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The Power of Positive Attitudes: Student Outcomes on a Science Education Curriculum about Drugs of Abuse

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Abstract

Science literacy is critical for civil society, and attitudes toward science in school have been found to be strong predictors of achievement. Science literacy is of particular concern for the field of substance abuse research. The objectives of this paper are to report the results of an evaluation of a science education curriculum for late elementary school students on drugs of abuse and to explore the role that attitudes toward science and attitudes towards drugs played in predicting student outcomes. This study uses data from a pretest/post-test quasi-experimental model, in which 93 fourth- and fifth-grade students were exposed to the curriculum. Students completed measures on knowledge, attitudes toward science, and attitudes/intentions toward drug use. We use the Theory of Reasoned Action and a multifold methodology to explore these theoretical and statistical linkages.

The main finding is that students with positive attitudes toward science before the implementation of the curriculum tend to show greater acquisition of knowledge. In contrast, students with negative or less protective attitudes toward drugs were found to show greater knowledge acquisition. This study suggests that the development of new pedagogical methods to improve science achievement by identifying and intervening with students who may have more negative attitudes toward science, prior to the implementation of core content, may have value. Further research is needed to determine the impact of pre-existing attitudes about drugs on educational outcomes related to this topic.

Introduction

The objectives of this paper are to report the results of an evaluation of a science education curriculum for late elementary school students on drugs of abuse and to explore the role that attitudes toward science and attitudes towards drugs played in predicting student outcomes. The primary goal of science education in schools is student achievement, and from a curriculum and educational policy perspective, science achievement is a construct of what students should know and be able to do in science. Often this knowledge and ability is codified through content standards and assessment frameworks (Lee, 1999), which equate closely with academic performance in science subjects. Science achievement also includes science literacy, which encompasses the basic understanding of fundamental terms and ideas, the process of scientific inquiry (Miller, 1998), and the ability to apply these in everyday life in order to make informed personal decisions (Hazen & Trefil, 1990; National Research Council, 2005; Shamos, 1995).

The personal and societal value of science achievement is significant. Science achievement and literacy empowers youth to think critically and understand and apply scientific findings in their daily lives. As adults, scientifically literate people are better able to make fully informed medical, political, economic, and social decisions concerning individual and societal welfare (American Association for the Advancement of Science, 1993; Miller, 2002). A scientifically literate public also contributes significantly to the growth and competitiveness of science and technology in the nation (Laugksch, 2000; Miller, 2002).

Unfortunately, only 17% of adults in the U.S. can be considered scientifically literate (Miller, 2002), and students in the U.S. perform significantly lower on science achievement tests than many of their peers internationally (NCES, 2004). For instance, only 68% of fourth graders are performing at or above a "basic" achievement level (NAEP, 2005), which requires students to know information like the role of organs in the body. The number of students achieving this basic level drops over time, to 59% in eighth grader, and 54% by twelfth grade (ibid, 2005).

There are also different levels of science achievement between groups. Although girls have average higher grades in science than boys, boys tend to outperform girls in standardized science tests from elementary to high school, a trend found both in the U.S. and internationally (NAEP, 2005). In addition, minority students tend to have lower science achievement scores than non-minority students (Jones, 1998; NAEP, 2005), and students from diverse languages and cultures, students with disabilities, and students from low socioeconomic backgrounds tend to exhibit relatively low performance in science and are underrepresented in science-related careers (Lee, 1999; Prime & Miranda, 2006). In an increasingly technological and science-reliant environment, research suggests that these achievement disparities may widen the social and economic gaps between society's haves and have-nots (Muller, Stage & Kinzie, 2001). What is more, innovative methods are needed to boost scientific literacy and achievement in students in order to create generations of adults that are prepared to address personal, community and societal advances that can be better informed by scientific thought. As research suggests, changing attitudes toward science is one approach that holds merit.

Science attitudes

Attitudes are defined as an emotional orientation of a student to respond favorably or unfavorably to concepts or ideas (Papanastasiou & Papanastasiou, 2004). More specifically, Klopfer (1971) define the following components of *science attitudes* in science education: 1) favourable attitudes toward science and scientists; 2) acceptance of scientific inquiry as a way of thought; 3) adoption of "science attitudes;" 4) enjoyment of science learning experiences; 5) interest in science and science-related activities; and 6) interest in pursuing a career in science or science-related work.

The correlation between positive attitudes toward science and higher levels of science achievement is well documented (Atwater, 1996; George, 2006; Hoffman & Haussler, 1998; Koballa, Crawley, & Shrigley, 1990; Liu, 2006; Muller et al., 2001; Neathery, 1997; Osborne, Simon & Collins, 2003; Papanastasiou & Papanastasiou, 2004; Papanastasiou & Zembylas, 2002). More importantly, research suggests that this relationship is not spurious. Indeed, there is evidence that attitudes themselves have a significant and direct effect on achievement (Schibeci and Riley 1986). Because positive attitudes toward science predict higher scientific achievement and literacy, it is essential that science education captivates students from an early age and continues to actively engage them. Studies show, however, that while students in elementary school report generally positive attitudes toward science, these positive attitudes fall as students progress through middle and high school (George, 2006; Greenfield, 1995; Papanastasiou & Papanastasiou, 2004). Not surprisingly, attitudes toward science tend to follow the same subgroup patterns as science achievement. Males have more positive attitudes toward science, as well as higher levels of achievement than women (Muller et al., 2001). Minorities also have less positive attitudes toward science than non-minorities (Catsambis, 1995).

The importance of science achievement and attitudes for the field of drug prevention

The call for a scientifically literate public is universal across educators, policy makers, and public institutes, (American Association for the Advancement of Science, 1993; National Research Council, 2005), and public scientific literacy is a critical concern for the field of drug abuse prevention. Indeed, science has revolutionized our understanding of the action of drugs in the brain, how this can result in addiction, and the implications of these biological changes for prevention and treatment (Leshner, 1999), particularly in recent years. These concepts are complex, but research has suggests that accurate information on the brain, body and drugs can be disseminated widely and accurately if presented in engaging and accessible ways (Holtz & Twombly, 2007, Twombly, Holtz & Tessman, 2007).

A foundation of positive attitudes toward science and basic scientific literacy paves the way for this dissemination. Indeed, a greater public understanding of the science of drug abuse has been linked lower rates of drug use on personal and community levels, decreased stigma for drug users, more supportive public policies related to substance use and abuse, and professional entry into related careers to continue scientific progress in this field.

With respect to public understanding, it is important for people to know about the effects of drugs on the brain and body, as low science literacy rates in the population have been shown to increase levels of drug abuse within communities (IOM, 1997). On an individual level, science literacy is important for leading healthy lifestyles and making healthy decisions, particularly as they relate to drugs (Cameron & Chudler, 2003). Other research has found that a greater understanding of the risks of drug use is linked with lower use of drugs (Johnston et al 2006), suggesting that accurate scientific knowledge and protective attitudes toward drugs are keys to prevention.

Scientific literacy can also decrease stigma. Many people misunderstand the nature of addiction as a biologically based brain disorder (NIDA, 2006), despite efforts at advocacy and public education. The misconception that addiction is a moral failing creates barriers to treatment and increased stigma (IOM, 1997), increasing the burden of drug use on individuals and communities. Accurate information about the brain changes that result from drug use can correct these misconceptions.

Scientific literacy also impacts substance abuse related public policies, such as access to treatment (IOM, 1997). What is more, a lack of understanding of the biological basis of addiction can lead to punitive policies toward drug users, decreased funding for treatment programs (ibid), and even decreased public support for research on the topic of drug abuse treatment and prevention (ibid).

In the end, though, scientific progress depends in large part on the degree to which students and the general public are literate and well-educated (National Research Council, 2005). For continued progress in all fields of science, there is a need to ensure that adequate numbers of students enter science education tracks and eventually pursue careers in the biomedical sciences (NIDA, 2006). Students' positive attitudes toward science and early science literacy predict later enrolment and science courses (Farenga & Joyce, 1998) and aspirations to science careers (Catsambis, 1995), suggesting this is a fruitful area for intervention to increase the number of drug abuse researchers.

From the foundation of previous research on the relationship between science achievement and attitudes about science, as well as the importance of science literacy to the field of drug abuse prevention in particular, this paper presents the results of an evaluation of science education curriculum on drugs and the brain with a focus on the relationship between attitudes toward science, attitudes toward drugs, and science achievement. More specifically, we use data collected from a pretest/posttest quasi-experimental model, whereby fourth- and fifth-grade students in the treatment group were exposed to the curriculum and those in the control group were not in order to address the following empirical questions:

- What are the attitudes of students about science prior to the implementation of the curriculum?

- How do these pre-existing attitudes about science correlate with the change in knowledge about drugs of abuse?
- To what extent do attitudes about science predict change in knowledge about drugs of abuse when statistically controlling for student demographic variables and other factors?

The remainder of this paper discusses the development and theoretical foundation of the curriculum, provides the methodology used its evaluation, describes the key findings of the evaluation, and concludes with the theoretical and practical implications of using a science education-based curriculum for the field of substance abuse prevention in youth.

Development of a Science Education-Based Drug Curriculum

The curriculum, entitled *Brain Power!* was developed with funding from the National Institute on Drug Abuse, which is part of the National Institutes of Health of the United States. It provides students in grades K–8 and their teachers with lessons on the normal functions of the brain, nervous system, and body, and how drugs change these processes. The curriculum was developed through an iterative process, incorporating input from the target audiences of youth and teachers and experts in the field of substance abuse and neuroscience. Moreover, because of the policy push in primary and secondary education in the U.S. to increase the proficiency of students in math, reading, and science, the content of the curriculum was aligned with National Science Education Standards (NSES) (National Research Council 2005) and standards of learning from key states such as New York and California (upon which many other states base their standards).

The curriculum covers several types of drugs, including alcohol, nicotine, inhalants, prescription and over-the-counter drugs, marijuana, cocaine, heroin, steroids, methamphetamine, and club drugs such as GHB, MDMA, Ketamine, and Rohypnol. The curriculum consists of four separate educational programs, each designed for children in specific grades: kindergarten through first, second through third, fourth through fifth, and sixth through eighth. The curriculum is divided into several age groups, because each group has unique developmental and learning needs, and previous research found that tailored programs are more effective (Oetting, Edwards, Kelly, & Beauvais, 1997; Tobler & Stratton, 1997; Botvin et al., 1995).

Each program includes a range of components, including a teachers' guide, interactive student materials, and parent materials. Each lesson that makes up the curriculum has specific learning objectives. For example, the fourth- through fifth-grade program—which is the focus of this paper—contains six lessons that were administered to students over a 6-week period. Lessons build on one another cumulatively, and early lessons on the typical functioning of the brain serve as a foundation for later modules on how drugs change that functioning. The specific learning objectives for six lessons are provided in Figure 1. All lessons were field tested with the target audiences prior to initiating the formal evaluation of the curriculum.

Figure 1:
Learning Objectives for *Brain Power!* for 4th and 5th Grades

Module 1: Students participate in discussion and activities to prompt thinking about drugs and their impact on society. They are asked to think about differences between legal and illegal drugs and what drugs fall into each category, as well as how the media portrays drugs.

Module 2: Students learn about the major parts of the brain, and are asked to give examples of activities that involve the different parts. Students also learn about different techniques used to study the brain, and what each can tell us about the brain and its functioning

Module 3: Students learn about neurons and how they communicate through the process of neurotransmission.

Module 4: Students learn about legal and illegal drugs classified as stimulants (caffeine, nicotine, methylphenidate (Ritalin), amphetamines, and cocaine), and their effects on the brain and body.

Module 5: Students learn about alcohol, marijuana, and inhalants, and the ways that these drugs affect the body, brain and nervous system

Module 6: Students learn about addiction as a disease resulting from changes in the brain.

Evaluation Approach and Analytic Methods

To assess the effectiveness of the curriculum on changes in knowledge about drugs, we collected data from students in fourth and fifth grades using a pretest, post-test quasi-experimental design. The 93 students in the two grades who participated in the full curriculum received identical surveys with questions pertaining to knowledge and attitudes about drugs before (pretest) and after (post-test) the implementation of the curriculum. The survey included questions from the following instruments.

- *Knowledge instrument*: We developed a 20-item multiple-choice instrument to assess children's knowledge about drugs and drug abuse before and after the curriculum intervention. Items test knowledge, application, and synthesis of content material in the curriculum.
- *The How I Feel About Science Questionnaire* (HIFAS) (Rim, 1971) was adapted for this study. The HIFAS, which is a 36-item instrument designed for elementary school settings, measures six aspects of children's attitudes toward science such as attitudes toward science class and attitudes toward science professions.
- *Attitudes and Intention to Use Drugs*: We modified and excerpt several instruments with demonstrated reliability and validity for children for this study. They include: 1) *Tentative Drug Use Scale* (TDUS) (Horan & Williams, 1975), 2) the *Alcohol Expectancies Questionnaire* (AEQ) (Christiansen, Goldman & Inn, 1982), and 3) *The American Drug and Alcohol Survey* (ADAS: Edwards, Beauvais & Oetting, 1986). The TDUS was designed to evaluate drug abuse prevention programs. The AEQ, an often-used alcohol expectancy instrument in research and clinical settings, has well-demonstrated concurrent and predictive validity and shown to uniquely increase the prediction of alcohol use and abuse. Finally, ADAS is a widely used and well-validated scare that measures students' experience with a variety of drugs. We used portions of the children's version, designed for students in grades

three through nine.

For the knowledge questions, we recorded pretest and post-test answers and determined their correctness. Each student could receive a maximum of 18 correct answers on the survey. We summed the correct answers for each student in the pretest and the post-test and created a measure to determine the amount of change between the two points in time.

The survey also allowed us to create several independent variables that we test to determine their predictive value on changes in knowledge about drugs. The primary independent variable – and the focus of this paper – is positive attitudes about science. Stemming from the established measurement instruments noted above, we asked students six questions about their feelings about science. Each question was structured with a five-point Likert scale. We analyzed the results by creating an overall numeric attitude score for each student. To do so, we summed the number of answers in which the student indicated "positive" or "very positive," corresponding to level 4 or level 5 on the five-point Likert scale. Next, we divided that total by six (e.g., the total number of attitudinal questions about science) and multiplied the result by 100. The result is a composite score with a standardized range of zero to 100 that estimates the attitude about science of each survey participant at pretest. So, for example, if a student answered one of the six science-related attitude questions either positively or very positively, he or she received a total score of 16.67. A student who reported positive or very positive answers on all six questions received a score of 100.00.

We also constructed composite scores for attitude-related questions about drugs of abuse and alcohol. More specifically, we used the methodology described above to ascertain the degree to which survey participants had protective attitudes about drugs of abuse and protective attitudes about alcohol. These "pre-existing" factors, one may theoretically reason, may help to explain some of the variation in knowledge change. Additional independent variables include student-level demographic controls, such as gender, race, and grade. Gender (male/female) and grade (4/5) are measured dichotomously. Due to the distribution of students, race is measured as white, black, and other.

There are two data limitations to this study. First, although the curriculum was developed for students in kindergarten through eighth grade, the most comprehensive and current data are available for the fourth- and fifth-grade population. As a result, the generalizability of the findings to other school populations should be viewed cautiously.

A second limitation is the non-randomness by which students were recruited to participate in the study. Survey participants came from two schools in the Washington, D.C., metropolitan region, and their demographic composition, as shown in Table 1, varies from national data on primary and secondary students reported by the National Center for Education Statistics (NCES). More than 30% of students in the study are African American, compared with 17.3% of students nationally. Approximately 46% of survey participants were male. In contrast, 51% of students nationally are male. Finally, among students in the study, 60.2% of students were in the fourth grade and 39.8 were in the fifth grade. NCES data suggest, however, that there are slightly more students in the fifth grade than the fourth in the United States. Because the students in this study are not statistically representative of students nationally, the findings in this paper must be considered carefully.

Despite these limitations, these primary data allow us to gain considerable insight on the linkage between change in knowledge about drugs attitudes through the implementation of science-based educational curriculum and attitudes about science. To statistically explore this connection, we used a twofold analytic approach. First, we ran a set of descriptive statistics that provides information on knowledge change and pre-existing attitudes about science, drugs of abuse, and alcohol, as well as bivariate correlates for these pre-existing attitudes and the characteristics of study participants. Second, we used an ordinary least squares (OLS) model to calculate the independent effect of pre-existing attitudes about science on the change of knowledge of drugs, while controlling for other factors. A review of the data suggests that their distribution fail to violate assumptions of an OLS model.

Findings

As shown in Table 2, survey participants varied in their attitudes about science, drugs of abuse, and alcohol. Overall, with an average composite of 74.0, students had relatively strong and protective attitudes about drugs. Students tended to have less favourable attitudes about science. The composite score on this measure was 65.5, although the standard deviation for the science measure was higher than for drugs of abuse or alcohol, indicating greater variance in scores. Indeed, the data reveal that some students had particularly positive feelings about science, scoring the maximum of 100.0 on the composite measure, while others had quite negative views about science, scoring a minimum of 12.5.

Students, on average, had the least positive/protective attitudes about alcohol. On the 100-point scale, the composite score was 46.4. These scores also tended to cluster relatively strongly. The standard deviation on the alcohol measure was 13.0. The data do not allow us to determine why the protective attitudes of survey participants on the issue of alcohol was relatively low, but the findings could reflect the relative acceptance of alcohol in the United States and, perhaps, increasing alcohol usage of pre-teens.

Figure 2 provides more details on the distribution of attitudes about science, alcohol, and drugs of abuse in the study population. For each attitude measure, we arrayed the distribution of scores and divided them into quintiles. For example, students who scored from zero to 19.99 on the composite science measure comprise the "very negative/unprotective" category. In contrast, students who scored from 80.0 to 100.0 constitute the "very positive/protective" category.

The findings of the distribution in Figure 2 confirm that study participants generally feel positively or protectively toward science and drugs of abuse, while they have decided less positive or protective views of alcohol. More than 73% of students had positive or very positive attitudes about science, while only 5.4% viewed science very negatively. Similarly, more than 70% of students had protective attitudes about drugs of abuse, and only 2% had very unprotective views.

Less positive from a public health or societal perspective was the relatively high degree of unprotective attitudes about alcohol in the study population. Indeed, nearly one-third of survey participants had unprotective or very unprotective attitudes about alcohol. Only 16% of students had protective attitudes, and none had very protective attitudes. While the nonrandomized nature of the survey population suggests that generalizability of these findings may be problematic, they are nonetheless cause for some concern and further inquiry to assess their possible explanations.

Table 3 uses the Pearson correlation test to examine the degree to which the three composite attitude scores statistically associate with other factors, including knowledge change about the effects of drugs on the brain and body following the implementation of the curriculum and various demographic characteristics of the study participants. Again, the focus of this paper is on the extent to which pre-existing factors, such as attitudes about science, relate to changes in knowledge stemming from one science-based educational curriculum.

The findings of Table 3 suggest two key findings. First, pre-existing attitudes about science and knowledge acquisition about the effects of drugs on the brain and the body from pretest to post-test are significantly and positively related. In other words, students who had more positive attitudes before the implementation of the curriculum showed greater knowledge acquisition. This is an important finding, because it suggests that students who view science positively may be more receptive to science-based educational approaches, a pedagogical movement supported by the National Institutes of Health and some advocacy groups in the United States.

Second, pre-existing attitudes about drugs of abuse are significantly and negatively associated with knowledge changes about the impact of drugs on the brain and the body. We suspect that this finding relates to the fact that children with low opinions about drugs at the outset of the curriculum also had a relative lack of knowledge about the effects of drugs. Indeed, these students tended to score lower on the knowledge based questions at pretest. When presented with the science-based curriculum, these students were able to gain knowledge more markedly from pretest to post-test, despite their relatively unprotective initial attitudes about drugs.

The positive relationship between knowledge acquisition and positive attitudes toward science and the negative relationship between knowledge gains and protective attitudes about drugs remain evident and significant in the multivariate analysis. In fact, Table 4 shows that positive attitudes about science at the pretest phase are the most important determinant of knowledge change. Indeed, for every additional unit on the scale of positive attitudes toward science, study participants gain 0.3 more correct answers. This finding suggests that youth who enjoy science may have a stronger incentive to learn about the effects of drugs. In other words, a science-based education may resonate most strongly with youth who feel good about science at the outset. Another possibility is that youth who had pre-existing positive attitudes about science are better performing students relative to their peers, which may positively impact their ability to acquire and retain knowledge.

Preexisting attitudes about drugs remain significantly and negatively correlated with a change in knowledge when holding constant other factors. In fact, the data suggest that, for each additional unit of protective attitudes about drugs at pretest, students lose 0.7 correct questions on the post-test. Again, this finding may relate to students with relatively unprotective attitudes about drugs of abuse at pretest having a greater band of knowledge to acquire than students with protective attitudes, who had a strong understanding of the effects of drugs before the curriculum was implemented. Indeed, if one interprets the finding somewhat differently, then one may suggest that a lack of protective attitudes about drugs positively and significantly relates to positive knowledge change, when controlling for other factors.

Discussion

The first major finding of this paper is that student attitudes toward science is an important predictor of achievement on a science education curriculum specifically focused on drugs of abuse. Students with positive attitudes before the implementation of the curriculum tended to show greater acquisition of knowledge. This finding is consistent with previous research that has documented the relationship between positive student attitudes and high science performance (Atwater, 1996; George, 2006; Hoffman & Haussler, 1998; Koballa, Crawley, & Shrigley, 1990; Liu, 2006; Muller et al., 2001; Neathery, 1997; Osborne, Simon & Collins, 2003; Papanastasiou & Papanastasiou, 2004; Papanastasiou & Zembylas, 2002). Student attitudes toward science in the sample were generally high, with 73% of students reporting positive attitudes, but there was great variance in this measure with some students scoring at the highest end of the scale and other students scoring toward the lower end.

This finding suggests the potential benefit of pedagogical methods to improve science achievement by identifying and intervening with those students in the class who may have more negative attitudes toward science prior to the implementation of core content. Furthermore, boosting the attitudes of all students toward science may have commensurate benefits for science performance. Because science attitudes are generally high in late elementary school and decline with age (George, 2006; Greenfield, 1995; Papanastasiou & Papanastasiou, 2004) the fourth and fifth grade period may be a prime time for such intervention.

Several factors in previous research have shown promise in improving attitudes about science, and could be used as methods to provide such an intervention. For instance, strong teachers, a supportive learning environment, positive science self-concept, and encouraging peer attitudes toward the topic have been shown to correlate with positive science attitudes (Beaton et al, 1996; George, 2006; Papanastasiou & Papanastasiou, 2004; Simpson & Oliver, 1990). Research suggests that teachers' enthusiasm and ability to engage students in the curriculum is essential (Ebenezer & Zoller, 1993; Myers & Fouts, 1992; Von Secker & Lissitz, 1999). Students also tend to respond well to hands-on inquiry based activities that encourage independent exploration (Ornstein, 2006). This type of environment promotes active learning and participation and engages students in the learning process. It is also important to make the material relevant to student's daily lives, particularly for adolescents (Liu, 2006; Hutchinson et al, 2007; Schwartz-Bloom & Halpin, 2003). Providing context and relevance also allows students to actively apply information outside of the classroom, thus increasing engagement, motivation, and positive attitudes (Keselman, Kaufman, & Patel, 2004; Schwartz-Bloom & Halpin, 2003; Yiping, 1996). More research is needed to identify the most powerful methods to change attitudes toward science, in tandem with innovative and engaging methods to deliver this content to the classroom.

The second major finding of this paper is that attitudes toward illicit drugs also impacted students' performance on the curriculum. Students with less protective attitudes toward drugs at pretest gained greater knowledge from this curriculum. Knowledge and attitudes and toward drug use have been found to have important theoretical linkages to actual drug use (Fishbein & Middlestadt, 1987), so this finding suggests that the curriculum may have value as a drug prevention tool for students at risk.

Indeed, these findings suggest a slightly different perspective on the Theory of Reasoned Action (Ajzen, 1991), which has long been used as a foundation for drug abuse prevention programmes (McNeal et al 2004; Worden & Slater 2004; Amaro et al 2001). Generally, this theory explains the relationship between knowledge, attitudes, and behavior thus: exposure to new persuasive information causes progressive changes in knowledge, attitudes, and ultimately behavior (Ajzen, 1991). In this case, unprotective attitudes preceded greater knowledge change – the opposite relationship documented for science attitudes. This finding suggests the need for more research to explore how negative attitudes affect learning across different domains.

Taken together, the findings of this paper affirm that attitudes are an important component of learning. When providing educational information that may also have an impact on health, like drug abuse and prevention, the power of positive attitudes to potentiate learning may have particular impact on student outcomes. Innovative approaches to measure, understand and maximize student attitudes in the field of science education are needed.

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Table 1. Mean characteristics of study participants

Characteristic	Mean
Race	
White	58.1
Black	31.2
Other	10.7
Gender	
Male	46.2
Female	53.8
Grade	
4	60.2
5	39.8

Source: Authors' tabulations of *Brain Power!* data
N=93

Table 2. Composite Scores of Pre-existing attitudes of Study Participants

Measure	Mean	Std.	Max	Min.	Range
Drugs of abuse	74.0	20.5	100.0	14.3	85.7
Science	65.5	21.8	100.0	12.5	87.5
Alcohol	46.4	13.0	66.7	16.7	50.0

Source: Authors' tabulations of *Brain Power!* data
N=93

Table 3. Pearson correlation coefficients: pre-existing attitudes and other population characteristics

		Attitudes			Gender		Grade		Race			
Category	Variable	Science	Alcohol	Drugs of abuse	Male	Female	4th	5th	White	African American	Other	Knowledge change
Attitudes	Science											
	Alcohol	0.18										
	Drugs of abuse	0.00	0.22 *									
Gender	Male	-0.05	0.06	-0.10								
	Female	0.05	-0.06	0.10	-1.00 **							
Grade	4th	0.00	0.03	-0.03	0.05	-0.05						
	5th	0.00	-0.03	0.03	-0.05	0.05	-1.00 **					
Race	White	-0.06	0.02	-0.14	0.00	0.00	-0.25 *	0.25 **				
	African-American	0.12	0.04	0.09	-0.07	0.07	0.17	-0.17	-0.79 **			
	Other	-0.09 *	-0.08	0.08	-0.10	0.10	0.14	-0.14	-0.41 **	-0.23 *		
Knowledge change		0.33 *	0.09	-0.26 *	-0.05	0.05	-0.09	0.09	0.04	-0.01	-0.04	

Source: Authors' tabulations of *Brain Power!* data

N=93

P<=0.05 = *; P<=0.01=**

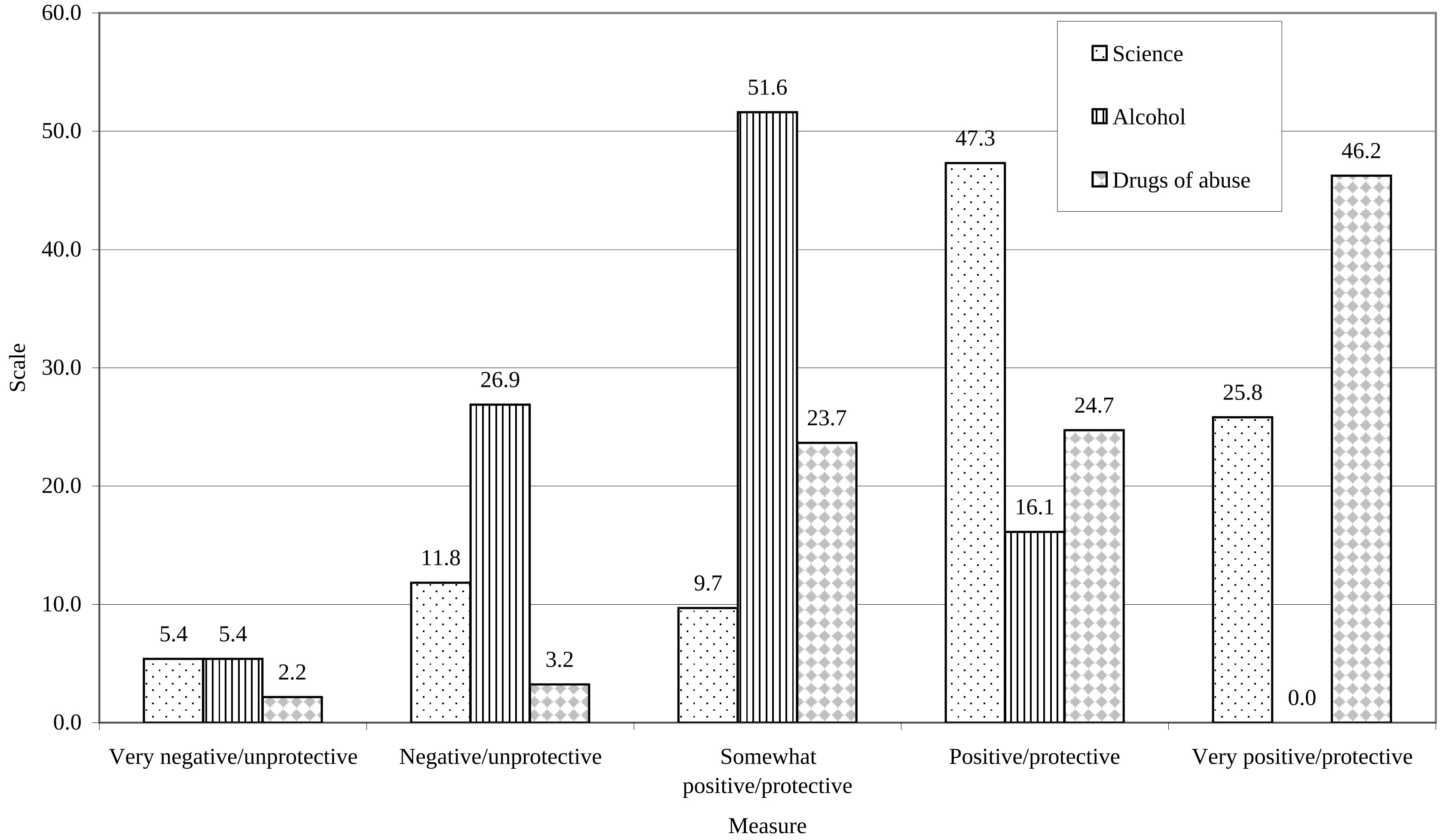
Table 4. Determinants of Knowledge Change of Drugs of Abuse

Variable	Coefficient	S.E.	Signif.
Positive attitudes about science	0.3	0.1	**
Protective attitudes toward alcohol	0.3	0.3	
Protective attitudes toward other drugs of abuse	-0.4	0.1	*
Male	-0.3	0.4	
Grade 5	0.4	0.4	
White	-0.2	0.6	
African-American	-0.3	0.7	
Intercept	1.2	1.1	

Source: Authors' tabulations of *Brain Power!* data
N=93
R-square = .20
P<=0.05 = *; P<=0.01=**

Notes: Reference groups in this model include females, students in grade 4, and study participants who neither self-identified as white or African American.

Figure 2. Scale of pre-existing attitudes aboout science, alcohol and drugs of abuse among study participants



Source: Authors' tabulation of Brain Power! Data