A Randomized, Controlled Trial of the Family Check-Up Model in Public Secondary Schools: Examining Links between Parent Engagement and Substance Use Progressions From Early Adolescence to Adulthood

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Abstract

Objective. Substance use in adulthood compromises work, relationships, and health. Prevention strategies in early adolescence are designed to reduce substance use and progressions to problematic use by adulthood. This report examines the long-term effects of offering Family Check-up (FCU) at multiple time points in secondary education on the progression of substance use from age 11 to 23 years. **Method.** Participants (N = 998; 472 females) were randomly assigned individuals to intervention or control in Grade 6 and offered a multilevel intervention that included a classroom-based intervention (universal), the FCU (selected), and tailored family management treatment (indicated). Among intervention families, 23% engaged in the selected and indicated levels during middle school. **Results.** Intention to treat analyses revealed that randomization to the FCU was associated with reduced growth in marijuana use ($p < .05$), but not alcohol and tobacco use. We also examined whether engagement in the voluntary FCU services moderated the effect of the intervention on substance use progressions using complier average causal effect (CACE) modeling, and found that engagement in the FCU services predicted reductions in alcohol, tobacco, and marijuana use by age 23. In comparing engagers with nonengagers: 70% versus 95% showed signs of alcohol abuse or dependence, 28% versus 61% showed signs of tobacco dependence, and 59% versus 84% showed signs of marijuana abuse or dependence. **Conclusion.** Family interventions that are embedded within public school systems can reach high-risk students and families and prevent progressions from exploration to problematic substance use through early adulthood.

Public Health Significance Statement

This study suggests that family-centered interventions designed to be embedded within the public school service system can have long-term preventive effects on reducing risk for marijuana use especially, but also tobacco and alcohol. By actively and respectfully encouraging at-risk families to participate, those most likely to benefit will engage and have motivation to change, thus optimizing the use of resources while maintaining the significant impact of the intervention.

Keywords: Drug use, drug dependence, adaptive intervention, middle schools, motivational interviewing, parent training

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Substance use before age 15 is among the best predictors of progression to abuse and dependence by early adulthood (Anthony, Warner, & Kessler, 1997; Robins & Przybeck, 1985), and initiating substance use in late adolescence is associated with increased likelihood of criminal behavior and physical health problems in adulthood (Tucker, Ellickson, Orlando, Martino, & Klein, 2005). In the late teens and early twenties, alcohol, marijuana, and tobacco use reaches a peak (Compton, Thomas, Stinson, & Grant, 2007). Substance use, even at a low frequency, is a major disruptor of nearly every aspect of the transition into adulthood, including lack of educational achievement, disruption of work, interpersonal relationships and family life, and progression to problematic substance use (Kandel et al., 1999; Newcomb & Bentler, 1988; Tucker et al., 2005; Yamaguchi & Kandel, 1985). In addition, the costs associated with substance use are high. In 2002, economic costs of illicit drug abuse in the United States were estimated at $180.9 billion (Office of National Drug Control Policy, 2004). This represents, among others, costs related to the criminal justice system, costs incurred by victims of drug-related crimes, and health care costs for substance use–related problems.

Because only a small minority of adolescents and young adults seeks treatment for emerging substance use problems (Teesson, Baillie, Lynskey, Manor, & Degenhardt, 2006), considerable investment has been put into the design and testing of effective early prevention. A key principle is to develop models of early-onset substance use and then to design interventions that target etiological factors that are malleable (Dishion & Patterson, 1999; Stanis & Andersen, 2014). This study focused on a family-centered approach to prevention of early-onset substance use and on the evaluation of the long-term impact on the progression of substance use from early adolescence to adulthood.

Etiology of Substance Use

The etiology of substance use in adolescence and early adulthood is complex in that it involves individual risk factors (e.g., early-onset persistent antisocial behaviors, academic failure, alienation and rebelliousness, positive attitudes about drugs, early adolescent drug use), family risk factors (e.g., family behaviors and attitudes about substance use, family management practices, family conflict, bonding to the family), and extra familial factors (weak commitment to school, early peer rejection, and affiliation with drug-using peers; for reviews see Hawkins, Catalano, & Miller, 1992; Sloboda, Cottler, Hawkins, & Pentz, 2009). Further, these domains of risk are interdependent. For instance, Dishion, Capaldi, Spracklen, and Li (1995) found that several risk factors were associated with early-onset tobacco, alcohol, and marijuana use, with a unique constellation of risk for each substance. Although major studies of the etiology of substance use have been based on global measures of substance use (Catalano, Kosterman, Hawkins, Newcomb, & Abbott, 1996; Tarter et al., 2003), studying the unique etiology related to the use of various substances can be quite informative. For example, Dishion et al. (1995) showed that although tobacco, alcohol, and marijuana use were predicted by childhood antisocial behavior and involvement with deviant peers, tobacco use was uniquely predicted by peer rejection, alcohol use by inconsistent and harsh discipline, and marijuana use by disrupted families (divorce and remarriage). Several studies of risk have found that antisocial behavior is often the key predictor of substance use (Hawkins & Catalano, 1992; Kellam, Brown, Rubin, & Ensminger, 1983; Smith & Fogg, 1979). The central role of antisocial behavior in the development of early-onset substance use has been tested as a dynamic cascade model (Dodge et al., 2009) showing that antisocial behavior leads to negative developmental sequelae, such as school failure and poor peer relationships, which lead to association with substance-using peers.

Studies have revealed a process of premature autonomy that underlies the progression of multiple forms of problem behavior in adolescence and young adulthood. Patterson, Reid, and Dishion (1992) described a “cascade of effects” of antisocial behavior in middle childhood on adolescent progressions to more serious problem behavior. Specifically, youth with a history of problem behavior tend to become marginalized in school by teachers and peers and subsequently seek unsupervised contexts that involve peers and deviance. Longitudinal studies revealed that a combination of problematic parenting in adolescence and involvement with deviant peers or siblings leads to increases in problem behavior later in adolescence and into young adulthood. Researchers assessed number of daily meals with parents, daily discussions with parents about activities, affection with parents, and time spent with peers unsupervised by adults. By far, the best predictor of growth in substance use was the number of unsupervised hours with peers. In the absence of intervention to reduce youth problem behavior, time spent with peers and emergence of problem behavior leads to further deterioration in parent–adolescent relationships, which contributes to escalating problem behavior (Bradley & Corwyn, 2012; Dishion, Bullock, & Kiesner, 2008; Dishion, Nelson, & Bullock, 2004; Keijsers et al., 2012; Low, Snyder, & Shortt, 2012).

Parenting skills stand out as a key intervention target for the prevention of substance use. Early adolescence is a crucial period to intervene with parents, because it is late enough for risk factors to be reliably identified but early enough to intervene before substance use is initiated or before it escalates. Furthermore, embedding parenting interventions in a school-based prevention program strengthens the program's ability to act on the mutual influences among adolescents, family, and their extrafamilial context (Hawkins et al., 1992).

Several programs have been developed to support parents during the early-adolescence transition. By far, the most common strategy is to implement universal parenting programs that engage parents within the public school system (e.g., Fleming, White, Haggerty, Abbott, & Catalano, 2012; Hawkins, Von Cleve, & Catalano, 1991; Gonzales et al., 2012; Park et al., 2000; Spoth, Greenberg, Bierman, & Redmond, 2004; Spoth, Redmond, Shin, Greenberg, Feinberg, & Schainker, 2013; Spoth & Redmond, 2002). There is considerable evidence that universal approaches to supporting families in public school settings have long-term benefits (e.g., Brown, Catalano, Fleming, Haggerty, & Abbott, 2005; Hawkins, Catalano, Kosterman, Abbott, & Hill, 1999; Spoth, Trudeau, Guyll, Shin, & Redmond, 2009). Although early intervention is necessary to prevent substance use before its emergence, intervention effects tend to disappear by early adulthood if prevention efforts are not pursued into adolescence (Hawkins, Kosterman, Catalano, Hill, & Abbott, 2005; Hawkins et al., 2007; O'Donnell, Hawkins, Catalano, Abbott, & Day, 1995). Universal approaches to supporting parenting practices face two key challenges. One is that the most at-risk parents often do not show up for universal parenting programs (Hawkins et al., 1992) unless paid staff exerts extensive and expensive efforts to engage them (Eddy, Reid, Stoolmiller, & Fetrow, 2003). Second, it is difficult for universal programs to address the myriad intervention needs of high-risk parents and families. Failure to attend to the multiple risk domains of high-risk families is associated with their poor response to psychosocial intervention (Forgatch & Patterson, 2010; G. E. Miller & Prinz, 1990).

The Family Check-Up: An Adaptive Approach to Intervention and Engagement

Linking universal prevention with engagement of high-risk participants requires a systematic, economical and respectful approach to screening. Multiple gating for schools was designed to build on the extensive risk prediction literature to identify subgroups of students and families who would most benefit from additional intervention resources (Loeber, Dishion & Patterson, 1984; Dishion & Patterson, 1993). Similar to multistage personnel selection through assessments (Cronbach & Glesar, 1965), the least expensive measures are used first to identify a subgroup worthy of more consideration. In the Family Check-up model in schools (FCU; Dishion & Kavanagh, 2003; Dishion, Kavanagh, & Kiesner, 1998), teachers provide the first "gate" of assessment. Students whom teachers see no risk are passed over, and the remaining groups are assessed by parents. If parents also are concerned about student risk, then further assessment involves the parent and child (i.e., the FCU). The FCU multilevel model and engagment process are detailed below.

Major challenges arise when evaluating intervention effects with an adaptive and tailored approach to engagement and intervention. When family services are provided to the entire population, only a minority of families requires more intensive family-based services. Thus, a traditional intention to treat (ITT) analytic strategy does not address whether engagement in the intervention increased effect sizes. Using a traditional ITT design when only part of the intervention group is expected to engage in the FCU decreases the statistical power to detect intervention effects (Angrist, Imbens, & Rubin, 1996). An alternative analytic strategy has been suggested to analyze intervention effects in such designs: complier average causal effect (CACE) modeling (Imbens & Rubin, 1997; Jo, 2002; Little & Yau, 1998). CACE modeling facilitates the analysis of client engagement as a moderator of intervention effects by use of longitudinal mixture modeling of self-reported drug use from ages 11 through 23 years, with predefined “engager” and “nonengager” classes within the intervention group and estimated “engager” and “nonengager” classes in the control group. A critical assumption in CACE modeling is that nonengagement with the FCU, for example, does not change behavior. Holding that assumption, longitudinal classes of control engager- and nonengager-equivalent groups are formulated. Within this longitudinal framework it is valid to compare the intervention engagers with the control engager-equivalent group with respect to their longitudinal trajectories, retaining the virtues of random assignment to the intervention condition.

In a previous study using this sample (Project Alliance 1; Connell, Dishion, Yasui, & Kavanagh, 2007), we used CACE modeling and found that youth whose family engaged in the FCU had less growth in alcohol, tobacco, and marijuana use from age 11 through 17 years, fewer substance use diagnoses by age 19, and less likelihood of having a police record by age 16–17 than did the adolescents from the engager-equivalent control group whose family was not offered the FCU. CACE analyses also revealed that positive intervention effects generalized to other important areas of adolescent development in that sample. Participants whose family engaged in the FCU had stable grade point averages (GPAs) and improved school attendance between ages 11 and 17 years, whereas matched control participants experienced a decrease in GPA and an increase in absenteeism (Stormshak, Connell, & Dishion, 2009). Some of these results regarding substance use were replicated with a different sample (Project Alliance 2; Stormshak et al., 2011) on the basis of data collected when participants were age 11 through 13 years. Less growth in substance use and antisocial behavior was observed among participants whose family engaged in the FCU than among matched participants from the control group. In the same sample, long-term intervention effects were found using an ITT approach, and researchers concluded that reductions in family conflict mediated long-term reductions in antisocial behavior by age 18–19 years (Van Ryzin, Stormshak, & Dishion, 2012).

One question that remains unanswered based on past research is whether the positive intervention effects of the FCU on substance use observed throughout the teenage years are maintained when participants transition into early adulthood. A 10-year follow-up assessment such as the one presented here that encompasses two major life transitions (from middle to high school, and from adolescence to adulthood) is exceptional in that a follow-up occurring from 18 to 24 months after the intervention is commonly referred to as *long-term*. Because some well-known and promising prevention programs have failed to yield a significant reduction in substance use or abuse when participants reached late adolescence or early adulthood (Eckenrode et al., 2010; Webster-Stratton, Rinaldi, & Reid, 2011), we must recognize that the maintenance of FCU effects after the transition to adulthood is not guaranteed and should be verified based on new data now available. In addition, the diversity of substance use patterns during adolescence (Tucker et al., 2005) makes it essential to reassess FCU effects in early adulthood, because some groups of at-risk adolescents are difficult to identify earlier in adolescence (e.g., late-increasing users). Some seemingly low-risk youth who engage in low-stable or declining patterns of substance use throughout adolescence are still at higher risk for substance-related problems in adulthood than are abstainers (Tucker et al., 2005), hence the importance of looking at the impact of the FCU not only on growth in substance use, but also on substance abuse and dependence in adulthood.

This Study

The goal of this study was to test the hypotheses that family engagement in the FCU reduces the growth in substance use during adolescent years and protects against substance abuse or dependence once participants reach adulthood (age 23 years). These hypotheses were tested by applying both ITT and CACE modeling to the longitudinal data and considering tobacco, alcohol, and marijuana use separately.

Method

Participants

Participants were 998 adolescents and their families recruited in Grade 6 (*M* age = 12.2 years, *SD* = 0.37) from three middle schools in an ethnically diverse urban community in the Northwest region of the United States to participate in the Project Alliance 1 study. We approached the parents of all Grade 6 students in two cohorts (years 1996 and 1998) for participation, and 90% consented to participate (see Figure 1). The sample included 472 females (47.3%) and 526 males (52.7%). According to youth self-report, there were 423 European Americans (42.3%), 291 African Americans (29.1%), 68 Latinos (6.8%), 52 Asian Americans (5.2%), and 164 (16.4%) adolescents of other ethnicities (including biracial). Participants lived with their biological father in 585 families (58.6%). During the spring of Grade 6, we randomly assigned each participant to either a control classroom (498 youth) or an intervention classroom (500 youth) for the next year (Grade 7), in collaboration with each middle school. Participants in intervention classrooms were then exposed to the universal intervention program in class (see Dishion & Kavanagh, 2003, and the Intervention Protocol subsection of this article for more detail), and their parents would have access to a family resource center. Public schools agreed to randomization of families to specific Grade 7 home rooms and the associated resource center because it reduced the need for services at the school-wide level. In the initial agreement, the research staff agreed not to deny family resource center services to the control group if requested. During the course of the middle school period, only one control parent requested services, and that was via a telephone call to the project director (Dr. Kavanagh) and not by a visit to the family resource center in the school.

Approximately 80% of youth were retained across the longitudinal span of our study (age 13, n = 857; age 14, n = 829; age 15, n = 820; age 17, n = 794; age 19, n = 735; age 22, n = 818; and age 23, n = 839). Gross annual household income measured during high school ranged from $4,999 or less to $90,000 or more, with a median value of $30,000–$39,999, and primary caregivers' education ranged from "no formal schooling" to "graduate degree," with a median value corresponding to "partial college." Although some participants were lost to attrition by the last wave of data collection, the demographic composition of the sample remained essentially the same.

Intervention Protocol

The first level of the program, a universal intervention, established a family resource center in each of the three participating public middle schools. The entire intervention group had access to parent-centered services of the family resource center, but this center was not promoted to the families assigned to the control group, who therefore did not request its services. These services included brief consultations with parents, such as telephone consultations, FCUs with parents, and access to videotapes and books relevant to parents' concerns. Parent consultants were selected to match the most prevalent ethnic groups in the sample (European American, African American, Hispanic). The parent consultant also engaged students in six in-class lessons called the Success, Health, Active coping and Peace Curriculum (SHAPE; see Dishion & Kavanagh, 2003). This intervention was modeled on the Life Skills Training program described by Botvin, Baker, Dusenbury, Tortu, and Botvin (1990), but it was reduced in scope (six lessons in SHAPE versus 16 in Life Skills Training). Each component of the SHAPE was accompanied by a home practice exercise that emphasized parent–student interactions to support family management. The six sessions focused on the following topics: (a) school success, (b) health decisions, (c) building positive peer groups, (d) the cycle of respect, (e) coping with stress and anger, and (f) solving problems peacefully. Brief parent–student activities designed to motivate and engage discussions supportive of family management were included in this intervention.

The selected intervention consisted of the FCU. This brief, three-session intervention is based on motivational interviewing and was modeled on the Drinker's Check-Up (W. R. Miller & Rollnick, 2002). All families in the intervention could request an FCU, but families of high-risk youth were specifically approached and offered the FCU in Grades 7 and 8. Youth deemed to be at high risk had been rated as such by teachers using the within-classroom standardized scores on the teacher report of risk behavior (TRISK; see the "Measures" subsection later in this article), so they were about equally distributed among classrooms. Participants were selected as high risk based on their relative ranking in their own classroom, and we made sure they were equally distributed across genders. We predetermined that as many as 300 participants (i.e., about one-third of the full sample) could potentially be considered "high risk" and that these youth would be equally distributed across the intervention and control groups. Participants who ranked highest on the overall TRISK questionnaire for their gender were progressively included until the high-risk subgroup was filled. However, a cutoff of one standard deviation above the mean on the TRISK was established to identify "high-risk" status, so the final number of high-risk participants was 272, which represents 27.2% of the sample (27.4% of the participants assigned to the intervention group). Families of high-risk adolescents who were invited to participate in the FCU represented 40.9% of those who engaged in the FCU, while 59.1% were families who were mostly referred by school staff, but not considered high risk using our own rating system. Of the 137 “high-risk” youth assigned to the intervention condition, 34.3% (n = 47) engaged with the FCU and 65.7% (n = 90) did not. Of the 363 “low-risk” youth assigned to the intervention condition, 18.7% (n = 68) engaged with the FCU and 81.3% (n = 295) did not. Thus, the density of high-risk families engaged in the FCU during middle school (34.3%) was greater than expected by chance $\chi^2(1) = 13.62$, $p < .001$. In other words, although most of the families who engaged in the FCU were low-risk (59.1%), families of high-risk children were significantly more likely to enroll (34.3%) than were families of low-risk children (18.7%).

To maintain the randomized component of the study, none of the families in the control group were offered the FCU, even if more than one-quarter of them were considered to be high-risk participants. It is telling that none of the parents randomly assigned to the control group actively requested services from the parent consultant. These numbers suggest that invitations to a brief family service were partially successful in reaching high-risk families. A large part of our resources were used to help families in greatest need of our services without excluding those families who were at lower risk according to our screening procedure and who thought the FCU could help them support their youth’s positive development.

The three FCU sessions included (a) an initial interview (20–30 minutes), (b) an assessment session (60 minutes), and (c) a feedback session involving the consultant and the parents (usually 60 minutes or longer, if needed). The three sessions were scheduled as close in time as possible, usually within 1 to 2 weeks. However, when families’ availability was limited, it could take up to 3 months to complete all three sessions. In the initial interview, a parent consultant explored parent concerns and stage of change and encouraged the parents to engage in a family assessment in the home. In the assessment session, family members were videotaped while they engaged in discussions about eight topics that were meant to help evaluate parent–

child interactions. Topics included planning a family fun activity, discussing a family problem identified by the parent, and discussing how parents could help their adolescent improve in an area of personal growth identified by the youth. During the feedback session with the parent, the therapist summarized the results of the assessment while using motivational interviewing strategies to support reflection about behavior change. An essential objective of the feedback session was to explore potential intervention services to support family management practices.

The FCU is designed as a gateway to more intensive family interventions when needed, including the Everyday Parenting curriculum (EPC; Dishion et al., 2011), which consists of 12 parent management sessions. The EPC is grounded in the Adolescent Transitions Program parenting intervention (Dishion & Andrews, 1995) and the Parent Management Training–Oregon group parent training (Forgatch & Patterson, 2010). Following the FCU, sessions were identified and delivered to parents on the basis of the results of the assessment and their motivation to engage in services. These services were provided in Grades 6, 7, 8, or 9 by parent consultants. The selection and offering of specific sessions within the EPC varied as a function of family needs and parent preferences. In addition, some parents chose to make changes in their family management practices without further contact with the parent consultant. Because of the diversity of session content and number of sessions, this study focused on engagement in the FCU as a general indicator of intervention compliance.

In the intervention condition, 115 families (23%) chose to receive the FCU during middle school, and 88 (77%) of them received further intervention services after the FCU. For Cohort 1, 46% of FCUs were completed after the Grade 7 family assessment, 53% were completed after the Grade 8 family assessment, and 1% were completed after the Grade 9 family assessment. For Cohort 2, 93% of FCUs were completed after the Grade 7 family assessment, and 7% were completed after the Grade 8 family assessment. In addition to the FCU sessions, the total length of in-person or phone contacts between the engager families and the intervention staff varied widely during the course of the study, ranging from 40 minutes to 67 hours per family (*M* = 11.47 hours; *Mdn* = 6.67 hours; *SD* = 11.52 hours). Most of the interactions between families and the consultant were in person, *M* = 71% of contact hours, *Mdn* = 75%. Contrary to expectations, most families elected to receive brief consultations and periodic FCU meetings rather than more intensive treatment. FCUs were also offered in high school (in Grades 10–11) for those families remaining in the school district. During high school, 170 families (34%) received the FCU, 109 of whom had not received it during middle school; therefore, 224 families (45%) received the FCU in middle school, high school, or both. The covariation between teacher rated risk status and engagement in the FCU in high school was not reliable, indicating that the density of high and low risk families engaging was the same as would be expected by chance.

When youth were age 16–17 we offered a Teen Check-up (TCU), similar to and complementary to the FCU; 174 youth (35%) elected to participate in the TCU, including 58 who did not participate in the FCU either in middle or high school. The TCU included the same three sessions as those in the FCU (initial interview, assessment, and feedback session), and it directly involved the adolescent (although parents could also receive a feedback session). Because this study sought to assess the effects of a family intervention on substance use outcomes, participation in the TCU in and of itself was not considered an indicator of engagement in the intervention.

Assessment Procedures

Prior to data collection, this study underwent evaluation and received approval from the University of Oregon’s Internal Review Board. Participants and their parents or guardians provided informed consent by signing a consent form. There were no exclusion criteria; all youth and families who were enrolled in the participating public schools in regular education classes were recruited for participation in this prevention trial. In the spring semester of Grades 6 through 9 and again in Grade 11, students were surveyed with an instrument developed by colleagues at the Oregon Research Institute (Metzler, Biglan, Rusby, & Sprague, 2001). Most assessments were conducted in the schools. If students moved out of their original schools, they were followed up at their new location. For assessments conducted at ages 19, 22, and 23, questionnaires were mailed to the participants, who mailed them back to our research office. Participants were paid for completing each assessment. Completion and retention rates were similar for the intervention and the control groups.

Measures

Adolescent substance use. Youth completed a self-report survey about their drug use at ages 11, 12, 13, 14, 16–17, 19, and 22. Each year they were asked to report the frequency with which they had used alcohol (number of drinks), tobacco (number of cigarettes), and marijuana (number of times smoked) in the previous month.

Child gender. Child gender was coded as 0 = “male” and 1 = “female.”

Child ethnicity. Youth reported about their ethnicity, which was coded as 0 = “European American” and 1 = “ethnic minority.”

Father presence. Youth reported about biological father presence in their primary residence in Grade 6, which was coded as 0 = “biological father not present” and 1 = “biological father present.”

Teacher report of risk behavior (TRISK) in Grade 6. Teachers were asked to use a 16-item questionnaire to rate their full roster of Grade 6 students on a variety of risk behaviors associated with problem behavior in adolescence. This measure was revised from an earlier version of the TRISK measure developed by Soberman (1994). The frequency with which youth engaged in these problem behaviors was reported using a 5-point scale ranging from 1 (*never/almost never*) to 5 (*always/almost always*). Items included aggression, oppositionality, peer relationship problems, disliking school, and moodiness. The mean for this sample was 1.85 (*SD* = 0.85). High internal consistency reliability was found for this scale (α = .95), and total scores were standardized. This variable was standardized within classroom and mean centered for use in analyses.

Deviant peer involvement in Grade 6. Youth reports of deviant peer involvement during Grade 6 were measured averaging across four items, that is, participants' reports of the number of times in the past week they had spent time with peers who (a) get into trouble, (b) fight a lot, (c) take things that don't belong to them, and (d) smoke cigarettes or chew tobacco. Responses ranged from 0 (*never*) to 7 (*more than seven times*). The mean for this sample was 0.76 (*SD* = 1.11). Good internal reliability was found for this scale (α = .79). Deviant peer involvement was centered about its mean for use in all analyses.

Family conflict in Grade 6. Youth reports of family conflict during Grade 6 were measured averaging across five items. Items reflected the frequency with which family members engaged in a variety of conflict behaviors (e.g., "got angry with each other," "argued at the dinner table"). Responses ranged from 0 (*never*) to 7 (*more than seven times*). Good internal reliability was found for this scale (α = .81). This variable was mean centered for use in analyses.

Intervention status. Random assignment was coded as 0 = "control," and 1 = "intervention."

Engagement status. Although any family in the intervention condition could elect to receive the FCU, parent consultants used the previously described teacher rating of students' risk behavior to identify youth and families in the intervention group whom they actively invited to participate in the FCU. The at-risk students and families were invited to participate in more intensive assessments, and then in turn, in a feedback session based on their assessments. The procedure was initiated in Grade 7 and then repeated in Grade 8 (middle school) and in Grade 11 (high school). There were two levels of potential refusal. One was to not engage in the assessment. Because the FCU is based on feedback, if a parent did not engage in the family assessment, feedback was not possible. The second was to have the assessment but decline feedback about the assessment. All intervention families who participated in the assessment were equally recruited into a 1-hour feedback session. Despite the brief nature of the feedback session, 52.1% of the families declined the feedback after completing an assessment in middle school. However, at any time, a family could request an FCU despite prior refusals to engage in either the assessment or feedback sessions. In fact, 44.7% of families who declined the FCU in middle school after completing an assessment decided to participate in the FCU or the TCU later on, in high school.

Although the concept of engagement can be defined using a continuous score that reflects a combination of behavioral and psychological involvement with the program (Byrnes, Miller, Aalborg, Plasencia, & Keagy, 2010), the statistical framework used in this study (CACE models) requires a stricter, dichotomous operationalization of this concept (i.e., engager or nonengager). Engagement status was thus coded to reflect family participation in the FCU at any time the service was offered during the middle school period (and further intervention services, as warranted). Families in the intervention condition who elected to receive the FCU were coded 1

(n = 115), and families in the intervention condition who did not receive the FCU were coded 0 (n = 385). Another specificity of our operationalization of the concept of engagement relative to that of other studies is that control engager- and nonengager-equivalent groups were formulated using the CACE statistical modeling protocol developed by Jo (2002). In other words, mixture modeling made it possible to assign families from the control group to either the engager or the nonengager class, even though they had not been offered the intervention. This assignment is crucial to the estimation of treatment effects within the CACE framework.

Problematic substance use in Early Adulthood. We created three scores that would reflect the degree of abuse or dependence for tobacco, alcohol, and marijuana use reported at age 23. Questions were those asked in the Composite International Diagnostic Interview (CIDI) version 2.1 (WHO, 1997). They included, “Have you tried to stop using [a substance] and found you could not?” (used for all substances), “How many times have you had five or more drinks in a row?” (used for alcohol), “When you drink alcohol, do you usually get buzzed?” (used for alcohol), “When you used marijuana, did you get high?” (used for marijuana), and “Have you found that you can’t get as high (or buzzed) on [this substance] as you used to?” (used for alcohol and marijuana), “Have you ever gone to school or work when you were high (or drunk) on [this substance]?” (used for alcohol and marijuana), and “Have you ever had any problems related to school or work, such as not doing assignments or forgetting things because of this substance?” (used for marijuana). Those questions were answered by *yes* (coded 1) or *no* (coded 0). For the “…did you get high?” (marijuana) and “…do you usually get buzzed?” (alcohol) items, a follow-up question was provided to individuals who answered “yes,” asking “How high (buzzed) did you get?” Using a 3-point scale, participants indicated whether they got “a little,” “quite a bit,” or “very much” high or drunk. Participants’ responses to this question were combined with the previous one and placed on a scale between 0 and 1. Possible scores included .33 (*a little bit*), .66 (*quite a bit*), and 1 (*very much*). Answers to all questions were summed such that total scores could range from 0 to 1 for tobacco, from 0 to 5 for alcohol, and from 0 to 6 for marijuana on the early-adulthood problematic substance use scales. Therefore, problematic substance use scores were dichotomous for tobacco (i.e., participants' report that they tried to stop using tobacco but could not) and continuous for alcohol and marijuana.

Analytic strategy. CACE analyses were conducted as mixture models using Mplus version 6, with the maximum likelihood robust estimator and full information maximum likelihood (FIML) estimation to account for missing data. This enabled us to run the CACE model on all participants with complete data on all predictor variables (n = 977). As described in further detail by Jo (2002), CACE modeling is predicated on a number of assumptions that are required for the CACE analyses to provide an unbiased estimate of the intervention effect for the complier group. These assumptions include (a) assignment to treatment is random; (b) potential outcomes for each participant are independent of the outcomes for other participants; (c) there is no effect for "nonengagement" in the intervention group; (d) there are no "defiers," that is, individuals who will always do the opposite of instructions regardless of the instruction; and (e) the average causal effect of assignment to intervention on the actual receipt of intervention is not zero. The third assumption ("c"), known as the *exclusion restriction*, is critical to the validity of the CACE model findings (Jo, 2002). In this study, we assumed that there was no effect on families or youth for declining the FCU service. To make our CACE models even more reliable, we also included several predictors of compliance status. Including significant predictors of compliance provides many benefits: It improves the prediction of compliance class, it increases power to detect treatment effects among participants in the "complier" class, and it helps protect against potential biases that could arise if the exclusion restriction were violated (Jo, 2002). For more information about the identification of relevant predictors of compliance for our CACE models, see the Results section under the subhead “Comparison of engager and nonengager families.”

Observed engagement/nonengagement with the FCU in the intervention condition was used as a “training” variable in Mplus. This information was available for families in the intervention group but missing for control group families because the latter were not offered the intervention, so they did not have a chance to either accept or decline the FCU. Using mixture modeling, Mplus estimates the likelihood that individuals in the control condition would have engaged with the FCU if they had been assigned to the intervention group, based upon the observed engagement in the intervention group and covariates, to identify individuals in the control group most likely to have engaged with the FCU, if they had had the opportunity to do so. Using a standard visual presentation for mixture modeling (e.g., Muthén & Muthén, 1998–2012), the general model applied for each substance separately is shown in Figure 2.

Results

Preliminary Analyses

Missing data analysis. A missing-value analysis was conducted using SPSS version 21. The Little’s MCAR test conducted on all measures (excluding categorical variables, i.e., gender, ethnicity) revealed that the pattern of missing values was not completely random, $\chi^2(1973) = 2345.14$, $p < .001$. Using a variable that summed the number of missing values for each participant, we found weak (.07 to .16) but significant correlations between missingness and risk behavior, the male gender, being a member of a minority ethnic group, and absence of biological father. Substance use was correlated with missing data for each of our three models (i.e., alcohol, tobacco, marijuana). Therefore, the missing data pattern was likely “missing at random” (MAR), such that the inclusion of several predictors of missingness in our primary models made it reasonable to assume that FIML would successfully address our missing data issue.

Descriptive statistics. Means and standard deviations, available in Table 1, indicate that participants increased their use of all substances across adolescence. Table 1 also presents bivariate correlations. The upper section presents intercorrelations among the variables that had been shown in past research to predict engagement in the FCU and that were retained to play that role again in this study. To these four variables, we added two demographic variables, gender and ethnicity, and the variable representing intervention group. As expected, the correlations between all these variables and the intervention variable were close to zero. The lower section of Table 1 shows how substance use correlates with demographic variables and predictors of engagement in the intervention. For all three substances (alcohol, tobacco, marijuana), we included the five measures of substance use in adolescence and two measures of substance abuse or dependence in early adulthood.

Comparison of engager and nonengager families. We first examined differences between families who engaged or did not engage with the FCU when randomly assigned to the intervention condition. Ultimately, variables distinguishing engagers and nonengagers in the intervention group would help assign participants in the control group to the engager or nonengager subgroups in the CACE models. Prior work with CACE modeling in this sample identified several significant predictors of engagement at baseline, including family conflict, deviant peer association, and the presence of the biological father at home (Connell et al., 2007). As would be expected based on the multiple gating engagement strategy, teacher rating of risk was predictive of FCU engagement in middle school. Table 2 shows that when the subgroup of participants who were assigned to the intervention was examined, these variables were indeed significantly related to engagement status. In fact, some participants with risk factors in their background (i.e., father absence, high levels of family conflict, and more deviant peers) were more likely to engage in the intervention, even after controlling for the significant contribution of teacher rating of risk. Table 2 shows that proportions of females and minority youth did not differ for engagers and nonengagers.

Intent to treat (ITT) analyses. To verify whether the intervention had significant effects on change in substance use in adolescence and problematic substance use by early adulthood regardless of participants' engagement in the intervention, we ran traditional ITT analyses. Specifically, for each of the three substances, we modeled growth in substance use from age 12 through age 22 using a linear and a quadratic term. A positive quadratic term reflects acceleration of substance use over time, whereas a negative quadratic term reflects its deceleration. We also included a variable reflecting problematic substance use in early adulthood. Treatment assignment (along with all control variables) was simultaneously regressed on the linear and quadratic slopes and on problematic substance use at age 23.

For alcohol and tobacco use, randomized assignment to the intervention group was not significantly related to growth in substance use during adolescence or to problematic substance use by early adulthood. No significant results emerged when looking at European Americans and minority participants separately. Nevertheless, participants' assignment to the intervention group was associated with a deceleration in the growth of marijuana use observed from early adolescence to adulthood ($\beta = -.09$, $p < .05$).

CACE Models Results

Separate models were conducted for two formulations of engagement in the FCU and for each of the substance use outcomes. The first version of engagement was more restrictive in that it was based on participation in the FCU as part of the middle school intervention, in the context of which our team was able to provide indicated services. The second operationalization was based on participation in the FCU as part of either the middle school or the high school intervention. Because the FCU in high school was not followed by follow-up services offered by our team, this is a liberal operationalization of engagement in the intervention.

Engagement in middle school FCU. Tables 3 through 5 show the relation between each predictor and participants' class membership (i.e., engager or nonengager). They also show the relation between predictors and the growth in substance use throughout adolescence. More important, these tables show whether intervention status relates to growth in substance use. Because the participants were randomly assigned to either the intervention or the control group at the beginning of the study, we can assume that treatment assignment is unrelated to participants' class membership, so this relationship has been fixed to zero. Similarly, intervention group can be assumed to be unrelated to the intercept of substance use in the growth model, which was thus fixed to zero. In line with the exclusion restriction assumption of CACE modeling, the relation between intervention status and growth in substance use or problematic substance use was assumed to be null in the nonengager class, and these parameters were fixed to zero.

CACE models are based on mixture modeling. Therefore, available fit indices are different from the absolute and comparative fit indices that are usually reported for structural equation modeling. The fit index used for the current analyses was entropy, which represents the probability that a participant belongs to the group to which it was assigned. In this model, the classes were "engagers" and "nonengagers." Entropy values ranged from 0 to 1.0, and although specific cutoffs for adequate entropy have not yet been established, higher values indicate better model fit because it means that, on average, participants from the control group can be efficiently assigned to their class (engager or nonengager), with a low probability of error (Muthén & Muthén, 1998–2012). For all three models tested here, entropy values were high: .93 for the alcohol model, .98 for the tobacco model, and .96 for the marijuana model.

Predictors of engagement. In each model, Grade 6 predictors were used to discriminate participants' class membership. These analyses were conducted using a logistic regression framework in which the nonengager class was the reference group. Across all three models (alcohol, tobacco, and marijuana), participants were more likely to be assigned to the engager class when their biological father was absent from home and when their teacher reported higher levels of risk. As expected based on the school engagement strategy, these predictors were at least marginally significant across the three models. Females and youth who reported higher levels of family conflict were at least marginally more likely to belong to the engager class in the alcohol and tobacco models. Last, youth who had more deviant peers were more likely to be assigned to the engager class in the tobacco model.

Predictors of within-class variation. The key question in all three CACE models was whether random assignment to the intervention (FCU) predicted variation in substance use, abuse, and dependence within the engager and nonengager classes. The answer to this question is depicted in Figures 3 and 4, which illustrates the results reported in Tables 3 to 5. In the alcohol model (Figure 3, panel A), engagers in the control group had a steeper linear increase in alcohol use than did engagers in the intervention group. There was a marginally significant quadratic effect, suggesting that engagers in the intervention group delayed initiation of alcohol use, but they tended to "catch up" with engagers in the control group in early adulthood. To compute the treatment effect size, we used the difference between alcohol use among engagers in the treatment group and alcohol use among engagers in the control group, at the last time point of measurement in the growth model (i.e., age 22). The difference in alcohol use was medium to large range, $d = 0.62$ (Cohen, 1988). Problematic alcohol use was also lower for engagers in the treatment group than for engagers in the control group, with a large associated effect size, $d = 1.20$. Panel A in Figure 4 shows the percentage of participants who displayed at least one symptom of alcohol abuse/dependence by age 23, separately for the four groups (engagers and nonengagers from the intervention group, and control-equivalent groups for each). Engager-equivalent participants in the control group displayed strikingly higher rates of abuse/dependence.

In the tobacco model, engagers in the control group showed a steeper linear increase in tobacco use compared with engagers in the intervention group. There was also a significant quadratic effect, revealing that the rapid increase in tobacco use among engagers in the control group was followed by a decrease in tobacco use when they entered adulthood (Figure 3, panel B). In contrast, engagers in the intervention group used relatively small quantities of tobacco during adolescence, but their usage accelerated into early adulthood. The effect size associated with the difference in tobacco use by age 22 between the two groups was large, $d = 1.14$. By age 23, engagers in the intervention group displayed less problematic tobacco use than did engagers in the control group, with an effect size of $d = 0.69$, which is in the medium to large range. Panel B in Figure 4 shows the percentage of participants who displayed tobacco dependence by age 23, separately for the four groups. Engager-equivalent participants in the control group displayed strikingly higher rates of dependence.

In the marijuana model (Figure 3, panel C), engagers in the control group had a steeper linear increase in marijuana use than did engagers in the intervention group. The effect size associated with the difference between the two groups at age 22 was large, $d = 1.17$. By age 23, engagers in the intervention group had less problematic marijuana use than did engagers in the control group. This result is marginally significant, but the effect is medium in size, $d = 0.53$. Panel C in Figure 4 shows the percentage of participants who displayed at least one symptom of marijuana abuse/dependence by age 23, separately for the four groups. Engager-equivalent participants in the control group displayed strikingly higher rates of abuse/dependence.

Engagement in middle or high school FCU. Overall, CACE model results obtained when the more liberal formulation of FCU engagement was used tended to yield results similar to those obtained with a stricter definition of engagement (i.e., middle school only). For the alcohol use model, entropy dropped to .54 when this more liberal definition of engagement was used. Also, intervention was unrelated to linear or quadratic change in alcohol use during adolescence and to problematic alcohol use by age 23. The tobacco model yielded an entropy value of .83 and confirmed that the intervention protected engagers in the intervention group against a linear growth in tobacco use, although this result was marginally significant ($b = –.81$, $p = .09$). The intervention had no effect on acceleration in tobacco use, but we confirmed that engagers in the intervention group were protected against problematic tobacco use by age 23 ($b = –1.60$, $p < .001$). In the marijuana model, entropy remained high (.89). The intervention effect on linear increase in marijuana use was no longer significant, but engagement in the FCU in either middle or high school protected against acceleration of marijuana use during adolescence ($b = –.11$, $p < .001$), a finding that did not emerge when considering middle school engagement only. Again, the intervention predicted less problematic marijuana use by age 23 ($b = –1.09$, $p < .001$).

Discussion

Intervention Effects

The goal of this study was to test the hypothesis that a multilevel, family-centered prevention strategy offered in public middle schools decreased substance use, abuse, and dependence from early adolescence until early adulthood (age 23). It is noteworthy that over 90% of the community of families enrolled in the three targeted schools agreed to participate in research assessments, and 80% of those were retained through early adulthood. Thus the findings apply to the preventive impact of embedding family services within schools for all students within this community. When we simply used ITT models to compare the longitudinal pattern of alcohol, tobacco, and marijuana use through early adulthood, we found that the intervention youth used less marijuana during the 10-year follow-up period. These results are encouraging for the prevention of substance use because it is rare for early adolescent interventions to have such enduring effects (Hawkins et al. 2005; 2007; O'Donnell et al., 1995). However, no significant effects were detected on alcohol and tobacco use in the ITT models, perhaps because of the legalilty of those substances and potential for normative use in late adolescence.

When applying CACE modeling, engagement in the FCU increased the effect size of treatment impact on all substances. Youth whose families engaged in the FCU in middle school used less tobacco, alcohol, and marijuana in adolescence. They were also less likely to be dependent or to experience negative consequences of substance use by age 23, a finding based on the number of symptoms of abuse and dependence reported at that age. One major difference between these findings and past results based on this sample during the adolescent period only (Connell et al., 2007) is that only the linear term of the growth models was significant in the previous study, whereas the current study estimated the quadratic term which captures acceleration and deceleration in substance use. An analysis of quadratic trends in the context of the CACE models suggested that intervention effects on tobacco and alcohol were diminishing due to acceleration of use of these legal substances in the intervention group during early adulthood. However, despite these acceleration trends, the findings suggest enduring effects of the FCU on preventing progressions in problematic use and dependence of tobacco, alcohol, and marijuana.

The use of CACE modeling (Jo, 2002) to study engagement is a recent statistical tool that is particularly effective for the analysis of public health-oriented preventive interventions in which every individual in the community is availed the opportunity to use a service, and engagement in the service for the intervention group is completely voluntary. In this study, even though all the high-risk families assigned to the intervention group were equally invited to participate in the FCU, only a subgroup agreed to do so during middle school (33.4% of high-risk families) or high school (31.0% of high-risk families). Findings from this study suggest that engagement of high-risk families is indeed possible yet imperfect. High-risk families were initially invited to participate, but also families were referred during the school year if student behavior or academic problems emerged. Thus, as would be expected, baseline characteristics of the participants revealed that engagers were generally higher risk longitudinally than nonengagers. It is noteworthy that it is difficult to disentangle efforts to reach out to families of students that teachers identified as at risk from school referral processes and family motivation to engage. However, it is critical for future research to identify optimal, respectful strategies for identifying and engaging parents who would most benefit from the FCU and other parenting services.

It is worth noting that the formulation of the engager- and nonengager-equivalent control participants is a specific application of mixture modeling of longitudinal data. Engagement and nonengagement within the intervention group is estimated as a categorical latent variable, based upon the longitudinal trajectories of substance use and status on baseline predictors, as well as the assumption that not engaging in an intervention does not have a causal effect on the outcomes of interest (Jo, 2002). In these models, some of the baseline predictors of engagement were consistent across the three models, whereas others were not. In all three models, biological father's absence predicted engagement in the FCU. We hypothesized that our program would be particularly appealing for families with an absent father and a single mother burdened by raising children alone who is keen to get extra support from a parent consultant. Single mothers may also be attracted to this school-based program that includes home visits, because it requires less time and presents fewer obstacles than does visiting a professional's office. Similarly, family disadvantage might predict engagement because the FCU services were freely available to all families. These findings suggest that evidence-based family support services embedded within school systems could be one strategy for reducing health disparities. It is noteworthy that ethnicity of the family did not predict engagement, or not.

It is not surprising that teacher ratings of risk were associated with engagement, given the multiple gating strategy for engagement. By way of comparison, other family-centered researchers note that as little as 17% of families identified will participate in family research, even though they may be assigned to the control group (Spoth et al., 2013). The fact that 34.3% of all identified high risk families engaged is promising, even though two thirds of high-risk families did not engage in the FCU, despite its repeated availability. We have since revised the multiple gating approach to begin with parents assessment of student readiness at school entry, which is then followed by teacher assessments later in the school year (see Moore, Garbacz, Gau, Dishion, Brown, Stormshak, & Seeley, in press).

Female gender and ethnic minority group membership also helped distinguish among engagers and nonengagers in the alcohol and tobacco models. Based on gender norms, the threshold at which parents of girls become worried about their substance use may be lower than it would be for boys, so parents of girls may be motivated to participate in the FCU even when their daughter shows relatively low levels of problem behavior (Kulis, Marsiglia, & Hecht, 2002). This finding is also consistent with a commonly reported trend that compared with parents of adolescent boys, parents of adolescent girls monitor their children more carefully (Dishion, Ha, & Véronneau, 2012). Cultural norms and lower prevalence of substance use among some ethnic groups, including African Americans (Miller-Day & Barnett, 2004; Roberts, Roberts, & Xing, 2006), could have a similar effect and motivate parents of some minority students to seek external support when they witness relatively minor warning signs.

Deviant peer affiliation was predictive of engagement only in the CACE model of tobacco use. This outcome could have resulted because the teacher-reported measure—which also functioned as a screening instrument that helped us reach out to families at risk—included items about friendships with peers who smoked cigarettes. Because cigarette smoking is known to be a socially contagious behavior (Dishion et al., 1995; Rowe, Chassin, Presson, Edwards, & Sherman, 1992), this item might have helped us identify adolescents who were at particularly high risk for this behavior and reach out to them. If this is true, including items in the screening tool about other risk behaviors among participants' friends may be an efficient way to target at-risk participants.

Other Predictors of Substance Use

Besides assignment to the treatment group, several other variables contributed to predicting change in substance use throughout adolescence and problematic substance use in adulthood. Consistent with available epidemiological data (Wallace et al., 2002) and with previous findings based on this sample (Connell et al., 2007), our study data indicated that European Americans in the engager group were at higher risk than were participants from minority groups to have a steep increase in tobacco and marijuana use. Among nonengagers, an even stronger pattern was revealed, with European American adolescents increasing their use of all substances more steeply and with greater acceleration than did minority participants. They were also more likely to present symptoms of abuse of or dependence on alcohol and marijuana. Normative beliefs and values about substance use in some minority groups might help keep substance use at lower levels, even among nonengager participants (Miller-Day & Barnett, 2004).

CACE models showed that deviant peers were the most consistent risk factor for substance use across engagers and nonengagers, even after controlling for participants' own problem behavior, perhaps because peer pressure for deviant behaviors, such as substance use, is a mechanism that was in place before the intervention. Deviant peers predicted higher levels of tobacco and marijuana use at the onset of the study, and past research suggests that deviancy training may start as early as kindergarten (Snyder et al., 2005). It could be hard for a middle-school intervention to counteract deviant peer influence that may have been at work for several years before parents were offered the FCU, and some peer influences may have been deeply ingrained.

Strengths and Limitations

The randomized design and the measurement of engagement in this prevention trial made it possible to gain unique insights about the development of substance use among normative youth and to observe moderation effects of engagement in the FCU, the targeted component of an adaptive, ecological prevention program that is school based and family focused. Our 12-year longitudinal design and very high retention rate provided a rare opportunity to study changes in substance use from early adolescence to early adulthood. Even more important, the study revealed the effects of a brief intervention—fewer than 12 hours per family on average over several years—on substance use 10 years later. The multiethnic sample helped us test for ethnic differences in intervention effects and to reflect on the power of cultural norms and values as a protective factor against substance use among minority students. Modeling the growth in substance use from age 11 through 22 and problematic substance use at age 23 separately for alcohol, tobacco, and marijuana use is also a strength of this study in that specific effects of the FCU on each substance were identified.

In spite of its strengths, this study also presents some limitations. Participants' yearly retrospective self-reports about their substance use may introduce some measurement error; from that perspective time line follow back approach would improve accuracy of recall in future studies. In addition, because levels of socioeconomic status were not measured at baseline, we could not include this variable as a baseline predictor of engagement or substance use. It is likely that families with limited resources are particularly attracted to free services like the FCU and follow-up interventions; this possibility and its implications for implementation of such programs need to be tested. Limitations related to the CACE modeling framework also must be noted. First, it is difficult to be sure that declining participation (nonengager class) did not influence outcomes (exclusion restriction). However, as can be seen from all analyses, the nonengager group was generally less risky than those who engaged, and therefore, it seems most likely that the FCU simply was not relevant to the families' needs or concerns. In addition, by identifying several predictors of engagement and including them in the model as covariates, the results from this model are more likely to be valid. Second, CACE models do not currently allow inclusion of mediators that would make it possible to test for mechanisms that explain observed differences among engagers from the control versus the intervention group. When these analytic options are available, it will become possible to test whether aspects of family dynamics that are influenced by the FCU mediate the effects of intervention, when taking engagement into account. Aspects of family dynamics that have been shown to be influenced by the FCU include the quality of family relationships, family conflict, and parental monitoring (e.g, Caruthers, Van Ryzin, & Dishion, 2014; Dishion, Nelson & Kavanagh, 2003; Van Ryzin et al., 2012).

Last, CACE models do not yet provide the opportunity to look at complex patterns of compliance over time, and the comparison of results using various formulations of compliance is preliminary. Although intervention components such as the TCU and the high school FCU may have contributed to some extent to the long-term intervention effects above and beyond the impact of middle school FCU, the powerful effect of middle school FCU cannot be denied. Specifically, this intervention was powerful enough to significantly reduce antisocial behavior and substance use at age 16–17, that is, prior to the delivery of high school FCU and TCU (Connell et al., 2007). Furthermore, the sensitivity analyses used to examine different definitions of engagement (FCU in middle school only, FCU in middle or high school, and FCU or TCU) suggested that the strongest intervention effects are observed when we limit our definition of engagement to FCU in middle school. Engager-equivalent participants in the control group could not be as clearly identified when our definition of engagement was broadened and intervention effects were attenuated, which means that high school FCU and TCU do not fully explain the long-term intervention effects reported here. This suggests that the effects of these additional components are mixed, perhaps because of diverse and complex patterns of compliance that are difficult to capture with available techniques or because of varying levels of efficacy across the FCU and TCU. Yet to be explored, however, is the added value of engaging in the FCU many times rather than just once, or of engaging in the TCU in addition to the FCU. These questions are beyond the scope of this study; nevertheless, forthcoming methodological developments (e.g., Lin, Ten Have, & Elliott, 2008) could facilitate the examination of time-varying compliance in future studies.

Implications

Response to Intervention (RTI) is a general strategy for addressing the varying needs of students within a public school environment (Brown-Chidsey & Steege, 2011). Our data suggest that a similar strategy (i.e., multiple gating) could be applied to address the social and emotional needs of students in middle school. Interventions such as the FCU that are data driven, and target and successfully engage high-risk families is a promising public health strategy for the prevention of substance use progressions, antisocial behavior, and depression. We contend that family interventions should be embedded within public school systems in such a way that would seamlessly engage parents and improve their monitoring and support of students within a well-coordinated system of family-centered services (Dishion, 2011).

We suspect that our study reflects a conservative estimate of the potential of the FCU model to influence prevention effects. We hypothesize that offering FCU and parent management services every year in a seamless, nonstigmatizing fashion in the public school environment would enable parents to turn around risk trajectories that lead to a variety of problem behaviors, including early substance use and abuse. One of the major barriers, however, in moving forward with evidence-based family interventions in the public school, is the lack of identified staff with the training and professional mandate to successfully engage parents to complement efforts in schools to manage and retain high risk students in the mainstream learning environment. In a randomized trial of 41 public middle schools, implementation of the FCU by school staff was compromised by the lack of school counselors training in working with parents, staff turnover and the lack of school district support for parent engagement in evidence based support services (Dishion, Garbacz, Moore, Stormshak, Kim, & Seeley, 2015). We hypothesize that school district support for the integration of evidence-based family services with a range of other positive behavior management services would significant improve the mental health and reduce the risk for substance use and dependence among young people at the community level.

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Table 1. Descriptive Statistics and Bivariate Correlations

Variable	*M*	*SD*	Intervention	Gender	Ethnicity	Family conflict age 11	Deviant peer association age 11	Teacher risk perception age 11	Biological father presence age 11
Intervention	.50	.50	—						
Gender	.47	.50	−.02	—					
Ethnicity	.42	.49	.01	−.02	—				
Family conflict	.91	1.03	.02	.01	−.16***	—			
Deviant peer association	.75	1.11	−.01	−.10**	−.15***	.46***	—		
Teacher risk perception	.00	.98	.02	−.25***	−.19***	.19***	.28***	—	
Biological father presence	.59	.49	−.06*	−.06*	.16***	−.09**	−.05	−.23***	—
Alcohol use									
Wave 1	.55	1.76	.03	−.03	.09**	.28***	.30***	.14***	.00
Wave 2	.61	1.69	.09**	−.01	−.02	.12***	.15***	.11**	.02
Wave 3	.65	1.82	−.02	.01	.05	.12***	.15***	.10**	−.03
Wave 4	.70	1.99	−.02	.05	.10**	.04	.06†	.09**	−.09**
Wave 6	1.10	2.32	.04	−.03	.20***	.01	.03	.03	.01
Wave 7	3.80	4.80	.03	−.16***	.28***	−.03	−.04	−.02	.06
Wave 8	6.88	4.99	−.04	−.21***	.26***	.00	.01	−.01	.18***
Problematic alcohol use (Wave 9)	1.42	1.07	−.02	−.15***	.18***	.04	.03	.00	.08*
Tobacco use									
Wave 1	.50	2.19	.04	.03	−.09**	.20***	.32***	.11***	−.01
Wave 2	.70	2.59	.04	.03	−.04	.11***	.20***	.13***	−.01
Wave 3	.60	2.44	.00	.07†	.01	.12***	.17***	.15***	−.08*
Wave 4	1.13	3.75	.00	.06†	.08*	.04	.13***	.15***	−.16***
Wave 6	2.24	5.37	.05	.06	.10**	.08*	.16***	.12***	−.05
Wave 7	3.51	6.50	.01	.02	.13***	.08*	.12**	.11**	−.06
Wave 8	5.11	7.47	.03	−.06†	.08*	.09*	.17***	.14***	−.07*
Problematic tobacco use (Wave 9)	.20	.40	.05	−.05	.01	.06	.12***	.13***	−.03
Marijuana use									
Wave 1	.22	1.26	.03	−.02	−.08**	.17***	.26***	.14***	−.06†
Wave 2	.34	1.50	.10**	.04	−.11***	.07*	.18***	.11**	−.03
Wave 3	.46	1.77	.01	−.01	−.04	.12***	.16***	.16***	−.07†
Wave 4	.69	2.30	−.03	.06†	−.01	.04	.12***	.13***	−.10**

Wave 6	1.34	3.31	.00	−.04	.07*	.06†	.09*	.09*	−.03
Wave 7	1.92	4.02	−.03	−.12***	.09*	.04	.09*	.08*	.01
Wave 8	3.26	5.16	−.06	−.14***	.10**	.01	.04	.10**	−.03
Problematic marijuana use (Wave 9)	1.18	1.29	−.03	−.12***	.10**	.08*	.08*	.12***	.04

*p <.05; **p < .01; ***p < .001. Intervention: 0 = no, 1 = yes; gender: 0 = male 1 = female; ethnicity: 1 = Euro, 0 = minority; *M* = mean; *SD* = standard deviation.

Table 2. Comparison of Engager and Nonengager Randomized to the Intervention Condition

	Nonengagers (n = 385)		Engagers (n = 115)		
Variable	%	*M* (*SD*)	%	*M* (*SD*)	Omnibus test
Female gender	44.9		51.3		$\chi^2(1, N = 500) = 1.44$, *ns*
Ethnic minority status	55.6		62.6		$\chi^2(1, N = 500) = 1.79$, *ns*
Biological father present	61.1		40.4		$\chi^2(1, N = 494) = 15.27, p < .001$
Family conflict (6th grade)		0.84 (0.93)		1.25 (1.28)	$F(1, 494) = 14.09, p < .001$
Deviant peers (6th grade)		0.66 (1.05)		1.01 (1.26)	$F(1, 495) = 9.45, p < .01$
Teacher perception of risk (6th grade)		−0.07 (0.96)		0.31 (1.01)	$F(1, 494) = 13.88, p < .001$

Table 3. CACE Model Testing Effect of Intervention on Growth in Alcohol Use During Adolescence and on Problematic Alcohol Use in Early Adulthood

		Within-class variation							
	Class membership	Nonengager class				Engager class			
Intervention status, variable, and parameter	Engager vs. nonengager logit (*SE*)	Intercept est. (*SE*)	Linear slope est. (*SE*)	Quadratic slope est. (*SE*)	Problematic alcohol use (*SE*)	Intercept est. (*SE*)	Linear slope est. (*SE*)	Quadratic slope est. (*SE*)	Problematic alcohol use (*SE*)
Intervention status	Fixed at 0	Fixed at 0	Fixed at 0	Fixed at 0	Fixed at 0	Fixed at 0	-1.44 (.55)**	0.13 (.07)†	-1.18 (.46)**
Variable									
Gender (female)	-0.38 (0.22)†	-0.05 (0.11)	0.24 (0.09)**	-0.05 (0.01)***	-0.33 (0.08)***	0.10 (0.35)	0.08 (.30)	-0.02 (0.04)	-0.33 (0.25)
Ethnicity	-0.17 (0.22)	-0.09 (0.10)	0.08 (0.07)	0.02 (0.01)*	0.40 (0.09)***	-0.13 (0.47)	0.60 (.40)	-0.03 (0.05)	0.20 (0.25)
Biological father present (6th grade)	0.37 (0.22)†	0.31 (0.12)	-0.30 (0.08)***	0.04 (0.01)***	0.03 (0.09)	-0.09 (0.49)	-0.47 (.33)	0.06 (0.04)	0.39 (0.25)
Family conflict (6th grade)	-0.30 (0.10)**	0.32 (0.09)	-0.16 (0.05)**	0.02 (0.01)**	0.01 (0.06)	0.07 (0.19)	-0.02 (.12)	-0.01 (0.02)	0.08 (0.11)
Deviant peers (6th grade)	-0.01 (0.11)	0.28 (0.07)	-0.07 (0.05)	0.00 (0.01)	0.04 (0.05)	0.47 (0.17)**	-0.13 (.13)	0.02 (0.02)	-0.04 (0.16)
Teacher report of risk (6th grade)	-0.27 (0.11)*	0.12 (0.07)	0.02 (0.04)	0.00 (0.01)	-0.04 (0.05)	0.05 (0.17)	0.00 (.14)	-0.01 (0.02)	0.00 (0.11)
Parameter									
Intercept/threshold	1.75 (0.23)***	0.48 (0.10)***	-0.26 (0.09)**	0.10 (0.01)***	1.32 (0.09)***	0.78 (0.33)*	1.02 (0.68)	-0.03 (0.08)	2.50 (0.52)***
Residual variance	—	0.74 (0.23)**	0.23 (0.11)*	0.01 (0.00)***	1.01 (0.07)***	0.74 (0.23)**	0.23 (0.11)*	0.01 (0.00)***	1.01 (0.07)***

Table 4. CACE Model Testing Effect of Intervention on Growth in Tobacco Use During Adolescence and on Problematic Tobacco Use in Early Adulthood

		Within-class variation							
	Class membership	Nonengager class				Engager class			
Intervention status, variable, and parameter	Engager vs. nonengager logit (*SE*)	Intercept est. (*SE*)	Linear slope est. (*SE*)	Quadratic slope est. (*SE*)	Problematic tobacco use (*SE*)	Intercept est. (*SE*)	Linear slope est. (*SE*)	Quadratic slope est. (*SE*)	Problematic tobacco use (*SE*)
Intervention status	Fixed at 0	Fixed at 0	Fixed at 0	Fixed at 0	Fixed at 0	Fixed at 0	-5.02 (1.17)***	0.50 (0.15)***	-1.44 (0.56)**
Variable									
Gender (female)	-0.51 (0.21)*	0.13 (0.14)	0.19 (0.10)*	-0.03 (0.01)**	-0.27 (0.21)	0.54 (0.41)	0.14 (0.39)	-0.01 (0.06)	-0.10 (0.46)
Ethnicity	-0.27 (0.22)	-0.17 (0.12)	0.17 (0.09)*	0.00 (0.01)	0.11 (0.21)	-0.57 (0.42)	0.92 (0.35)**	-0.04 (0.04)	0.10 (0.44)
Biological father present (6th grade)	0.80 (0.21)***	0.06 (0.14)	-0.16 (0.11)	0.01 (0.01)	-0.10 (0.65)	0.98 (0.57)†	-0.36 (0.39)	0.01 (0.05)	0.75 (0.49)
Family conflict (6th grade)	-0.16 (0.09)†	0.20 (0.11)†	-0.12 (0.14)	0.02 (0.01)†	-0.08 (0.12)	-0.25 (0.26)	0.35 (0.19)†	-0.05 (0.02)*	0.08 (0.21)
Deviant peers (6th grade)	-0.23 (0.09)*	0.55 (0.14)***	-0.22 (0.09)*	0.03 (0.01)*	0.20 (0.10)†	0.53 (0.21)**	-0.34 (0.20)†	0.06 (0.02)**	-0.10 (0.18)
Teacher- reported risk (6th grade)	-0.32 (0.10)***	0.04 (0.09)	0.04 (0.07)	0.01 (0.01)	0.18 (0.11)	0.38 (0.23)	-0.04 (0.19)	0.00 (0.02)	0.36 (0.21)†
Parameter									
Intercept/threshold	1.85 (0.22)***	0.47 (0.13)***	-0.21 (0.12)†	0.08 (0.01)***	1.44 (0.21)***	0.20 (0.34)	4.68 (1.33)***	-0.42 (0.18)*	-0.42 (0.18)*
Residual variance	—	1.24 (0.57)*	0.71 (0.21)***	0.01 (0.00)***	—	1.24 (0.57)*	0.71 (0.21)***	0.01 (0.00)***	—

Table 5. CACE Model Testing Effect of Intervention on Growth in Marijuana Use During Adolescence and on Problematic Marijuana Use in Early Adulthood

		Within-class variation							
	Class membership	Nonengager class				Engager class			
Intervention status, variable, and parameter	Engager vs. nonengager logit (*SE*)	Intercept est. (*SE*)	Linear slope est. (*SE*)	Quadratic slope est. (*SE*)	Problematic marijuana use (*SE*)	Intercept est. (*SE*)	Linear slope est. (*SE*)	Quadratic slope est. (*SE*)	Problematic marijuana use (*SE*)
Intervention status	Fixed at 0	Fixed at 0	Fixed at 0	Fixed at 0	Fixed at 0	Fixed at 0	-1.47 (0.49)**	0.08 (0.07)	-0.69 (0.41)m
Variable									
Gender (female)	-0.22 (0.26)	0.02 (0.09)	0.10 (0.06)	-0.03 (0.01)**	-0.24 (0.11)*	0.22 (0.17)	0.47 (0.23)*	-0.08 (0.03)**	-0.27 (0.28)
Ethnicity	-0.25 (0.20)	-0.07 (0.08)	-0.07 (0.06)	0.03 (0.01)**	0.32 (0.10)**	-0.24 (0.15)†	0.39 (0.23)†	-0.04 (0.03)	0.23 (0.26)
Biological father present (6th grade)	0.50 (0.21)**	-0.06 (0.10)	-0.03 (0.07)	0.00 (0.01)	0.10 (0.11)	-0.07 (0.18)	-0.14 (0.22)	0.01 (0.03)	0.28 (0.28)
Family conflict (6th grade)	-0.27 (0.09)	0.07(0.06)	-0.10 (0.04)*	0.01 (0.01)†	0.08 (0.06)	0.04 (0.11)	0.02 (0.10)	-0.02 (0.02)	-0.03 (0.14)
Deviant peers (6th grade)	-0.09 (0.08)	0.27 (0.08)***	-0.04 (0.05)	0.00 (0.01)	-0.02 (0.05)	0.21 (0.11)*	0.04 (0.10)	0.01 (0.02)	0.15 (0.13)
Teacher report of risk (6th grade)	-0.23 (0.10)*	0.09 (0.05)†	0.01 (0.04)	0.00 (0.01)	0.15 (0.06)**	0.12 (0.08)	0.13 (0.11)	-0.03 (0.02)	0.11 (0.15)
Parameter									
Intercept/threshold	1.62 (0.22)***	0.33 (0.10)***	-0.07 (0.07)	0.04 (0.01)***	1.01 (0.11)***	0.11 (0.12)	1.31 (0.56)*	-0.01 (0.08)	1.96 (0.51)***
Residual variance	—	0.62 (0.27)*	0.17 (0.10)†	0.01 (0.00)***	1.53 (0.09)***	0.62 (0.27)*	0.17 (0.10)†	0.01 (0.00)***	1.53 (0.09)***

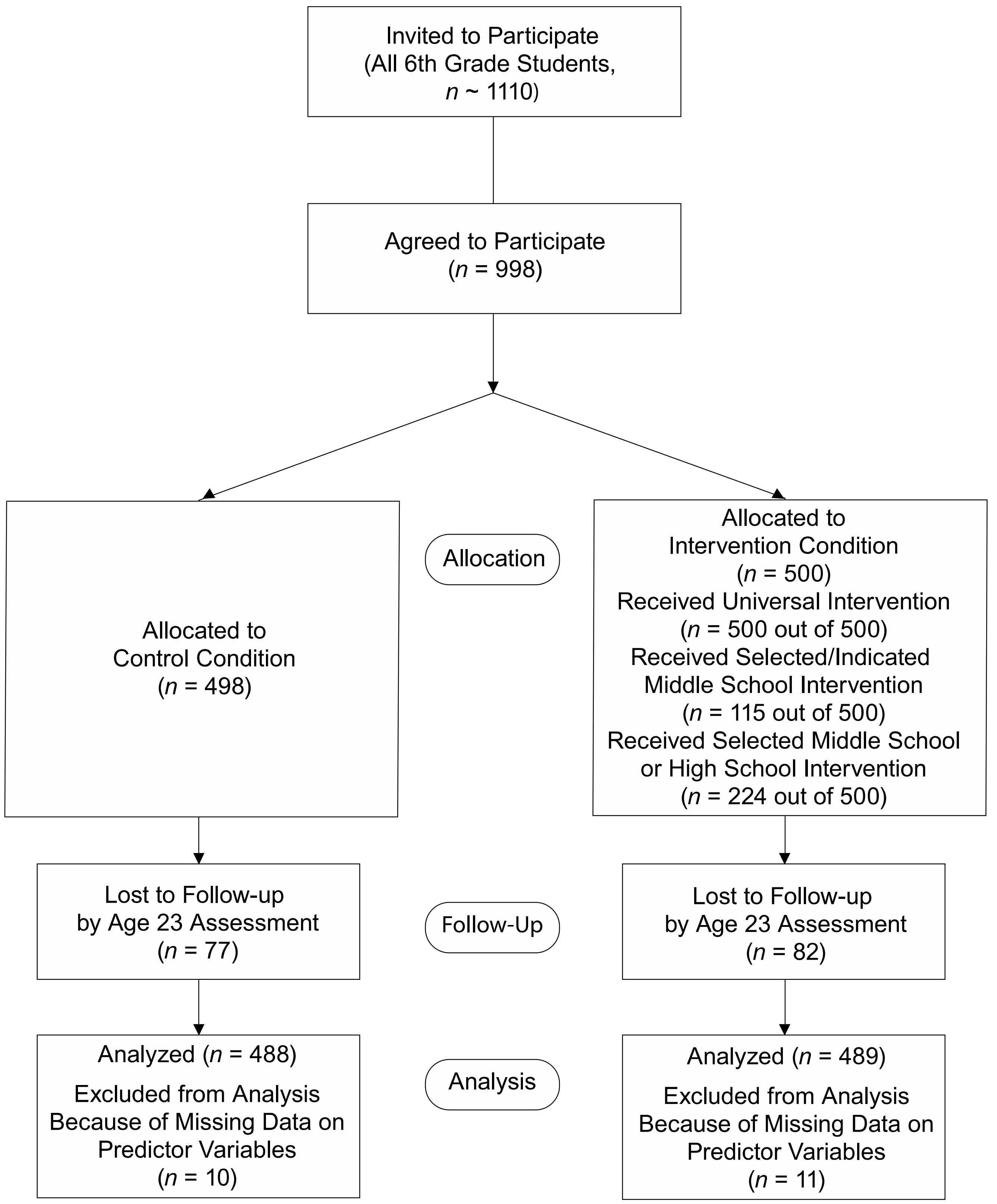

Figure 1. Flowchart of participants through each stage of the study.

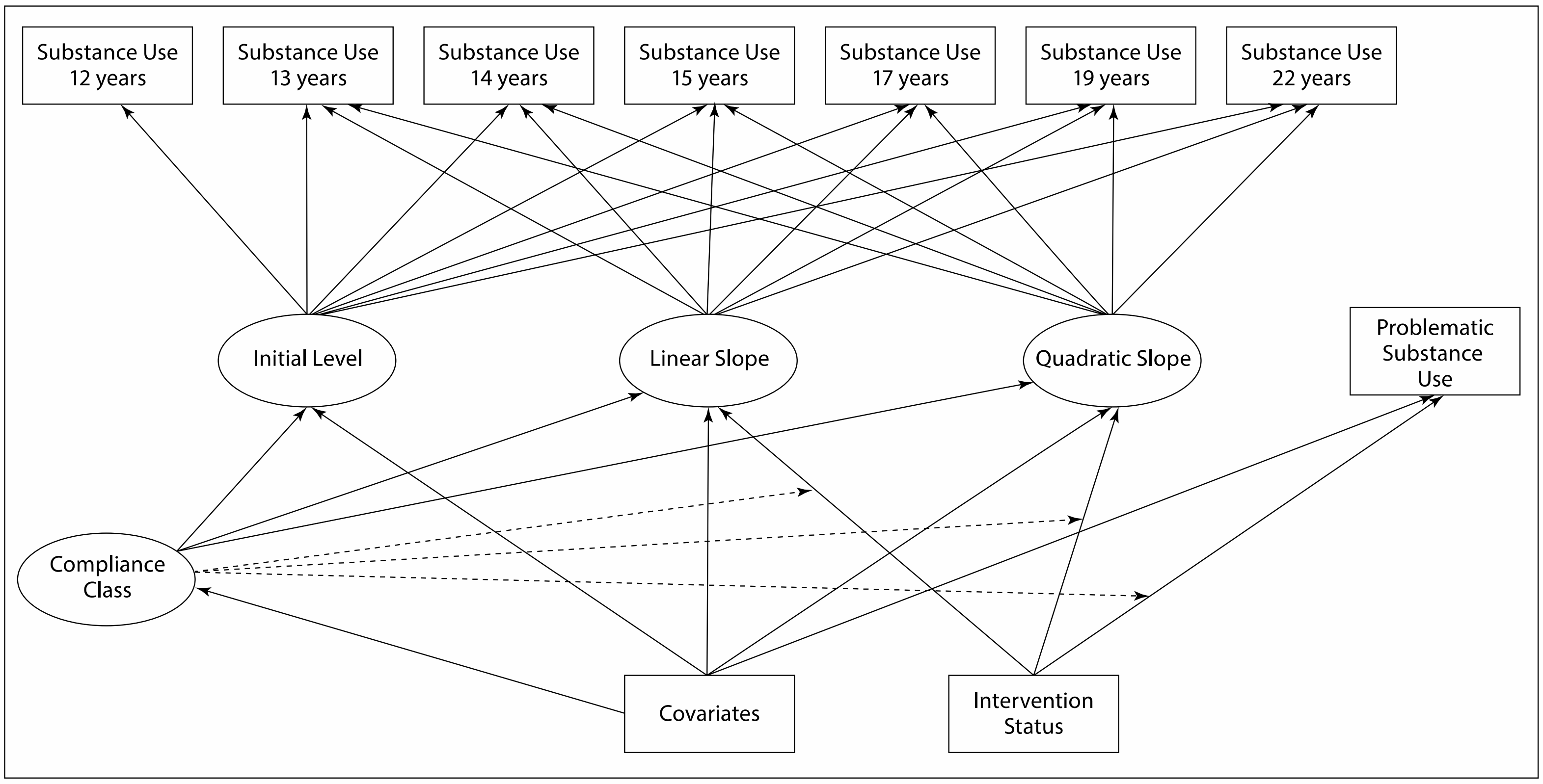

Figure 2. General CACE model applied to each type of substance. Dotted lines show the moderation effect of compliance class on the relation between intervention status and in substance use (i.e., linear and quadratic growth in adolescence, and problematic substance use in early adulthood).

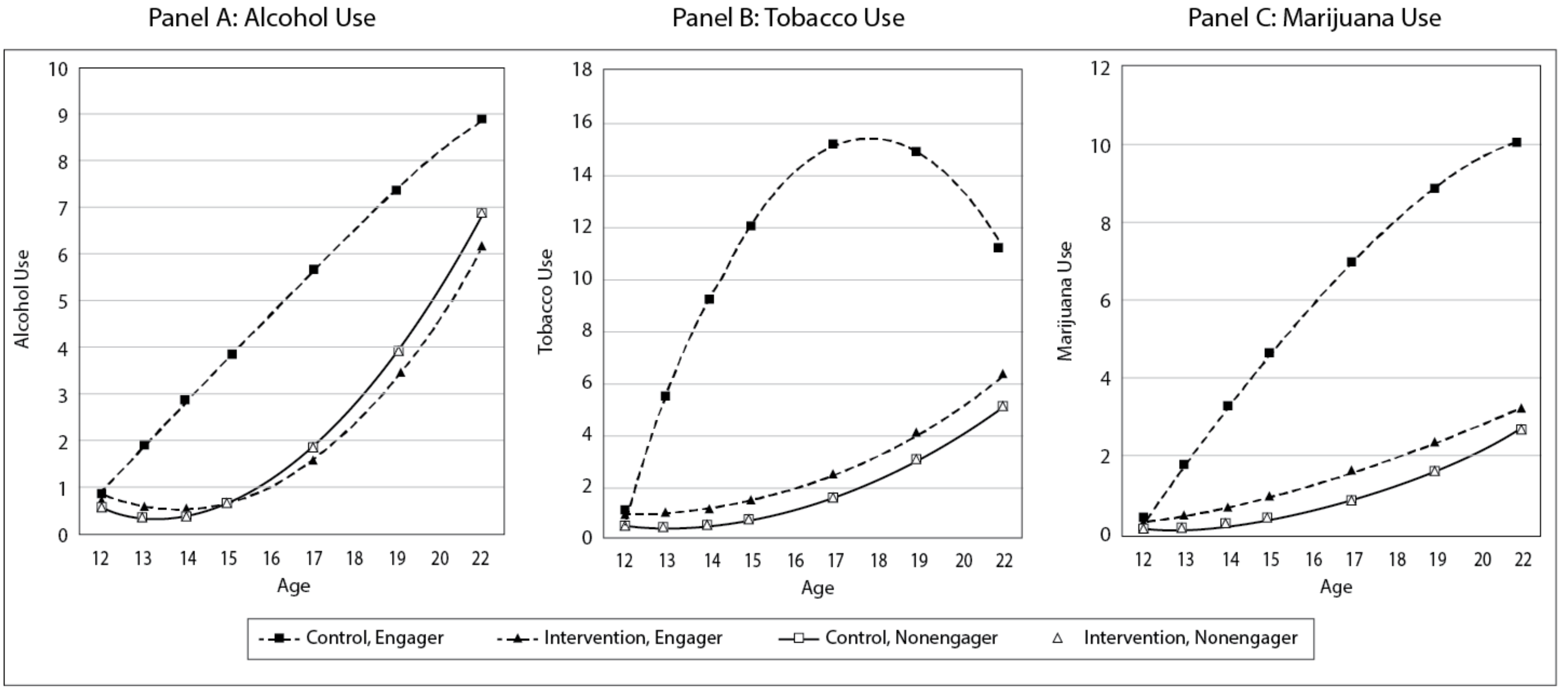

Figure 3. Change in substance use over time for engagers and nonengagers within the intervention groups and the engager- and nonengager-equivalent control participants, according to the CACE models. Values on the Y axis represent number of drinks (Panel A), cigarettes (Panel B), or frequency of marijuana smoking (Panel C) during the past month. For tobacco use, values greater than 10 represent number of packs of cigarettes (e.g., 11 = one pack; 12 = two packs; 13 = three packs). Differences between the intervention and control groups are expected to emerge only for engagers, because nonengagers in the control and intervention condition are equivalent, as assumed in the statistical model (Jo, 2002).

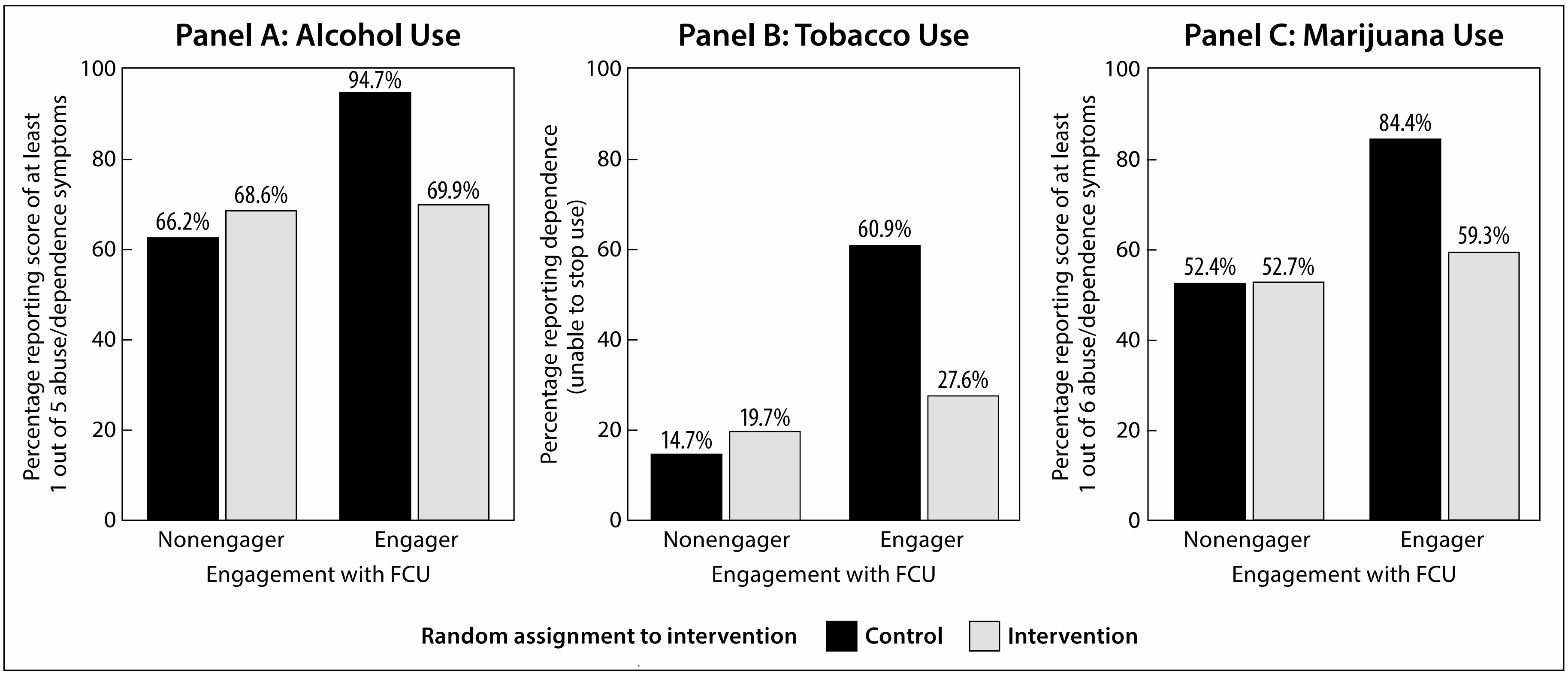

Figure 4. Percentage of participants who presented at least one symptom of substance abuse or dependence at age 23 for engagers and nonengagers in the intervention groups and the engager- and nonengager-equivalent control participants, according to the CACE models. Values on the Y axis represent percentage of participants within each of the four groups. Differences between the intervention and control groups are expected to emerge only for engagers, because nonengagers in the control and intervention conditions are equivalent, as assumed in the statistical model (Jo, 2002).