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Recanting of lifetime inhalant use: how big a problem and what to make of it

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Abstract

Aims—To establish the prevalence of recanting of lifetime inhalant use, identify correlates of recanting to gain insight to its causes, and develop a method for distinguishing recanters who truly are vs. are not lifetime users of inhalants.

Design and Setting—Longitudinal survey data from students in 62 South Dakota middle schools that were participating in a field trial to evaluate a school-based drug prevention program.

Measurements—At Grades 7–8, participants reported on their lifetime inhalant use, other drug use and drug-related beliefs, attitudes, and behaviors.

Findings—Forty-nine percent of students who reported lifetime inhalant use at Grade 7 recanted their reports a year later. Comparison of students who recanted inhalant use with those who consistently did or did not report inhalant use on drug-related beliefs, attitudes, and behaviors at Grades 7 and 8 suggested that whereas some inhalant use recanting reflects denial of past behavior, some reflects erroneous initial reporting. Based on a latent mixture model fit to the multivariate distribution of Grade 7 and Grade 8 responses of recanters and consistent reporters, we calculated the probability that each recanter was, in fact, a lifetime inhalant user. An estimated 67% of the recanters in our sample appear to be lifetime inhalant users of who admitted use in Grade 7 and then denied that use at Grade 8; 33% appear to be students who incorrectly reported use at Grade 7 and then corrected that error at Grade 8.

Conclusions—Inhalant use recanting is a significant problem that, if not handled carefully, is likely to have a considerable impact on our understanding of the etiology of inhalant use and efforts to prevent it.

Keywords

adolescents; inconsistent reporting; inhalants; recanting

Inconsistent reporting of drug use is an indisputable phenomenon that has been observed across household and school-based surveys in both Europe and the United States [1–6]. One

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type of inconsistent reporting that has been demonstrated repeatedly is the tendency to retract previously disclosed drug use when asked about the behavior in a subsequent survey (e.g., [1], [5], [7]). Because lifetime drug use should logically not decline, the occurrence of recanting provides evidence of inaccuracies in self-report measures of drug use.

To design strategies for dealing with such recanting, research is needed that goes beyond description of the prevalence of recanting and systematically evaluates its possible causes [8]. Some have argued that recanting of previously disclosed drug use is due mainly to the tendency of some adolescents to provide socially desirable survey responses as they mature [4,7]. If this were true, adolescents who are more likely to conform to societal norms with age should be more likely to recant over time. This view on recanting assumes that recanters knowingly deny previously disclosed (and perhaps continuing) behavior that they have come to see as socially unacceptable, and that their earlier survey responses represent the truth of the matter. Others have argued, however, that recanting is less the result of intentional distortion than of an inability to understand and thus to accurately respond to survey questions about drug use [3,9]. In particular, complexity and ambiguity in the wording of survey questions about drug use may lead youth to erroneously report behaviors that they then recant in later surveys when their understanding of the behavior in question has improved [10].

Whether it reflects motivated denial of previously disclosed behavior or appropriate editing of an erroneous earlier report, the problem of recanting is likely to be especially pronounced in longitudinal studies of inhalant use. Inhalant use is the deliberate inhalation of volatile substances (e.g., glue, paint, gasoline, and cleaning agents) to achieve feelings of intoxication, euphoria, and other effects [11]. Inhalant use is of great significance for public health, as it is associated with many adverse health consequences [12], including significant neurologic damage [13–15], renal disorder [16–17], pulmonary toxicity [18–19], and sudden death caused by cardiac arrhythmias [20–21]. It is also disturbingly prevalent, especially among younger adolescents. In 2007, inhalants were the most frequently reported class of illicit drugs used in the past year among adolescents aged 12 or 13 [22].

There are at least three reasons why inhalant use recanting may be common in multi-wave studies investigating lifetime drug use. First, inhalant use is an especially deviant type of drug use. Investigators have found strong links between inhalant use, antisocial attitudes, and drug-related criminal behaviors, and they have considered youth inhalant use—more so than use of other drugs—as a specific manifestation of a general syndrome of deviance [23–27]. As youth mature and become aware of the social unacceptability of inhalant use, they may be less likely to admit engaging in this stigmatized behavior (even if use has continued). Second, older youth commonly perceive inhalants as “kids’ drugs” [28], and may be reluctant to re-report what they have come to see as an “immature” form of substance use [29]. Third, questions about inhalant use are likely to be somewhat ambiguous to younger adolescents who may not be able to distinguish between casual sniffing and purposeful inhalation of vapors to deliver an effect. As adolescents mature and their interpretation of survey questions about inhalant use becomes more aligned with researchers’ intended meaning, they may correct their earlier “admissions” of inhalant use by recanting.

Although no longitudinal data on the recanting of inhalant use have been published, cross-sectional cohort data from the Monitoring the Future (MTF) study [30] suggest that such recanting may be highly prevalent. MTF is a national, annual survey of 8th, 10th, and 12th graders that began in 1992. Each year since its inception, the study reported a prevalence rate for “lifetime” inhalant use that decreased with age. For instance, in 2006, lifetime inhalant use rates were 16%, 13%, and 11%, respectively, among 8th, 10th, and 12th graders.

This trend is not observed for any other forms of substance use tracked by MTF, and only makes sense as an indication of reluctance among older adolescents to report inhalant use, "over-reporting" of inhalant use by younger adolescents, or both. If adolescents' reports about inhalant use cannot be trusted or if researchers cannot devise ways to encourage truth-telling or discern the truth from inconsistent reports, then our understanding of the etiology of this dangerous form of drug use and our efforts to prevent it will be compromised.

In the current study, we used two waves of survey data from a longitudinal study of adolescents enrolled in a school-based drug prevention program to (1) investigate the prevalence of recanting of lifetime inhalant use; (2) compare students who recant inhalant use with students who consistently do or do not report inhalant use on use of other substances and substance-related beliefs, attitudes, and behaviors to gain insight to the causes of inhalant use recanting; and (3) develop a method for distinguishing recanters who truly are not lifetime users of inhalants from those who truly are lifetime users of inhalants. We assume that inhalant use recanters are a mixture of true inhalant users who report but then later deny their lifetime use (deniers) and true non-users who erroneously report lifetime use and then later correct their error (error correctors). If inhalant use recanters are principally deniers, then we would expect them to report, at the initial survey, levels of other substance use and substance-related beliefs, attitudes, and behaviors that are similar to those of adolescents who consistently report lifetime inhalant use. Moreover, if deniers are compelled to recant their prior admission of lifetime inhalant use because they have come to perceive inhalant use as deviant then we would expect to observe changes in their beliefs, attitudes, and behaviors that indicate a less positive orientation toward substance use in general. On the other hand, if inhalant use recanters are principally error correctors, then we would expect them to report, at the follow-up survey, levels of other substance use and substance-related beliefs, attitudes, and behaviors that are similar to those of adolescents who consistently do not report lifetime inhalant use.

METHOD

Sample and Attrition

Participants in this study were students from 62 South Dakota middle schools involved in a field trial of the effectiveness of Project Alert, a drug prevention program for middle school students, and ALERT Plus, a program that also included high school lessons [31–32]. The baseline panel of 5,857 adolescents was approximately evenly distributed by sex and 86% Caucasian, 9% Native American, and 5% other racial/ethnic backgrounds including African American, Hispanic, and Asian. Approximately 1 in 5 of these adolescents reported grades of C or below at baseline, and 68% were living in households with both biological parents present. To be included in the analysis for the current study, students had to have participated in the baseline (Grade 7; Wave 1) and first follow-up survey (Grades 8; Wave 2) and provided valid inhalant use data at both time points. Ninety percent of the baseline sample (N = 5,269) met these criteria. Regression modeling indicated some selectivity in attrition (see [31]). To correct for this differential attrition, we created inverse-probability attrition weights and employed these weights in all analyses, appropriately accounting for their effects on standard errors. To gauge the upper bound effect of attrition on our estimate of the prevalence of inhalant use recanting, we provide additional estimates that assume that either all or none of those who reported lifetime inhalant use at Grade 7 and then were lost to attrition would have recanted at the first follow-up.

Procedure

Data from this study came from in-school surveys completed at Grades 7 and 8. Trained staff administered the surveys. Parental consent was solicited via procedures approved by

RAND's Human Subjects Protection Committee. Students were asked to assent at each survey administration. Project staff conducted make-up survey sessions in school and mailed surveys to movers and chronic absentees to minimize attrition. We took several steps to encourage accurate and truthful reporting. These included obtaining a Certificate of Confidentiality from the Department of Health and Human Services, using data collectors whom the students did not know, and giving parents and students the opportunity to refuse to participate.

Measures

Inhalant use and recanting—At each survey, participants were asked, "Have you ever sniffed (not just smelled) glue, paint, gasoline, or other inhalants to get high?" Students who responded "yes" to this question at Grade 7 were classified as recanters if they subsequently responded "no" at Grade 8.

Other measures—At each grade, participants were asked, "How much do you think kids your age might harm themselves if they smoke cigarettes/use marijuana/drink alcohol occasionally (1 = *not at all* to 4 = *a lot*)?" We averaged responses to these three questions at each wave to create a measure of participants' beliefs about the harm of occasional drug use (α = .86 at baseline). At each grade, participants were also asked how they thought their friends would react if they found out that they smoked cigarettes/used marijuana/ drank alcohol (1 = *disapprove and stop being my friends* to 4 = *approve*). We averaged responses to these three questions at each wave to create a measure of perceived peer approval of drug use (α = .78 at baseline). At each grade, participants indicated how often they were around kids who were smoking cigarettes/using marijuana/drinking alcohol, and whether they thought their best friend smoked cigarettes/used marijuana/drank alcohol. We standardized and averaged responses to these six questions at each wave to create a measure of time spent with peers using drugs (α = .80 at baseline). At each grade, participants reported how often they engaged in each of 6 deviant behaviors in the past year (e.g., purposefully damaging others' property; 0 = *not at all* to 5 = *20 or more times*). We averaged responses to these six questions at each grade to create a measure of deviant behavior (α = .80 at baseline). Low academic orientation at each grade was based on the average of two questions, reported grades (1 = *mostly A's* to 5 = *mostly F's*) and the highest level of schooling participants planned to complete (1 = *graduate or professional school* to 5 = *may not finish high school*; α = .56 at baseline). To create measures of change in drug-related beliefs, attitudes, and behaviors from Grade 7 to Grade 8, we subtracted students' scores on each Grade 7 measure of drug-related beliefs, attitudes, and behaviors from scores on the corresponding Grade 8 measure, using these continuous measures of change to distinguish students whose beliefs, attitudes, and behaviors became less supportive of drug use between those grades from students whose beliefs, attitudes, and behaviors stayed the same or became more supportive of drug use. Our analyses also included information about student gender, race/ethnicity (coded as White, Native American, or other race/ethnicity), and whether or not the student was in a Project ALERT/ALERT Plus intervention school.

Missing Data Imputation

Covariates were missing for less than 3% of the cases for all variables. To avoid bias associated with list-wise deletion of cases with missing data, we imputed missing data using standard imputation methods described in Ellickson et al. [31]. As noted above, students who failed to report data on lifetime inhalant use at one or both surveys were excluded from the analysis. Of those who completed both surveys, 99% had complete data on lifetime inhalant use.

Analyses

We used *t*-tests to compare inhalant use recanters with students who consistently did and did not report lifetime inhalant use at Grades 7 and 8 on demographic characteristics, frequency of other drug use and mean drug-related beliefs, attitudes, and behaviors at Grades 7 and 8. We also compared these three groups on changes in drug-related beliefs, attitudes, and behaviors from Grade 7 to Grade 8. We set the statistical significance level for individual comparisons at .001 to adjust for multiple comparisons via the Bonferroni method [33]. This method corrects the statistical threshold for multiple comparisons by dividing the significance level (α) by the number of comparisons made. For all tests, we used sandwich variance estimates [34] to account for the non-independence of observations from students who attended the same schools.

We then assessed which students in the sample of inhalant use recanters were true users who report and then later deny lifetime use (deniers) and which were true non-users who correct earlier misreports of use (error correctors). We identified these two (unobserved) groups of students by fitting a latent group mixture model to the multivariate distribution of Grade 7 and Grade 8 responses of recanters and consistent reporters (i.e., both those who consistently reported lifetime use and those who consistently reported no lifetimes use). Assuming that deniers truly used inhalants by Grade 7 and error correctors did not, we expected responses on items correlated with inhalant use to differ between these two groups at Grades 7 and 8. Under the assumption that deniers and consistent reporters of inhalant use both truly used inhalants by Grade 7, we expected these groups' to look similar on the correlates of inhalant use at Grade 7. Given our assumption that error correctors did not use inhalants, we expected that their Grade 7 status on the correlates of inhalant use would differ from that of both deniers and students who consistently reported use. We did not expect the Grade 7 responses of error correctors to exactly match those of students who consistently reported no use, as error correctors may have also made mistakes in reporting on variables other than inhalant use. We did, however, expect error correctors' status on Grade 8 correlates of inhalant use to be similar to that of students who consistently reported no inhalant use, as error correctors were presumably no longer making reporting errors by Grade 8. Finally, we expected that the Grade 8 responses of deniers would align neither with the responses of error correctors (even though deniers disavow their inhalant use, they may or may not change their reporting on correlates of inhalant use) nor with the responses of students who consistently reported inhalant use (the factors that lead deniers to recant inhalant use might also affect their standing on other outcomes).

We modeled the responses of recanters using a latent, two-group (deniers and error corrector) mixture model. In this model, we constrained deniers' means on the Grade 7 correlates of inhalant use to equal the corresponding means of students who consistently reported use and we constrained error correctors' means on the Grade 8 correlates of inhalant use to equal the corresponding means of students who consistently reported no use. We placed no other restrictions on the model. We used this model to analyze the multivariate distribution of the following correlates of inhalant use: beliefs about the harm of occasional drug use, perceived peer approval of drug use, time spent with peers using drugs, deviant behaviors, and academic orientation at both Grade 7 and Grade 8.

Because of the high dimensionality of the multivariate distribution for ten correlates, we were unable to obtain stable results in fitting the full multivariate, multi-group model. We therefore reduced the dimensionality by using the first canonical discriminant function [35] for the Grade 7 and the Grade 8 variables. The first canonical discriminant function is the linear combination of the five Grade 7 and Grade 8 correlates that provides maximal separation between students who consistently reported use and those who consistently reported no use of inhalants. We calculated the loadings of the first canonical discriminant

function using data from only the students who consistently reported using or not using inhalants to find the linear combination of the data that best separated these groups. We then used these loadings to calculate scores on the first canonical discriminant function for recanters. We repeated this analysis for the Grade 7 and 8 variables to obtain bivariate data for each student which we then modeled using our multi-group, mixture model. We assumed the data were normally distributed and estimated the mean, variances and covariance parameters of the groups (latent and observed) and the probability that each recanter was a denier by maximizing the log-likelihood function weighted by the attrition weights. We compared the fit of this model to a model that assumed all recanters were deniers and to one that assumed all recanters were error corrections using Akaike-and Bayesian-like information criteria (AIC and BIC) [36–37]. These indices not only reward goodness of model fit, but also include a penalty that is an increasing function of the number of estimated parameters. Thus, these criteria are useful for identifying the model that best explains the data with a minimum of free parameters. The preferred model is the one with the lowest AIC and BIC values.

RESULTS

Prevalence of Inhalant Use Recanting

Of the 501 students who reported lifetime inhalant use at Grade 7, 244 (48.7%) recanted at Grade 8. If all 87 students who reported lifetime inhalant use at Grade 7 but did not complete a survey at Grade 8 would have continued to report lifetime inhalant use if we had observed them at Grade 8, our estimated recanting rate would be 41.5%. If, on the other hand, all 87 of these students would have recanted had we observed them at Grade 8, our estimated recanting rate would be 56.3%.

Comparison of Recanters with Students Who Consistently Reported Inhalant Use and Those Who Consistently Reported No Inhalant Use

Table 1 compares inhalant use recanters with students who consistently reported lifetime inhalant use and those who consistently report no lifetime inhalant use on gender, race, and membership in the intervention vs. control condition of the ALERT/ALERT Plus field trial. Because the size of the groups is not equivalent, we report effect sizes as well as indicate statistical significance. As the Table shows, those who recant inhalant use do not differ from those who consistently report lifetime use of inhalants on any of these variables. The only statistically significant difference between inhalant use recanters and students who consistently reported no inhalant use is that the latter group includes a larger proportion of female students than the former.

Table 2 compares inhalant use recanters with students who consistently reported lifetime inhalant use and those who consistently report no lifetime inhalant on frequency of other drug use, and on drug-related beliefs, attitudes, and behavior at Grades 7 and 8. The table also compares those groups on changes in drug-related beliefs, attitudes, and behavior from Grade 7 to Grade 8. In Grade 7, inhalant use recanters were similar to students who consistently reported lifetime inhalant use in their frequency of use of cigarettes, alcohol, and marijuana, as well as in their beliefs, attitudes, and behaviors related to drug use. In contrast, there were consistent large differences on these variables at Grade 7 between inhalant use recanters and students who consistently reported no lifetime inhalant use. These results seem to suggest that recanters are primarily individuals who truly used inhalants but then later denied that use.

At Grade 8, however, inhalant use recanters looked neither like those who consistently reported no lifetime inhalant use nor like those who consistently reported using inhalants.

On all variables, inhalant use recanters were consistently at a level between those of students who consistently did and did not report inhalant use. If it is true that recanters are primarily individuals who truly used inhalants but then later denied their use, then these results seem to suggest that between the points of admission and denial inhalant use recanters may have changed in ways that are at odds with inhalant use. These results may also indicate, however, that recanters are a mixture of deniers who continued to use inhalants even at the point of denying use and error correctors who were not lifetime inhalant users at either point. The results at the bottom of Table 2 are more supportive of the former explanation than the latter. In all three groups—inhalant use recanters and those who consistently reported or did not report inhalant use—the majority of students changed their beliefs, attitudes, and behaviors in ways that indicate a greater inclination toward drug use between Grades 7 and 8. This was least evident, however, among the recanters. For example, whereas 82% of those who consistently reported inhalant use and 86% of those who consistently reported no inhalant use increased their association with substance-using peers between Grades 7 and 8, only 65% of recanters did so. Similarly, whereas 71% of those who consistently reported inhalant use and 84% of those who consistently did not report inhalant use increased their deviant behavior between Grades 7 and 8, only 52% of recanters did so.

Distinguishing Deniers from Error Correctors among Recanters

Table 3 provides weighted sample means of the first canonical discriminant functions (standardized to have variance equal to 1.00) for Grades 7 and 8 for the two groups of consistent reporters and the recanters. The table also provides model-based estimates of means for the two groups of consistent reporters and for the two latent groups, the deniers and error correctors. Consistent with the large differences between these groups on the correlates of inhalant use shown in Table 2, students who consistently reported inhalant use and those who consistently reported no inhalant use are very distinct on the first canonical discriminant functions, i.e., their group means are almost two full standard deviation units different. Also consistent with the results in Table 2, the mean for the recanters on the first canonical discriminant functions are between those of the two groups of consistent reporters. The model essentially recovers the means for the two observed groups in both grades. The model estimated means for deniers in Grade 8 and error correctors in Grade 7 differ from the observed groups in predictable ways. Values for the deniers are smaller than those of the students who consistently report use in Grade 8, reflecting either changes in the students' perceptions and beliefs or additional reporting bias, and the values for error correctors in Grade 7 are larger the corresponding values for the students who consistently reported no use of inhalants, possible reflecting additional errors.

Table 3 also provides a summary of our comparisons of the fit of our mixture model for recanters versus models that assumed that all recanters were either deniers or error correctors. AIC and BIC values for the mixture model are substantially smaller than either of the other models, providing strong evidence that the mixture model fits the data better than models that do not allow for both deniers and error correctors.

As shown in Table 3, we estimate from our model that about two-thirds of the recanters are actually deniers. Figure 1 gives a histogram of the estimated probabilities that individual recanters were deniers. It shows, that our data indicate a strong probability (over .90) of being a denier for a little over 50 percent of the recanters and a relatively strong probability of being an error corrector (probability of being a denier of less than 0.25) for about 30 percent of recanters. The remaining recanters are not as well classified by our data, i.e., they have less extreme probabilities of being a denier. These results reflect that fact that a significant portion of recanters report values on the correlates of inhalant use in Grade 7 that are large (large values indicate greater risk of substance use) and very similar to the value of most students who consistently report use. A smaller proportion of recanters report low

values on the correlates in Grade 8 that are more consistent with those of the students who consistently report no use.

DISCUSSION

Our study suggests that the problem of inhalant use recanting is a significant one. In our sample, 49% of students who reported lifetime inhalant use at Grade 7 retracted their reports a year later. In contrast, only 5% of students in our sample recanted lifetime cigarette use between Grades 7 and 8 and only 7% recanted lifetime alcohol use. Because inhalant use recanting is so prevalent, decisions about how to handle inconsistent data on lifetime inhalant use are likely to have major implications for what we learn about the emergence of inhalant use and the efficacy of prevention efforts.

Some have argued that social desirability concerns drive most drug use recanting [4]; others have argued that confusion due to ambiguous question wording is the main driver [3]. Our findings suggest that in the specific case of inhalant use recanting, both processes are operative, though to different degrees. Specifically, our data suggest that although a majority of inhalant use recanting reflects motivated denial of past behavior, a substantial minority reflects erroneous initial reporting. In other words, for some recanters, it is their initial reports of inhalant use that are to be trusted; for others, their “revised” reports are more accurate.

In addition to providing evidence on the prevalence and possible causes of inhalant use recanting, our study presents a method for using correlates of inhalant use (based on data from those who consistently do or do not report use) to distinguish recanters who deny true lifetime inhalant use from those who erroneously reported lifetime use and later corrected that error. We were able to classify a large majority (80%) of recanters as belonging to one or the other of these two groups with a high degree of certainty.

Several study limitations should be considered when evaluating our results. First, data for this study come from a sample of youth from a single Midwestern state that is largely white. Although the sample was representative of the population from which it was drawn and included youth from urban, suburban, and rural areas, our findings might not generalize to youth from highly urban areas with a different population mix. Second, we limited our analysis of recanting to two survey waves. Although this strategy helped make investigating the problem of recanting more manageable, it may have over-simplified the issue. For example, 75 of the 257 students in our analysis sample who consistently reported lifetime inhalant use at Grades 7 and 8 proceed to recant lifetime inhalant use at Grade 9. It is likely that recanting over longer versus shorter periods of time are qualitatively distinct phenomena (e.g., the former is more likely to be influenced by memory processes than the latter). Thus, what we have learned from our analysis of inhalant use recanting over a one-year period may not be informative about inhalant use recanting over longer periods. It may also not be informative about recanting among older adolescents.

Nevertheless, this study makes several significant contributions to the literature on inhalant use and recanting by investigating the prevalence of the problem, providing evidence of its causes, and offering a strategy for handling it. Additional research and strategies are needed to ensure that the problem of inhalant use recanting does not pose a threat to the validity of research in this area. Our analytic strategy is designed to handle the problem of inhalant use recanting after it has occurred and analyses that incorporate more waves of data (e.g., see [1]) might contribute to the effectiveness of this approach. Other efforts aimed at evaluating strategies for preventing the problem from occurring are needed as well.

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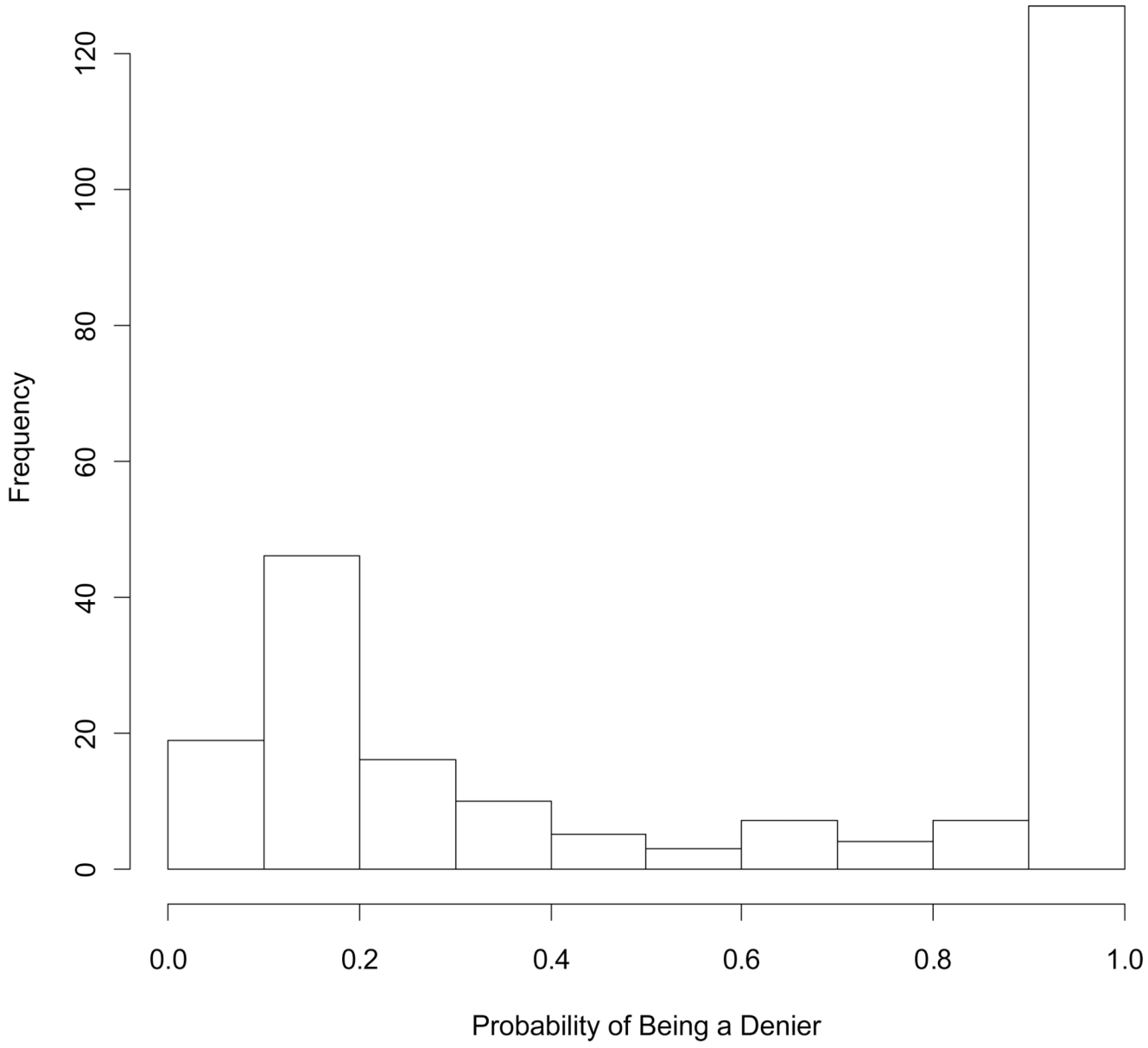

Figure 1.
Histogram of the probability that individual recanters are deniers.

Table 1

Comparison of inhalant use recanters with students who consistently reported inhalant use and students who consistently reported no inhalant use on demographic characteristics and intervention group status

Variable	Group			Group 1 vs. Group 2		Group 2 vs. Group 3	
	1. Consistently report lifetime inhalant use	2. Recant inhalant use	3. Consistently report no inhalant use	Effect size	Statistical significance	Effect size	Statistical significance
Female (%)	41.65	36.43	49.87	−0.10	ns	−0.27	*
White (%)	77.51	81.45	87.92	0.12	ns	−0.19	ns
Native American (%)	15.44	13.71	7.05	−0.06	ns	0.25	ns
Other race (%)	7.04	4.84	5.03	−0.10	ns	−0.01	ns
Intervention group participant (%)	64.75	71.17	68.03	0.14	ns	0.07	ns

*$p < .001$

Table 2

Comparison of inhalant use recanters with students who consistently reported inhalant use and students who consistently reported no inhalant use on drug-related beliefs, attitudes, and behaviors at Grade 7 and 8 and changes in those beliefs, attitudes, and behaviors

	Group			Group 1 vs. Group 2		Group 2 vs. Group 3	
Variable	**1. Consistently report lifetime inhalant use**	**2. Recant inhalant use**	**3. Consistently report no inhalant use**	**Effect size**	**Statistical significance**	**Effect size**	**Statistical significance**
Gr. 7 cigarette use frequency	4.43	3.87	0.84	−0.26	ns	1.40	*
Gr. 7 alcohol use frequency	4.31	3.68	1.14	−0.34	ns	1.35	*
Gr. 7 marijuana use frequency	1.82	1.39	0.15	−0.34	ns	0.97	*
Gr. 7 beliefs about the harm of drug use[†]	1.95	1.99	1.78	0.05	ns	0.28	*
Gr. 7 perceived peer approval of drug use	2.62	2.49	1.79	−0.20	ns	1.02	*
Gr. 7 association with substance-using peers	1.45	1.26	0.40	−0.31	ns	1.37	*
Gr. 7 low academic orientation	2.50	2.33	1.89	−0.22	ns	0.61	*
Gr. 7 deviant behavior	1.08	.093	0.19	−0.29	ns	1.46	*
Gr. 8 cigarette use frequency	5.94	3.99	1.69	−0.66	*	0.78	*
Gr. 8 alcohol use frequency	5.85	4.23	2.44	−0.61	*	0.67	*
Gr. 8 marijuana use frequency	3.63	1.98	0.57	−0.81	*	0.69	*
Gr. 8 beliefs about the harm of drug use[†]	2.22	2.01	1.70	−0.30	ns	0.45	*
Gr. 8 perceived peer approval of drug use	2.85	2.58	2.16	−0.39	*	0.61	*
Gr. 8 association with substance-using peers	1.96	1.41	0.80	−0.67	*	0.76	*
Gr. 8 low academic orientation	2.55	2.31	1.92	−0.31	*	0.50	*
Gr. 8 deviant behavior	1.40	0.77	0.35	−1.06	*	0.72	*
Perceived same or less harm from drug use	69.45	59.64	59.48	−0.20	ns	0.00	ns

Variable	Group			Group 1 vs. Group 2		Group 2 vs. Group 3	
	1. Consistently report lifetime inhalant use	2. Recant inhalant use	3. Consistently report no inhalant use	Effect size	Statistical significance	Effect size	Statistical significance
‡ (%)							
Perceived same or greater peer approval of drug use‡(%)	71.07	68.00	82.50	−0.08	ns	−0.37	*
Same or more time spent with peers using drugs‡(%)	82.42	65.39	85.92	−0.48	*	−0.57	*
Similarly or less academically oriented‡(%)	60.98	65.20	73.40	0.09	ns	−0.18	ns
Same or more deviant behavior‡(%)	70.97	52.22	83.88	−0.49	*	−0.83	*

†Scored such that higher scores indicate lesser perceived harm

‡Change between Grades 7 and 8

*$p < .001$

Table 3

Sample and model-estimated mean Grade 7 and Grade 8 canonical discriminant function scores by observed and latent groups, probability of being a denier for recanters, and model fit comparisons.

	Sample means		Model-estimated means	
Group	**Grade 7**	**Grade 8**	**Grade 7**	**Grade 8**
Consistently report lifetime inhalant use	1.78	1.74	1.88	1.80
Consistently report no lifetime inhalant use	−0.06	−0.07	−0.06	−0.08
Recanter	1.45	0.76	--	--
Deniers[a]	--	--	1.88	0.98
Error correctors[b]	--	--	0.23	−0.08
Probability that a recanter is a denier			0.67	
Comparison of Model Fit				
Model			AIC[c]	BIC[d]
Recanters include both deniers and error correctors			25786.82	25903.33
Recanters are all deniers			26197.89	26288.51
Recanters are all error correctors			26287.66	26378.27

[a] Grade 7 mean for deniers is constrained to equal the grade 7 means of the students who consistently reported lifetime use of inhalants.

[b] Grade 8 mean for error corrector is constrained to equal the grade 8 means of the students who consistently reported no lifetime use of inhalants.

[c] Equals the weighted log-likelihood plus 2 times the number of model parameters.

[d] Equals the weighted log-likelihood plus the natural log of the sample size times the number of model parameters.