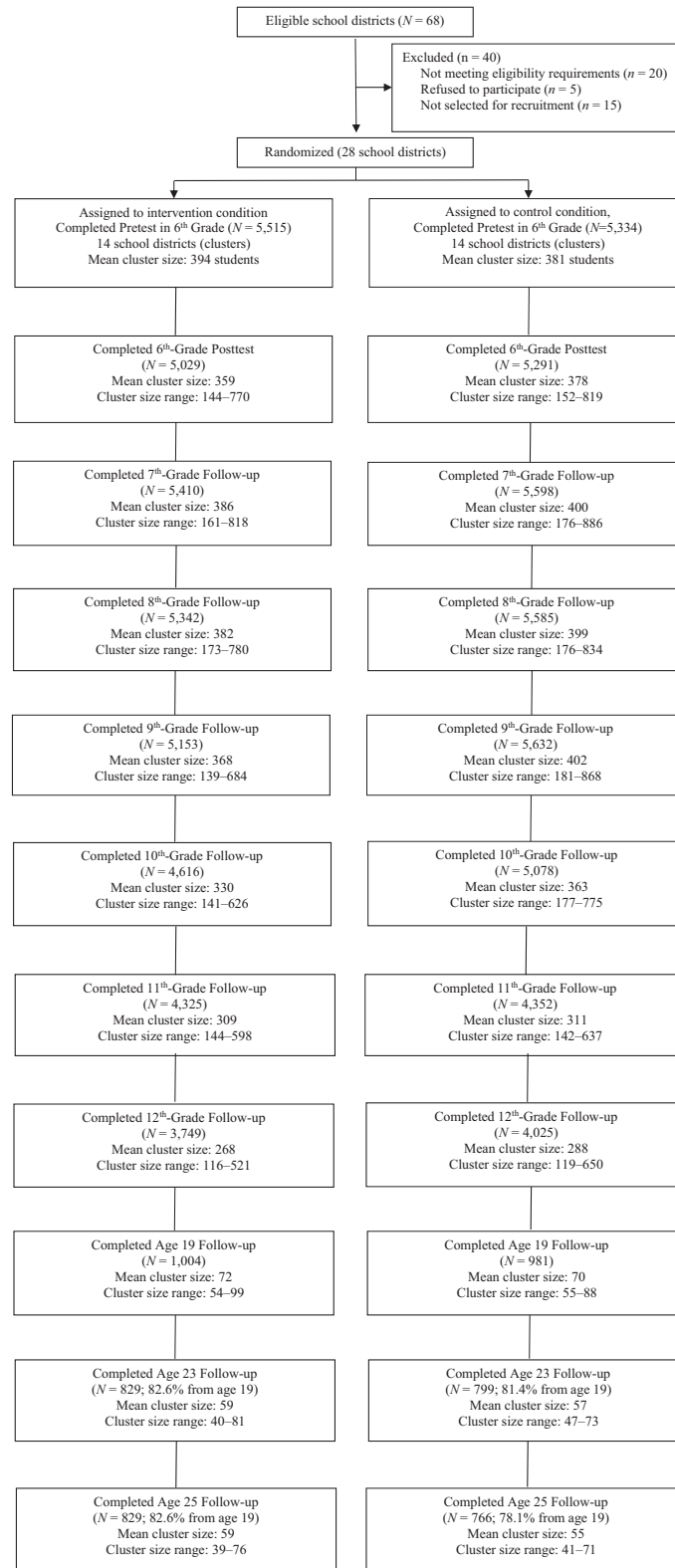


FIGURE 1 In-school survey and young adult follow-up assessment: Total participation by wave. *Note:* Reported participation rates include *all students* in both study cohorts completing the in-school survey at the indicated wave. All students enrolled in the project school districts and in the targeted grades were eligible for participation, regardless of their participation in earlier survey waves; as a result, participation at later waves may exceed participation at pretest. Young adult assessments were conducted with randomly selected participants from the in-school assessment sample that completed Sixth-grade pretest assessments and were still enrolled in their baseline school district in the ninth grade. 1985 young adults completed their survey at age 19—1628 (82.0%) and 1595 (80.4%) of those completed the surveys at ages 23 and 25, respectively. The numbers by the intervention condition are included in the figure above

was delivered in a class normally taken by all seventh grade students, generally by a trained classroom teacher (Spoth, Gyll, et al., 2007).

Measures

Outcomes evaluated at ages 23 and 25 were selected to (a) provide for continuity with prior outcome reports (age 19 and earlier, as indicated), and (b) encompass developmentally relevant young adult problem behaviors. Measures included self-reported substance use and misuse and conduct problem behaviors. Substance use and misuse outcomes include lifetime use of illicit or non-prescribed drugs, drug- and alcohol-related problems, along with current use and frequency of use of more commonly used substances. Substance-related questions were adapted from *Monitoring the Future* items (Johnston et al., 2015); items assessing conduct problem behaviors were adapted from Elliott and colleagues (Elliott et al., 1985). Multi-item measures are count indices designed to assess cumulative numbers of risk behaviors or negative outcomes; as such, alpha reliabilities are not reported.

Lifetime substance use and misuse and substance-related problems

Lifetime substance use and misuse measures included more than a sip of alcohol, drunkenness, use of electronic or e-cigarettes, marijuana, ecstasy, cocaine, methamphetamine, LSD, non-prescribed narcotics, and amphetamines, scored as any use (1) versus no use (0). The Illicit Substance Use Index includes lifetime use of five illegal substances (dichotomized and summed, including methamphetamines, ecstasy, LSD or other hallucinogens, cocaine, and GHB or Rohypnol). The Non-prescribed Drug Index measured "overall" prescription drug misuse and included three items, dichotomized and summed, addressing lifetime non-prescribed use of narcotics (i.e., Vicodin, Oxycontin, Percocet), amphetamines, and barbiturates.

Current use and frequency

More commonly used substances were measured with a current, 1-month time frame; a 1-year time frame was applied for those substances less frequently used. These dichotomous measures indicated past-month drunkenness, past-month cigarette/e-cigarette use, past-month and past-year marijuana use, past-year LSD (or other hallucinogen) use, past-year use of non-prescribed narcotics, and past-year methamphetamine use. Past-year frequency of substance use was assessed for drinking, drunkenness, cigarette use, marijuana use, and non-prescribed narcotic use. Measures of frequencies of

past-year use were truncated at 150 times in the past year to prevent undue influence of outliers.

Drug- and alcohol-related problems

Indices were constructed to assess consequences resulting from alcohol and drug use. Each index consisted of five dichotomous items adapted from the Short Inventory of Problems: Alcohol and Drugs (Blanchard et al., 2013). We adapted the measure by constructing indices to assess drug- and alcohol-related problems separately. Examples include: "You have failed to do what's expected of you because of your [drug/alcohol] use," and "You have had money problems because of your [drug and alcohol] use." We also measured past-year drinking and driving, as well as past-year frequency of drinking and driving as indications of substance-related problem behaviors.

Conduct Problem Behaviors Index

A count of conduct problem behaviors adapted from Elliott et al. (1985) was constructed using 13 dichotomously scored self-report items concerning past-year behaviors (behavior present vs. absent). These included both violent and non-violent illegal acts. Example behaviors include: "Steal money or take something that did not belong to you," "Beat up or fight with someone because you were mad at them," "Drive a car recklessly," and "Sell stolen goods."

Analyses

As summarized in the introduction, to evaluate the differences between intervention and control conditions, three types of analyses were conducted: point-in-time, growth specific to the emerging adult stage, and patterns of growth across all 10 waves of the project. First, to assess point-in-time effects, multi-level analyses of covariance were conducted to test for intervention effects on outcomes at ages 23 and 25. State, Block (school district size and location), Treatment condition, and Cohort were included as design factors in the models to accommodate this study's cluster-randomized design and address relevant variance components across model levels. Also, as a post-hoc factor, risk status (higher vs. lower) was included in the models. We utilized full information procedures at each time point. An intent-to-treat approach was applied for all analyses and two-tailed *p*-values are reported.

Although multilevel analyses were considered the primary analyses (consistent with the original experimental design), supplemental analyses at the individual-level were considered important for a fuller understanding

and interpretation of the pattern of findings, for three reasons. The first concerned cell size issues. Utilizing the design factors of Block (school district size), Cohort, Treatment Condition, and Risk-level in multi-level analyses, the average cell size of the analytic units was 15 for main effects analyses. For risk-related subgroup analyses, however, the higher-risk group had an average 6–7 cases (in fact, the smallest cell size of the higher-risk group was 2 because roughly 30% of sample was classified as a higher-risk group). The second reason is that intra-class correlations (ICCs) were smaller after high school; only 17% of all outcomes had ICCs larger than 0.01, about 20% were 0, and rarely were they above 0.02. Finally, almost 60% of the participating young adults moved from their original communities (603 out of 1023), exposing them to factors outside of their original community that could influence their health-risking behaviors (e.g., college and community environments). Thus, the individual-level analyses were considered useful as a point of comparison.

For all analysis of covariance models, potentially confounding variables and pre-test measures of the outcome were included in the model as covariates. Also, logarithmic transformations of past-year frequency outcomes also were analyzed but produced a very similar pattern of findings.

Concerning planned growth analyses, for emerging adults (age 19, 23, and 25), with its limited number of waves of data, a multi-level model with five factors was viable. It applied the UN (completely free) option of SAS for estimating the error structure from three repeated measurements. This analytic modeling entailed evaluation of both substance use and misuse growth patterns across the emerging adult developmental stages, from age 19 through 25.

Third, we examined overall patterns in trends of substance use and misuse starting at baseline (grade 6) and extending through the emerging adult stage (using the limited subset of substance misuse measures available across all 10 waves, 14 years past baseline). To allow us to examine all 10 waves we used school-based aggregated scores without any random effects other than the repeated occasions. This follows procedures for modeling in earlier reports that applied complex nested design modeling incorporating numerous waves of data to achieve viable run times and convergence in model testing. For estimating the error structure from 10 repeated measurements, the ARH (1) option of SAS was used. Also, the Kenward-Roger method was applied to approximate the degrees of freedom in testing all effects to adjust the degrees of freedom with repeated (correlated) measurements over time.

Binary outcomes were analyzed using SAS PROC GLIMMIX; other outcomes were analyzed using SAS PROC MIXED. The CONTRAST statements in SAS were applied to test all effects in the model such as the overall main effect of the intervention, risk-related moderation

effect of the treatment condition, the intervention effect on particular time point, and so on. The LSMEANS statements in SAS also were used to obtain the estimated values of all effects. Finally, as noted, risk-related moderation analyses were conducted to evaluate whether intervention effects for higher-risk youth were comparable to or stronger than effects for lower risk youth, as has been found in earlier analyses of PROSPER data.

Model-based relative reduction rates (RRRs) were calculated for binary outcomes to illustrate the practical significance of findings; they indicate the proportional reduction in behaviors in the intervention group relative to controls; that is, how much lower the estimated prevalence of a behavior is in the intervention group, expressed as a percentage of the control group prevalence (e.g., if the estimated prevalence in the intervention and control groups were 40% and 50%, the RRR for the intervention would be 20%; that is, $[50\% - 40\%] \div 50\% = 20\%$).

RESULTS

Sample quality

As with all previous assessment waves, pretest equivalence of the two conditions was assessed at ages 23 and 25. There were no significant differences on any sociodemographic measure (e.g., gender, age, race, school lunch status) or on any reported outcomes. Differential attrition threats at age 23 and 25 were assessed by examining whether the two-way interaction of Condition \times Outcome pretest scores predicted participation at age 23 and 25, respectively. No significant interactions were found.

Point-in-time effects at age 23 and 25

Multi-level models (see Tables 1 and 2) showed significant main effects indicating lower levels of lifetime substance misuse in the intervention group for methamphetamines, non-prescribed narcotics, and the Illicit Substance Use Index, at both ages 23 and 25, with LSD (or other hallucinogens) significant only at age 25. Ecstasy misuse showed a non-significant trend (0.1 level) at both time points. There were mostly null findings for current substance use and frequency of substance use, as well as the conduct problem behavior index. There were no effects on any measures of alcohol use. Exceptions to non-significant results for current use included a significant main effect for frequency of past-year cigarettes at age 23 and non-prescribed narcotics use at age 25. Finally, the Drug-related Problems Index was significant at age 23, but not at age 25. RRRs for significant binary outcomes ranged from 24.9% up to 36.8% (lifetime methamphetamines use) across ages 23 and 25.

It is noteworthy that the supplemental analyses (see Tables S1 and S2) with individual-level outcome models

TABLE 1 Point-in-time intervention-control differences for young adult outcomes: Multi-level modeling at age 23

Outcome	Intervention main effect			RRR %
	Control (SE)	Intervention (SE)	$F_{(1,12)}$ (p-value)	
Lifetime user				
Drink alcohol (more than a sip)	0.983 (0.007)	0.966 (0.009)	2.22 (.141)	1.7
Drunkenness	0.939 (0.012)	0.927 (0.012)	0.53 (.468)	1.3
E-cigarettes	0.302 (0.029)	0.313 (0.029)	0.14 (.715)	-3.6
Marijuana	0.675 (0.026)	0.689 (0.026)	0.17 (.683)	-2.1
Ecstasy	0.213 (0.019)	0.168 (0.017)	3.12 (.089) ⁺	21.1
Cocaine	0.243 (0.054)	0.195 (0.047)	3.46 (.073) ⁺	19.8
Methamphetamine	0.107 (0.014)	0.068 (0.010)	5.35 (.024)*	36.4
LSD (or other hallucinogens)	0.165 (0.028)	0.127 (0.024)	2.61 (.118)	23.0
Non-prescribed narcotics	0.336 (0.026)	0.246 (0.023)	6.70 (.015)*	26.8
Non-prescribed amphetamines	0.239 (0.055)	0.248 (0.057)	0.07 (.793)	-3.8
Illicit Substance Use Index	1.158 (0.149)	0.948 (0.151)	12.34 (.001)**	n/a
Non-Prescribed Drug Index	0.853 (0.117)	0.751 (0.118)	2.82 (.104)	n/a
Current substance use				
Past month drunkenness	0.573 (0.056)	0.584 (0.055)	0.15 (.698)	-1.9
Past month cigarette use	0.342 (0.029)	0.327 (0.028)	0.28 (.599)	4.4
Past month E-cigarette use	0.110 (0.018)	0.111 (0.017)	0.01 (.939)	-0.9
Past month marijuana use	0.121 (0.044)	0.133 (0.047)	0.31 (.585)	-9.9
Past year marijuana use	0.248 (0.060)	0.257 (0.063)	0.10 (.754)	-3.6
Past year LSD (other hallucinogens)	0.035 (0.012)	0.044 (0.015)	0.71 (.407)	-25.7
Past year narcotics	0.054 (0.009)	0.053 (0.009)	0.02 (.901)	1.9
Past year methamphetamines	0.029 (0.015)	0.014 (0.009)	1.20 (.274)	51.7
Frequency of substance use				
Past year drinking (more than a sip)	4.22 (2.78)	39.86 (2.76)	0.01 (.926)	n/a
Past year drunkenness	12.17 (3.00)	14.54 (2.94)	2.34 (.133)	n/a
Past year cigarette use	2.22 (0.072)	2.07 (0.072)	5.66 (.018)*	n/a
Past year E-cigarette use	1.47 (0.046)	1.48 (0.046)	0.14 (.711)	n/a
Past year marijuana use	1.62 (5.07)	7.26 (5.13)	2.15 (.149)	n/a
Past year non-prescribed narcotics	1.12 (0.438)	1.01 (0.435)	0.05 (.822)	n/a
Drug/alcohol-related problems				
Drug-related problems	0.466 (0.109)	0.378 (0.110)	4.51 (.034)*	n/a
Alcohol-related problems	1.060 (0.132)	1.051 (0.133)	0.02 (.902)	n/a
Past year drinking and driving (current)	0.300 (0.047)	0.306 (0.047)	0.06 (.805)	-2.0
Past year drinking and driving (frequency)	1.32 (0.67)	1.43 (0.67)	0.08 (.783)	n/a
Conduct Problem Behaviors Index	0.211 (0.018)	0.213 (0.017)	0.01 (.921)	-0.9

Note: LS means are model-based means. Analytic models initially included Block (school district size and location), State, Intervention Condition, and Cohort as design factors and Risk Status as a post-hoc factor; because models with all of these factors failed to converge, a simplified model with Block (school district size and location), Intervention Condition, and Risk Status was performed. Analyses of binary outcomes were conducted using SAS PROC GLIMMIX; relative reduction rates (RRRs) were calculated for binary outcomes. Analyses of continuous outcomes were conducted using SAS PROC MIXED. For level of significance, ⁺ = .1, * = .05, ** = .01.

showed relatively more significant outcomes than the multilevel models, concerning lifetime ecstasy, LSD (and other hallucinogens), methamphetamine and non-prescribed narcotics use and both the Illicit Substance Use and Non-prescribed Drug indices.

Risk moderation analyses for lifetime use revealed a significant Condition by Risk effect for the Illicit

Substance Use Index, at both age 23 and 25, and for lifetime Methamphetamine use at age 23. Higher-risk intervention participants demonstrated significantly lower levels of use than the higher-risk controls. Evidence for risk-related moderation also was shown for past year cigarette use at age 23 and for Alcohol-related Problems at age 25 (see Tables S1 and S2). Roughly parallel results

TABLE 2 Point-in-time intervention-control differences for young adult outcomes: Multi-level modeling at age 25

Outcome	Intervention main effect			RRR %
	Control (SE)	Intervention (SE)	$F_{(1,12)}$ (p-value)	
Lifetime use				
Drink alcohol (more than a sip)	0.989 (0.006)	0.972 (0.007)	2.51 (.115)	1.7
Drunkenness	0.954 (0.010)	0.933 (0.011)	1.97 (.166)	2.2
E-cigarettes	0.267 (0.027)	0.276 (0.028)	0.11 (.738)	-3.4
Marijuana	0.710 (0.024)	0.718 (0.024)	0.10 (.755)	-1.1
Ecstasy	0.229 (0.022)	0.180 (0.019)	2.91 (.099) ⁺	21.4
Cocaine	0.302 (0.059)	0.262 (0.055)	1.78 (.188)	13.2
Methamphetamine	0.125 (0.014)	0.079 (0.011)	6.72 (.012)*	36.8
LSD (and other hallucinogens)	0.242 (0.034)	0.178 (0.028)	5.56 (.026)*	26.4
Non-prescribed narcotics	0.342 (0.028)	0.257 (0.025)	5.08 (.033)*	24.9
Non-prescribed amphetamines	0.304 (0.060)	0.295 (0.059)	0.09 (.771)	3.0
Illicit Substance Use Index	1.331 (0.156)	1.132 (0.158)	9.24 (.005)**	n/a
Non-Prescribed Drug Index	0.957 (0.122)	0.827 (0.123)	4.25 (.057) ⁺	n/a
Current substance use				
Past month drunkenness	0.398 (0.056)	0.392 (0.055)	0.03 (.858)	1.5
Past month cigarette use	0.259 (0.027)	0.269 (0.027)	0.13 (.716)	-3.9
Past month E-cigarette use	0.093 (0.017)	0.093 (0.016)	0.01 (.960)	0.9
Past month marijuana use	0.224 (0.052)	0.176 (0.044)	1.35 (.254)	21.4
Past year marijuana use	0.247 (0.057)	0.253 (0.058)	0.06 (.810)	-2.4
Past year LSD (other hallucinogens)	0.045 (0.015)	0.036 (0.013)	0.71 (.399)	2.0
Past year narcotics	0.054 (0.030)	0.043 (0.025)	0.66 (.416)	2.4
Past year methamphetamines	0.025 (0.013)	0.030 (0.015)	0.09 (.764)	-2.0
Frequency of substance use				
Past year drinking (more than a sip)	36.82 (2.55)	4.88 (2.51)	1.54 (.232)	n/a
Past year drunkenness	14.19 (2.70)	15.10 (2.69)	0.43 (.514)	n/a
Past year cigarette use	1.98 (0.078)	1.90 (0.078)	0.25 (.621)	n/a
Past year E-cigarette use	1.39 (0.049)	1.35 (0.049)	0.72 (.402)	n/a
Past year marijuana use	9.47 (5.84)	6.70 (5.91)	0.86 (.358)	n/a
Past year non-prescribed narcotics	1.36 (0.32)	0.24 (0.31)	6.67 (.021)*	n/a
Drug/alcohol-related problems				
Drug-related problems	0.587 (0.101)	0.516 (0.102)	3.02 (.093) ⁺	n/a
Alcohol-related problems	0.844 (0.132)	0.795 (0.131)	0.55 (.457)	n/a
Past year drinking and driving (current)	0.171 (0.042)	0.184 (0.044)	0.37 (.550)	-7.6
Past year drinking and driving (frequency)	0.48 (0.48)	0.98 (0.47)	4.04 (.055) ⁺	n/a
Conduct problem behaviors index	0.149 (0.014)	0.177 (0.014)	2.29 (.131)	-18.8

Note: LS means are model-based means. Analytic models initially included Block (school district size and location), State, Intervention Condition, and Cohort as design factors and Risk Status as a post-hoc factor; because models with all of these factors failed to converge, a simplified model with Block (school district size and location), Intervention Condition, and Risk Status was performed. Analyses of binary outcomes were conducted using SAS PROC GLIMMIX; relative reduction rates (RRRs) were calculated for binary outcomes. Analyses of continuous outcomes were conducted using SAS PROC MIXED. For level of significance, ⁺ = .1, * = .05, ** = .01.

were found in the individual-level analyses (see Tables S3 and S4).

The age 19 analyses showed no significant health-risking sexual behavior (Spoth et al., 2019). We confirmed that the results also were null at ages 23 and 25; thus, they are not reported further. Detail on those null findings is available upon request.

Effects from growth analyses within and across developmental stages

Emerging adult growth analyses included measures available across three waves of data collection as summarized in Table 3. Regarding main effects, there were significant overall effects favoring the intervention

TABLE 3 Intervention-control differences in growth of young adult problem behavior outcomes: Multi-level repeated measure modeling, ages 19–25

Outcome	Overall Intervention effect <i>F</i> -value (<i>p</i> -value)	Intervention × risk × time <i>F</i> -value (<i>p</i> -value)
Lifetime user		
Drink alcohol (more than a sip)	1.18 (.284)	0.41 (.664)
Drunkenness	0.49 (.491)	0.47 (.626)
Marijuana	0.36 (.554)	0.15 (.861)
Ecstasy	6.01 (.019)*	2.44 (.105)
Cocaine	6.13 (.017)*	0.23 (.791)
Methamphetamine	19.26 (.001)**	0.37 (.692)
LSD (and other hallucinogens)	9.92 (.005)**	0.71 (.493)
Non-prescribed narcotics	4.50 (.051) ⁺	0.04 (.960)
Non-prescribed amphetamine	0.10 (.752)	3.22 (.040)*
Illicit Substance Use Index	16.75 (.001)**	2.38 (.093) ⁺
Non-Prescribed Drug Index	4.03 (.060) ⁺	0.90 (.405)
Current substance use		
Past month drunkenness	0.02 (.881)	0.24 (.785)
Past month cigarette use	2.43 (.119)	0.05 (.951)
Past month marijuana use	0.33 (.572)	0.70 (.497)
Past year marijuana use	0.07 (.792)	0.25 (.776)
Past year LSD (or other hallucinogen)	0.94 (.348)	0.33 (.721)
Past year non-prescribed narcotics	2.46 (.140)	0.03 (.969)
Past year methamphetamine	5.25 (.028)*	1.13 (.322)
Frequency of substance use		
Past year drinking	0.01 (.932)	0.81 (.447)
Past year drunkenness	0.04 (.838)	2.69 (.069) ⁺
Past year cigarette use	5.29 (.036)*	0.46 (.631)
Past year marijuana use	2.99 (.097) ⁺	0.69 (.504)
Past year non-prescribed narcotics	6.37 (.024)*	0.61 (.547)
Drug/alcohol-related problems		
Drug-related problems	6.16 (.013)*	0.61 (.543)
Alcohol-related problems	0.10 (.748)	3.18 (.042)*
Past year drinking and driving (current)	0.07 (.789)	1.32 (.267)
Past year drinking and driving (frequency)	0.31 (.575)	1.37 (.694)
Conduct Problem Behaviors Index	0.68 (.409)	1.91 (.148)

Note: The analytic models included Block (school district size and location), State, Intervention Condition, and Cohort as design factors and Risk Status as a post-hoc factor. The UN (completely free) option in SAS for estimating the error structure was applied. Analyses of binary outcomes were conducted using SAS PROC GLIMMIX; analyses of continuous outcomes were conducted using SAS PROC MIXED. For level of significance, ⁺ = .1, * = .05, ** = .01.

condition for the lifetime outcome measures, including: Ecstasy, cocaine, methamphetamines, LSD (and other hallucinogens), and illicit drugs. Non-prescribed narcotics showed a trend at the 0.1 level. For current use, only past year methamphetamines use was significant. Two of the six frequency use measures (past year cigarettes and past year non-prescribed narcotics use) also were significant, along with drug-related problems. There were two risk-related moderation effects in growth, with higher-risk participants showing greater intervention impacts on lifetime non-prescribed amphetamine use and alcohol-related problems.

Table 4 presents data for the 10-wave repeated measures analyses (posttest through age 25). Over the ten waves of data significant intervention effects favoring the intervention participants were found on most lifetime, past year, and past month outcomes. Significant effects were in evidence for lifetime drunkenness, marijuana, ecstasy, methamphetamine, and prescription narcotics use, along with past month cigarettes and marijuana use, plus past year methamphetamine use. Importantly, most of the nine outcomes (all except lifetime marijuana use) showed differences in growth trends for the high-risk group by experimental condition, indicating that there

were greater intervention effects in the higher-risk subgroup of the population. Two illustrations of significant main and risk-related moderation effects are provided in Figure 2.

DISCUSSION

The prevalence of youth substance misuse and its social, health, and economic consequences provide a compelling

TABLE 4 Intervention-control differences in growth trends for measures available across all 10 waves: Multi-level repeated measure modeling through age 25

Outcomes	Overall Intervention effect <i>F</i> -value (<i>p</i> -value)	Intervention × risk × time <i>F</i> -value (<i>p</i> -value)	Intervention effect in higher-risk group <i>F</i> -value (<i>p</i> -value)
Lifetime alcohol use (more than a sip)	3.18 (.077) ⁺	0.85 (.573)	5.85 (.017)*
Lifetime drunkenness	5.43 (.021)*	0.29 (.978)	6.96 (.009)**
Lifetime marijuana use	3.98 (.048)*	0.60 (.797)	2.24 (.136)
Lifetime ecstasy use	1.46 (.002)**	1.22 (.282)	12.17 (.001)**
Lifetime methamphetamine use	11.34 (.001)**	1.02 (.426)	12.08 (.001)**
Lifetime prescription narcotics use	16.26 (.001)**	0.96 (.472)	17.63 (.001)**
Past month cigarette use	7.40 (.007)**	0.43 (.919)	13.80 (.001)**
Past month marijuana use	5.48 (.020)*	1.42 (.179)	8.00 (.005)**
Past year marijuana use	3.51 (.063) ⁺	0.63 (.767)	5.99 (.015)**
Past year methamphetamine use	9.41 (.002)**	0.66 (.748)	15.21 (.001)**

Note: The analytic models used school-based aggregated scores without any random effects modeled other than the repeated measurement times. For estimating the error structure from the 10 repeated measurements, the ARH (1) option of SAS was applied; the Kenward-Roger method was applied to approximate the degrees of freedom in testing all effects, in order to adjust the degrees of freedom with repeated (correlated) measurements over time. In the case of the lifetime prescription narcotics use, the wording of the survey question for post-adolescent respondents added explicit reference to non-medical use. For level of significance, ⁺ = .1, * = .05, ** = .01.

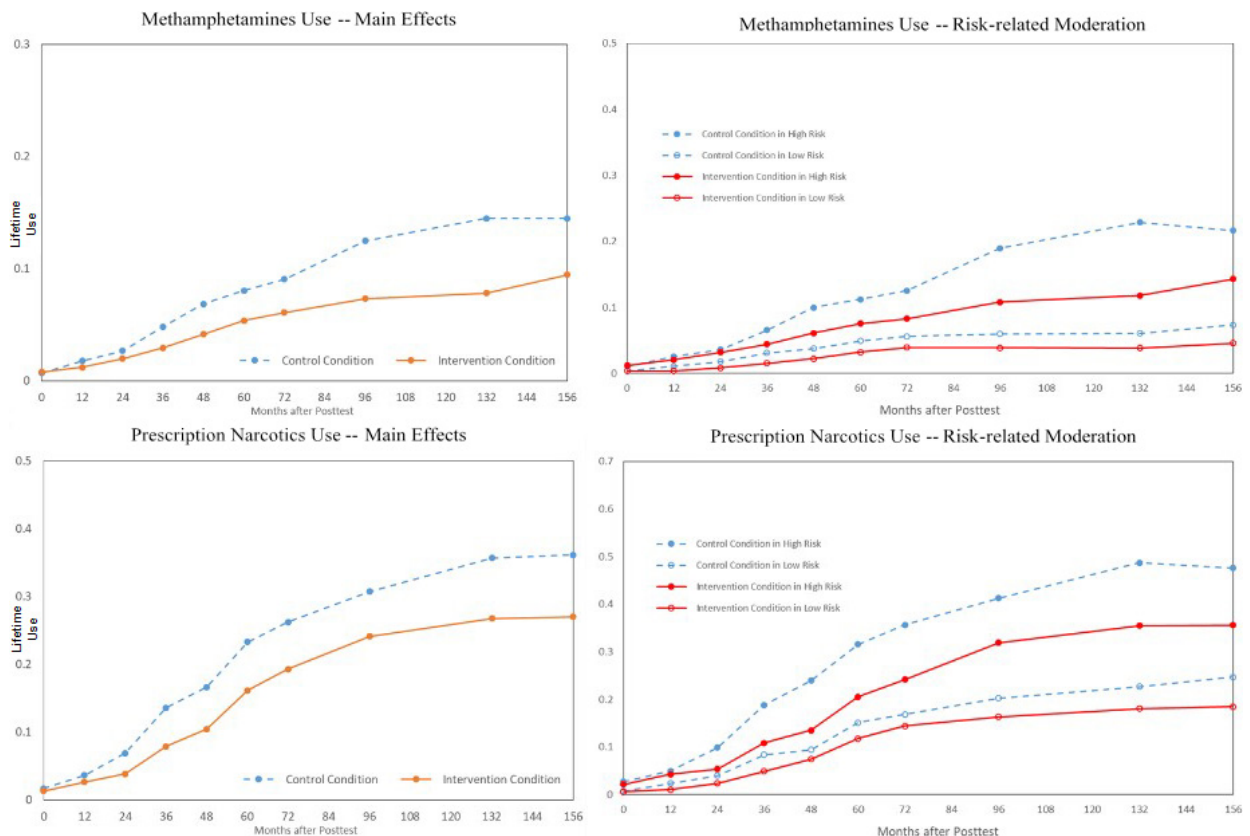


FIGURE 2 Graphic illustrations of intervention-control differences and growth trends for lifetime use across all follow-up assessments

rationale for testing universal preventive interventions to reduce misuse and improve population health. The PROSPER delivery system is a community-university partnership offering evidence-based prevention programming for young adolescents and their parents. The current study evaluated the effects of the PROSPER delivery system on substance misuse and conduct problem behaviors through the mid-twenties, 14 years after baseline.

Generally, there were only a few intervention effects that sustained in the *point-in-time* analyses, and they were primarily lifetime substance misuse outcomes. Specifically, there were limited effects for current substance use (past year cigarette at age 23 and non-prescribed narcotic use at age 25) and drug-related problems. The *growth analyses results that included ages 19, 23, and 25* also showed limited current use outcomes, albeit with significant effects on past-year methamphetamine, cigarette, and non-prescribed narcotic use. The growth analyses, however, showed additional lifetime use effects, beyond those observed in the point-in-time analyses (for ecstasy, cocaine, methamphetamine, and LSD, along with the Illicit Substance Abuse Index). Consistent with point-in-time analyses, there were no effects on alcohol use or drunkenness. Finally, *growth analyses using all 10 waves of data collection across 14 years* showed more positive intervention effects. Overall, intervention participants demonstrated slower growth on most of the outcomes examined, including lifetime use of illicit substances and prescription narcotics, along with past month cigarette use. Results were relatively weaker for marijuana use and no 10-wave effects were found for alcohol use.

Earlier reports from the PROSPER project noted *moderation by risk status*, with youth identified as high risk at baseline showing relatively greater benefits, when compared with high-risk youth in comparison communities. The current analyses were consistent with these earlier findings. More specifically, for the age 23–25 point-in-time analyses, effects emerged within the higher-risk group for lifetime non-prescribed narcotics and the Illicit Substance Use Index, while the age 19–25 growth analyses indicated that the higher-risk intervention condition participants demonstrated a lower rate of use than the higher-risk control condition participants. Also, somewhat paralleling the point-in-time results, risk moderation analyses showed greater effects for higher-risk students for lifetime illicit substance use (as well as cocaine, methamphetamine, and LSD) and drug-related problems and consequences. Finally, the growth analysis across all 10 waves indicated that, in almost every case, the effects were stronger in the higher-risk subgroup, suggesting that universal prevention models may have their largest impact on those teens who are most at risk for later substance misuse (see Table 4; Figure 2). One explanation for this finding is that students who were at higher risk at baseline had higher rates of use, allowing for greater potential intervention effects. In addition, they could have been predisposed to respond differentially

to the interventions; the risk reduction strategies taught could have had more salience for them and their parents.

Generally speaking, although PROSPER led to significant intervention-control differences in alcohol use, smoking and marijuana use for adolescents (up through 12th grade), the impacts sustained in emerging adulthood were primarily in the domain of illicit drug use and, to some extent, misuse of prescribed medications. Moreover, the fact that most sustained outcomes concerned lifetime measures warrants further comment. As noted in the introduction, the longitudinal study of the effects of a comprehensive community-based delivery system model for evidence-based interventions most similar to PROSPER was the CTC trial, with outcomes examined at age 21 (Oesterle et al., 2018) and 23 (Kuklinski et al., 2021). The primary evidence of sustained effects in the CTC case was observed with point-in-time incidence or lifetime use measures (described as “sustained abstinence”); no effects on prevalence (current or recent use) were reported, although it was noted that such effects were observed up through the 10th grade. Despite the few positive current use outcomes in the present study, like the CTC emerging adult results, sustained current use effects clearly diminished after high school (for PROSPER, after the 12th grade assessment). Concerning sustained effects on lifetime measures, point-in-time outcomes were the primary ones reported in the CTC studies. The strongest evidence of lifetime use effects in the PROSPER case, however, was shown by growth analyses, based on both the three emerging adult measurement time points and the ten time points across the course of the study, with most measures showing a slower rate of increase in lifetime use, including illicit use outcomes.

There were no point-in-time effects on alcohol use or drunkenness, unlike what had been demonstrated at younger ages. This could be attributed to the typical age-related patterns of alcohol use in the general population, given that drinking alcohol is normative among emerging adults at the legal drinking age or older. In the case of marijuana use, the legalization, decriminalization, and lowered penalties for marijuana use in many states during the PROSPER study may have contributed to more widespread use by emerging adults in both the intervention and the control groups. While results differ somewhat between age 23 and age 25, in general, intervention effects on lifetime use of illicit drugs and non-prescribed narcotics were the most robust findings, consistent with the age 19 results. Beyond that, the positive growth analysis results on lifetime use also were consistent with the age 19 results.

Regarding the null main effect findings for current use, there could be different patterns of current use among subgroups of emerging adult participants, with current use being moderated by college enrollment, employment, intimate relationship status, or other changes in physical and social environments (e.g., change to a non-rural residence), that were not directly addressed in

this study. Also noteworthy are the null findings on the conduct problem behaviors measure. Notably, the types of conduct problem items included are representative of the behaviors that are prevalent during late adolescence which show (Kazemian, 2016) declines in general emerging adult populations (e.g., Sameroff et al., 2004).

Concerning the overall pattern of findings, the longitudinal results from nearly 15 years of PROSPER research suggest that intervention impacts vary, depending on stages of development and, perhaps, their corresponding life challenges. Given rapid brain development in early adolescence—accompanied by consolidation of critical academic and social-emotional skills that set the stage for later adult functioning—substance initiation and use during this period can have a highly detrimental impact on brain growth and may disrupt skill acquisition (Feinstein et al., 2012; Squeglia et al., 2009). PROSPER's reduction in alcohol, tobacco, and marijuana initiation during the critical period of early adolescence may position youth to better manage these substances at later ages, particularly late adolescence, as their regular use becomes more normative and less developmentally disruptive. In emerging adulthood, however, observed effects appear to shift away from legal substance use and toward illicit substances, which present unique threats to successful adult functioning. In addition to risks associated with addiction, overdose, relationship problems, and vocational instability (Macleod et al., 2004), illicit drug use exposes emerging adults to possible criminal involvement, which can significantly erode life opportunities (Murphy & Dennhardt, 2016; Patton et al., 2007). These findings, which demonstrate a developmental “shift” in how behaviors are impacted by interventions over time, highlight the need for more rigorous longitudinal research on preventive interventions implemented in young adolescence and followed into adulthood, particularly *universal* prevention. Literature published over the past two decades suggests that, in general, there are many challenges to demonstrating indirect or mediating effects over multiple developmental stages, and that: (1) effects likely will be smaller and more difficult to detect, waning over time (see Orlando et al., 2005; Shrout & Bolger, 2002); (2) the complex interplay of long-term intervention effects will be difficult to capture by simple theoretical models (see Lipsey, 1990), and (3) main effects models should be supplemented by theory-based models investigating specific subgroups that show different types of findings, including prevention of problems in some subpopulations, and health-promoting findings in other subgroups (Greenberg & Abenavoli, 2017).

A review of the developmental literature suggests that, particularly in the case of universal preventive intervention implemented in middle school, shifting patterns of positive outcomes across developmental stages result from cascades of effects, in conjunction with normative influences that change across developmental stages (Lynne-Landsman et al., 2010; Muratori et al., 2017). PROSPER

interventions primarily target malleable risk and protective factors related to young adolescent substance use initiation, especially relationship and other social skills (e.g., problem solving, peer resistance, peer and relationship quality). These developmentally sensitive skills may mediate emerging adult outcomes through a positive developmental cascade involving progressive associations between various domains of adolescent-stage functioning and those in emerging adulthood (e.g., Lynne-Landsman et al., 2010). For example, youth who develop these skills in adolescence may have better relationships with peers and adults, be more successful in school, less likely to engage the criminal justice system, and therefore “set themselves up” for better adjustment at later developmental periods (Muratori et al., 2017; Sitnick et al., 2014).

The current findings support the hypothesis that implementation of the PROSPER delivery system shows some sustained effects, particularly concerning slower growth in lifetime substance misuse, and particularly in the domains of the more harmful illicit and non-prescribed drugs, through age 25, 14 years past baseline. In this connection, emerging adult effects have been found on other outcomes including college grades (Spath et al., 2019) and human services utilization (Crowley, 2019). That said, as hypothesized, the most clear-cut, wide-ranging benefits from PROSPER on substance misuse were largely during adolescence.

To place the overall pattern of findings in perspective, it is noteworthy that a report by the U.S. Surgeon General (U.S. Department of Health & Human Services [HHS], Office of the Surgeon General, 2016) identified an important knowledge gap regarding the effects of adolescent-stage preventive interventions on emerging adult outcomes. Our previous study of results of the PROSPER delivery system at age 19, along with the current study of results at ages 23 and 25, address this gap and support the benefits of developmentally well-timed early adolescent substance misuse prevention efforts extending into emerging adulthood.

There are important limitations to keep in mind when considering these findings, most of which have been highlighted in multiple earlier reports. First, the sample was drawn from rural and small-town populations; generalization to urban settings and populations that differ in relevant characteristics, such as ethnicity or geographic location, has not yet been established and will require additional research. Second, our outcome measures were based on self-reports. Self-reports may be susceptible to social desirability biases, although youth and emerging adult self-reports have been found to be valid in other studies (Murray et al., 1987; Smith et al., 1995). In this regard, it should also be noted that such biases, if present, would likely affect both the intervention and control groups in a similar manner, especially given the number of years that had elapsed between intervention delivery (in the sixth and seventh grades) and the age 23 and 25 assessments. Third, readers should attend to

the number of statistical tests conducted independently with similar types of outcomes. As has been the case in earlier published reports, p-values provided allow for assessing the robustness of significant results. Fourth, although the sampling method and equivalency analyses demonstrated no bias in the selection of the more limited emerging adult sample, it is possible that there may be additional variables not measured that could have influenced the representativeness of the selected sample. Notably, this study is subject to the widely applicable threats to validity in experimental studies associated with the potential failure of randomization to balance all pertinent factors. Finally, further research is needed to address the possible role of other factors that might impact intervention effects for emerging adults, such as gender, romantic relationships, and living contexts such as college or the military.

Several additional areas for future research are particularly important to consider. Given the limitations of the self-reported conduct problem behaviors measure noted above, the first area of future research will entail a full examination of related outcomes using emerging adult records of arrests, adjudication, and convictions for drug and alcohol-related offenses. The second is suggested by the pattern of relative reductions in illicit substance use and by the risk-related moderation of some of those outcomes. Future research will adopt a developmental cascade approach to an examination of pathways of influence of observed, risk-related adolescent outcomes on illicit substance use during emerging adulthood. Earlier developmental research on pathways of influences will inform the specification of the developmental cascade models. Ongoing analyses suggest, for example, a key role for cascading effects into emerging adulthood associated with adolescent problem-solving skills (LoBraico et al., 2020; Spoth et al., 2019). In this connection, future research also will include further examination of adolescent stage pathways to long-term intervention “crossover effects” on emerging adult mental health and utilization of mental health services. A fourth area of planned study will further evaluate the practical significance of emerging adult outcomes by conducting economic analyses of the intervention's cost-effectiveness. Finally, considering the high rates of alcohol, cigarettes, and marijuana use in the general population, investigation of interventions designed to reinforce and extend PROSPER effects on these types of substance use in emerging adulthood will be conducted.

In conclusion, acknowledging the more limited range of sustained effects on substance misuse and conduct problem behaviors during the mid-20s, the observed, slower rates of increases in lifetime use during an emerging adulthood, when substance use typically peaks, is important (Kuklinski et al., 2021). These emerging adult results supplement the positive findings of PROSPER interventions during adolescence, suggesting its public health value and supporting the evaluation

and dissemination of the PROSPER delivery system in additional communities. Overall, these findings underscore the practical benefits of community-based prevention delivery systems that have been documented and supported in the literature (Flanagan et al., 2018; Kuklinski et al., 2021; U.S. Department of Health & Human Services [HHS], Office of the Surgeon General, 2016), particularly with their built-in training and technical assistance protocols to increase the likelihood of sustained impact. Such benefits suggest the PROSPER partnership delivery system has potential to facilitate effective and efficient translation of proven universal preventive health interventions for young adolescents into community practice.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to report.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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