How All Stars Works:
An Examination of Program Effects on Mediating Variables

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Abstract

Prevention research continues to focus on school-based substance use programs aimed at adolescents. These programs are designed to reduce substance use and risk behavior by targeting key mediators, such as normative beliefs which in turn reduce substance use. All Stars is a recently developed program that was recently evaluated in a randomized field trial in 14 middle schools in Lexington and Louisville, KY. We examined targeted and non-targeted variables as possible mediators of program effectiveness. Findings indicate that All Stars achieved reductions in substance use and postponing sexual activity when teachers were successful at altering normative beliefs, lifestyle incongruence, and manifest commitment to not use drugs. The program was not successful when it was delivered by specialists. At least in part, this failure is attributable to specialists' inability to change mediators as intended by the program.

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The prevention of substance use remains a national priority. Prevention as a science has made significant progress during the past three decades, particularly the advancements made in understanding the role of mediators. Examining the role of mediators, variables targeted by programs that are hypothesized to account for subsequent behavioral effects, has long been advocated for gaining an understanding of how programs achieve their effects (Judd & Kenny, 1981; MacKinnon, 1994). Nonetheless, relatively few studies have been published to date that specifically adopt mediating variable analysis methods (Donaldson, et al., 1994; Hansen & McNeal; 1997; MacKinnon, et al., 1991).

School-based substance abuse prevention has generally proven to be challenging. Several reviews have demonstrated that the hoped for magnitude of effects of school programs are rarely achieved (Tobler & Stratton, 1997). However, promising approaches have been reported although consistent success has yet to be realized. Among those findings reporting modest success, few of the evaluations were conducted by independent evaluators. There are many reasons why a program may fail. However disconcerting failure to achieve outcomes may be, the appropriate response inherent in the tradition of prevention research is to examine the mechanisms of action against existing theory and data and use evaluation outcomes to plan next steps. It is in this line of tradition that the current research falls. First, we examine the effectiveness of the All Stars substance use prevention program. Second, we examine the degree to which All Stars affects key mediating concepts.

All Stars is a program that was developed as a distinct intervention beginning in the early 1990s (Hansen, 1996). All Stars's primary focus is on reducing adolescent risk behavior, particularly substance use and sexual activity. The program's main focus is to delay the erosion of key mediators that previous research has shown to be strongly linked to adolescent risk behavior (McNeal & Hansen, 1999). Specifically, All Stars addresses four student-centered mediators for intervention: (1) normative beliefs, (2) lifestyle incongruence, (3) commitment, and (4) bonding to school. Many of the elements of the program, particularly methods used for establishing positive peer group norms, were developed and tested earlier as part of the Adolescent Alcohol Prevention Trial with marked success (Donaldson, et al., 1994; Hansen, et al., 1988; Hansen & Graham, 1991; Palmer, et al., 1998; Taylor, et al., 2001). Versions of these program materials also formed the basis of the Project STAR school components tested in the Midwest Prevention Project (MacKinnon, et al., 1991; Pentz, et al., 1989).

All Stars also introduces many new elements not previously included in earlier drug prevention programs. Concepts were chosen based on findings from etiologic research that would have the potential to enhance program effectiveness. These included a focus on building perceived psychological incongruence between desired lifestyles and substance use and commitments to avoid substance use (Fearnow-Kenney, Hansen & McNeal, in press; Festinger, 1957; McNeal & Hansen, 1999). In addition, one-on-one meetings between students and teachers were designed to help social isolates become integrated into the social milieu of the school (Ennett & Bauman, 1993) and to increase the student's level of attachment to school (Hawkins, Catalano & Miller, 1993). Social integration and school attachment have been linked to a host of

outcomes, including substance use (Hawkins, Catalano, and Miller 1993), dropping out of high school (McNeal 1995), and adolescent delinquency (Hirschi 1969).

The purpose of this paper is to examine variables that have the potential to mediate between All Stars program exposure and targeted outcomes. Specifically, the purpose of this paper is to determine the degree to which All Stars has the potential to change mediating processes that account for substance use and sexual activity. This paper utilizes data for targeted mediators (normative beliefs, lifestyle incongruence, manifest commitment and bonding to school), as well as mediators of interest to the evaluation team but not targeted by the program (self-esteem, impulsive decision making, and sensation seeking). We examine whether changes in these constructs act as mediators through which changes in substance abuse can be observed (MacKinnon & Dwyer, 1993). Our goal is to understand whether the observed short-term outcomes can be accounted for by changes in mediators.

This is not the first assessment of All Stars' effectiveness. One randomized field trial of All Stars has been completed to date. This trial was independently evaluated by a team from the University of Kentucky (Harrington, et al., 2001). Short-term results were mixed with some evidence of program effectiveness on changing targeted mediators and reducing the onset of substance use and sexual activity, particularly when the program was delivered by regular classroom teachers instead of specialists. Long-term results were not promising for either group of interventionists. (The program has subsequently been revised and a booster program added. This version of the program is currently being evaluated in two longitudinal field trials, both of which are being independently evaluated.)

This analysis extends the previous research by decomposing substance use into separate measures; Harrington et al. (2001) use a poly-drug use measure which has the potential to mask effectiveness for specific kinds of substance use. This analysis also extends the range of mediators examined to determine whether All Stars effectively alters both targeted and non-targeted mediators.

Methods

Subjects and Setting. The sample consisted of 1857 students attending 14 middle schools in Lexington and Louisville, Kentucky. This sample represents 81.1% of the original 2,289 students who provided baseline data at pretest. The demographic profile of the final sample was 54% female, 69% white, 23.3% African-American, and 7.7% other ethnicity . Modal age at Time 1 was 12 years; 98% of respondents were between 11 and 13 years old.

Design. Schools were assigned to one of three conditions. Five schools received the program delivered by specialists who were hired by the project; the specialists were "outsiders" to the school, visiting to delivery the program. Three schools received the program delivered by regular classroom teachers. Six schools served as controls and received treatment as ususal. In most cases, treatment as usual was attendance in health education classes taught by teachers. Specialist and control schools were randomly assigned to their respective conditions after stratification based on school size, the distribution of gender and ethnicity, and the percentage of students receiving free/reduced lunch. The teacher condition was added after this assignment procedure had been completed and commitments were established.

Measures. Students were surveyed before delivery of the program in the fall of the school year and again at the end of the school year. The survey included items to assess three demographic characteristics of students, sex, age, and ethnicity. Lifetime, past year and past 30-day use of substances was assessed. Measures included in this analysis included the use of cigarettes (4 items; " = .87), smokeless tobacco (4 items; " = .84), alcohol (8 items; " = .87), marijuana (4 items; " = .90), and inhalants (4 items; " = .84). Students were also asked 14 items assessing their involvement in heterosexual intimate behavior (Adolescent Sexual Activity Index) (" = .86; Hansen, Paskett & Carter, 1999; Hansen, Wolkenstein & Hahn, 1992).

Mediating variables that were assessed included four scales that were specifically targeted by the program – normative beliefs about risky behaviors (12 items; " = .76), lifestyle incongruence (10 items; " = .79), manifest commitment to avoid risky behaviors (12 items; " = .88), and bonding to school (9 items; " = .80). These scales are replicated from previous research, where they possessed similar statistical properties (Hansen and McNeal, 1997; McNeal and Hansen, 1999). Three additional scales were included that were of interest to the evaluation team – self-esteem (13 items; " = .89), impulsive decision making (10 items; " = .80; Donohew et al., 2000), and sensation seeking (15 items; " = .87; Donohew, et al., 2000).

Results

Program Main Effects. From prior analyses (Harrington, et al., 2001) it was clear that there were overall main effect differences among the three conditions. These prior analyses aggregated prevalence and frequency of use across substances and did not report about individual substances. Analyses conducted separately for each substance confirmed the general pattern of results previously reported (see Table 1). Notably, the largest effects observed were when All Stars was delivered by regular classroom teachers. These teachers had the effect of significantly reducing the use of alcohol, cigarettes, smokeless tobacco, and inhalants. Effects were not significant for marijuana use or sexual activity, although the direction of effect for classroom teachers was in the desirable direction. Effects for specialists were significant and in the desired direction only for reducing the use of cigarettes. Results for substance use behaviors (which shared a common metric not shared by the ASAI) are presented in Figure 1.

The Relationship Between Mediators and Behavior. Table 2 presents correlations between the mediators and behaviors when both were measured at posttest. As is well known (Hansen & McNeal, 1997), the strength of relationship that exists between variables thought of as mediators and behaviors is crucial for explaining how programs achieve their outcomes. Three of the variables targeted by All Stars (normative beliefs, lifestyle incongruence, and commitment) were strongly and similarly correlated with behavioral outcomes. Bonding to school was similar in magnitude of relationship to self-esteem, impulsive decision making, and sensation seeking; each of these variables had a moderate relationship with behaviors of interest. Across targeted mediators, the average correlations were strongest for cigarette smoking (r = .584), sexual activity (r = .571), alcohol consumption (r = .536) and marijuana use (r = .509). Smokeless tobacco use (r = .275) and inhalant use (r = .264) were generally less strongly correlated with postulated mediators.

Mediating Variable Analysis. Table 3 presents the results of analyses examining the two component elements that constitute mediating variable analysis – the relationship between program exposure and mediators and the relationship between mediators and outcomes (MacKinnon and Dwyer, 1993). In these analyses, each program condition (Specialist and Teacher) is contrasted with the control condition to establish effects. All results are derived from multiple regression analyses, with age, gender, and minority status of the student statistically controlled as covariates. Standardized beta coefficients (i.e. effect size equivalents) from the multivariate regression analyses are presented.

As can be seen, the program had a significant effect on three of the four targeted mediators (normative beliefs, lifestyle incongruence, and commitment) for the Teacher condition, but not for the Specialist condition. In addition, regular teachers had an impact on impulsive decision making and sensation seeking, two measured characteristics not targeted by the program. Thus it appears that the All Stars program was modestly successful at changing targeted and non-targeted mediators when delivered by the regular classroom teacher.

Table 3 also presents the relationship of each mediator on each of the targeted behaviors after controlling for age, ethnicity, gender and program deliverer. Examination of the standardized beta coefficients reveals that manifest commitment best accounted for posttest use of marijuana, smoking cigarettes, and drinking alcohol. Lifestyle incongruence was a slightly stronger predictor of these behaviors than were students' normative beliefs.

As Table 3 illustrates, the relationship between mediators and substance use is generally stronger for the targeted than non-targeted mediators. This indicates that mediators chosen for targeting by All Stars hold more potential to alter substance use than the non-targeted mediators. Furthermore, those non-targeted mediators that were significantly altered by the program (impulsive decision making and sensation seeking) are generally not significantly related to substance use, as indicated by the non-significant findings in the second panel.

Table 4 presents the t-values for the indirect effects of All Stars on each substance via the mediators. These values are derived by dividing the indirect effect (i.e. multiplying the path from program to mediator by the path from mediator to behavior) by its asymptotic standard error (Sobel 1982). This strategy is identical to that used by Hansen and McNeal (1997) when examining indirect effects attributed to the DARE program via mediators. For simplicity, the teacher-delivered mode is contrasted with the combined specialist/control group. Given the lack of significance between specialist delivery and the control group, we decided to pursue the more parsimonious model specification.

As Table 4 indicates, the strongest mediated effects observed were for the effect of changes in manifest commitment on drinking alcohol, using marijuana, smoking cigarettes and engaging in sexual activity. Changes in lifestyle incongruence mediated teachers' effects on alcohol, marijuana, cigarettes, smokeless tobacco, inhalants and sexual activity. However, the effects were not as strong overall. Teachers' ability to change normative beliefs mediated outcomes for alcohol, marijuana, cigarettes, and sexual activity. Like changes in lifestyle incongruence, the mediated paths were of modest strength. Impulsive decision making, not specifically targeted by the program, nonetheless mediated changes in sexual activity among students. Impulsive decision making did not mediate substance use behaviors. No other variables included in the analysis played an apparent mediating role in achieving reductions in substance

use or sexual activity.

Discussion

The field of prevention has progressed from focusing almost exclusively on documenting whether a specific prevention program works to understanding how prevention programs achieve their aims. Because programs unavoidably rely on changing mediating processes as the primary means for achieving effects, the need to understand how programs effect measured mediators is essential to finding ways to make prevention practices effective. By focusing on mediating processes, program developers and practitioners alike can understand what specific elements of a program hold promise, which might well be abandoned, and which need strengthening and improvement.

Because of the differential effectiveness of two modes of intervention (teacher versus specialist), this project provided a unique opportunity to examine the role of each in accomplishing program goals via their ability to change mediators. It is clear from these analyses that one of the reasons specialists failed to have a strong impact on behavior was because of their relative lack of success at changing targeted mediators. On the other hand, the relative success of teachers can be attributed to program implementation that included having an impact on targeted mediating processes.

This project cannot offer evidence that would support a specific explanation of the efficacy of one group over the other. Because the programmatic approach used by teachers and specialists was the same, we can only speculate that some extrinsic factor may have moderated their success. Explanations that might be considered may include motivation of the teachers, skill at program delivery, the integration of program concepts into other areas in the curriculum, administrative support for program goals, and so forth. It is also possible that a specific student-teacher bond plays a significant role in effectively altering a student's beliefs and values toward substance use. Bonding to school itself was not a particularly strong mediator of effectiveness. On the other hand, classroom teachers had a positive effect on bonding and specialists a slightly negative effect. Other than following the curriculum, which both groups apparently did with reasonable fidelity (Harrington, et al., 2001), it is not clear how implementation variables might have differed sufficiently to produce a different result in mediators. Nonetheless, it is clear that these differences translated into differences in behavior change.

Of the mediators, manifest commitment was overall the strongest mediator between program exposure and behavioral outcomes. This was true for preventing the onset of alcohol use, marijuana use, cigarette smoking, inhalant use, and sexual activity. Lifestyle incongruence was the strongest mediator of smokeless tobacco use. Lifestyle incongruence and normative beliefs, overall, fared similarly with lifestyle incongruence performing just slightly better as a mediator of program outcome. In part, the findings of relative importance can be traced to both the strength of prediction that each variable affords as well as the degree to which teachers were able to have an impact on each variable. That is, manifest commitment was statistically a stronger predictor of behavior than were normative beliefs and lifestyle incongruence. However, in addition to this, teachers had a larger impact on changing students' personal commitments than they had on building perceptions that high-risk behaviors did not fit with desire lifestyles or on changing perceptions that these behaviors were not prevalent or acceptable. Some mediators

appear to be "winners" not only because they have a greater effect on substance use, but because the program (when delivered by teachers) more effectively alters the mediator.

Norm setting has recently received significant attention as promising approach to prevention. In contrast, building personal commitments has received little attention, although it is clearly related to intentionality which is included in theories that guide prevention programming such as Theory of Reasoned Action (Ajzen & Fishbein, 1980). Similarly, strengthening the perception that high-risk behaviors do not fit with desired lifestyles has not yet become approaches widely used by prevention practitioners or researchers although treatment providers and researchers have frequently used a highly related approach known as motivational interviewing which apparently attempts to change the same underlying processes (Miller & Rollnick, 1991). To the extent that the three approaches that most clearly mediated effects were complementary, targeting the combination is likely to have augmented program effectiveness overall.

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Table 1
Direct Effects of All Stars Exposure on Behaviors (Standardized Beta Coefficients)‡

	Alcohol	Cigarettes	Smokeless Tobacco	Marijuana	Inhalants	Sexual Activity
All Stars (Total)	! .018	! .054*	! .044†	.019	! .055*	! .011
All Stars (Specialists)	.006	! .040†	! .039	.037	! .038	.007
All Stars (Teachers)	! .058*	! .064*	! .042†	! .020	! .072*	! .039

‡ Effects are compared to control group, which received no treatment. Age, gender, and minority status are statistically controlled.
* $p < .01$
† $p < .05$

Table 2
Correlations between Mediators and Behaviors at Posttest‡

	Alcohol	Cigarettes	Smokeless Tobacco	Marijuana	Inhalants	Sexual Activity	Average
Normative Beliefs	! .458	! .506	! .222	! .441	! .228	! .517	! 0.395
Lifestyle Incongruence	! .546	! .588	! .304	! .505	! .274	! .584	! 0.467
Manifest Commitment	! .603	! .659	! .300	! .580	! .291	! .612	! 0.508
Bonding	! .271	! .285	! .177	! .255	! .149	! .289	! 0.238
Self-Esteem	! .217	! .278	! .163	! .187	! .150	! .227	! 0.204
Impulsive Decision Making	! .320	! .375	! .180	! .255	! .234	! .378	! 0.290
Sensation Seeking	! .267	! .314	! .154	! .197	! .192	! .334	! 0.243

‡ All correlations are statistically significant at $p < .01$

Table 3
Direct Effects of All Stars on Mediators and
the Effect of Mediators on Behaviors (Standardized Beta Coefficients)‡

	All Stars Predicting Mediators		Mediators Predicting Behaviors					
	Specialist	Teacher	Alcohol	Cigarettes	Smokeless Tobacco	Marijuana	Inhalants	Sexual Activity
Targeted Mediators								
Normative Beliefs	.020	.069*	!.102*	!.121*	!.047	!.115*	!.060*	!.190*
Lifestyle Incongruence	!.007	.083*	!.170*	!.171*	!.158*	!.101*	!.102*	!.218*
Manifest Commitment	.024	.107*	!.411*	!.449*	!.103*	!.492*	!.111*	!.270*
Bonding	!.017	.028	.004	.034	!.008*	!.002	.005	.041†
Non-Targeted Mediators								
Self-Esteem	!.011	.014	.016	!.036†	!.067*	.034	!.035	.015
Impulsive Decision Making	!.010	.071*	.041†	.021	.016	.089	!.067*	!.015
Sensation Seeking	!.011	.069*	!.009	!.033	.002	.029	!.043	!.097

‡ Age, Minority status, and gender are statistically controlled.
* $p < .01$
† $p < .05$

Table 4
Mediated Effects of Teacher-Delivered All Stars on
Individual Mediators and Behaviors (T values)

	Alcohol	Marijuana	Inhalants	Cigarettes	Smokeless	Sexual Activity
Targeted Mediators						
Normative Beliefs	-2.375†	-2.424†	-1.675	-2.510†	-1.382	-2.681*
Lifestyle Incongruence	-2.870*	-2.294†	-2.101†	-2.917*	-2.618*	-3.078*
Manifest Commitment	-4.141*	-4.243*	-2.297†	-4.241*	-2.125†	-3.895*
Bonding	0.174	-0.074	0.162	0.925	-0.282	0.959
Non-Targeted Mediators						
Self-Esteem	0.433	0.524	-0.514	-0.534	-0.547	0.432
Impulsive Decision Making	-0.406	1.164	-1.398	-1.437	0.066	-2.432†
Sensation Seeking	1.472	2.295†	-1.860	0.939	0.557	-0.650

* $p < .01$
† $p < .05$

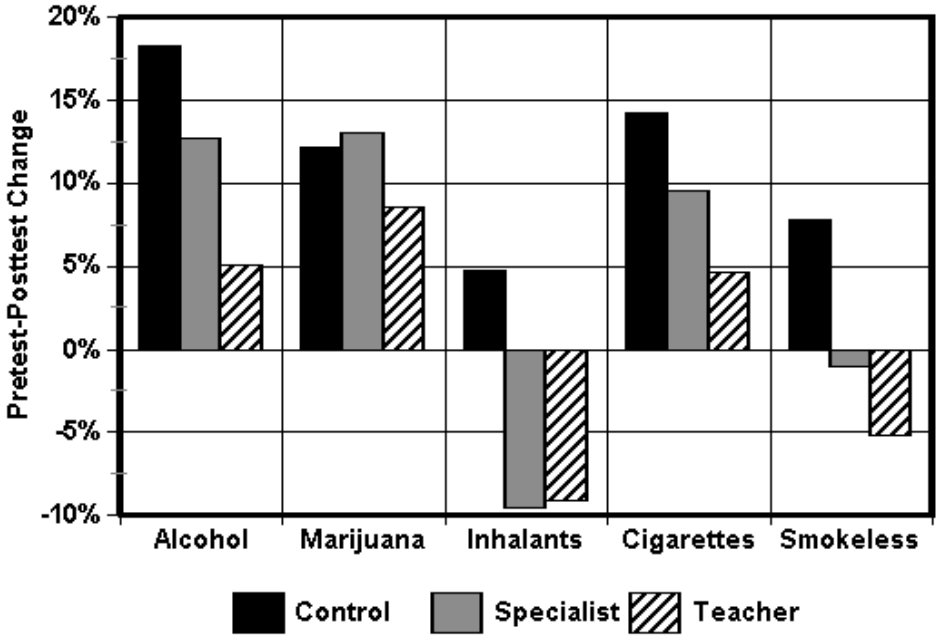

Figure 1. Differential effect of All Stars on substance use behavior outcomes.