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Lowering Risk for Early Alcohol Use by Challenging Alcohol Expectancies in Elementary School Children

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Altering alcohol expectancies has reduced alcohol use among young adults and may lead to successful prevention of early alcohol use. The authors randomly assigned 216 4th-grade children to an expectancy challenge or control condition and used individual-differences scaling to map expectancies into memory network format, with preference mapping to model likely paths of association. After expectancy intervention, children exhibited a greater likelihood to associate alcohol use with negative and sedating consequences and a decreased likelihood to associate alcohol with positive and arousing consequences. Children and adults who emphasize negative and sedating effects have been found to be less likely to use alcohol. Therefore, expectancy challenge interventions that have been successful at modifying expectancies and subsequently decreasing alcohol consumption of adults may be useful in reducing the likelihood of early alcohol use among children.

Traditionally, school-based substance use prevention strategies have used negative information dissemination or resistance skills training in their attempts to decrease the likelihood of substance use. Unfortunately, such approaches have not been shown to be significantly effective in preventing substance use in later years (Gorman, 1998; Hansen, 1992), and use of most substances has not decreased significantly over the past 15 years. Recent reviews of the prevention literature have suggested that the effectiveness of school-based alcohol use prevention programs in decreasing actual substance use is small when measured using immediate posttests (Ennett, Tobler, Ringwalt, & Flewelling, 1994) and nonexistent or negative at longer follow-ups (Duryea & Okwumabua, 1988; Harmon, 1993; Dunn, Bowers, Cruz, Ingram, & Besaw, 1998). The lack of effectiveness of popular programs could be due to the fact that many of the commonly implemented school-based prevention programs (e.g., Project DARE) are intuitive rather than research based (Dusenbury & Falco, 1995). Although theoretically based programs have been designed and implemented with promising results on a variety of variables, these approaches have only just begun to evaluate and incorporate the vast number of variables that have been associated with substance use (e.g., Botvin, Baker, Dusenbury, Tortu, & Botvin, 1990; Ellickson & Bell, 1990; Graham, Johnson, Hansen, Flay, & Gee, 1990; Sussman, Dent, & Stacy, 1999). New efforts to develop prevention strategies that target potential causal mechanisms are clearly warranted.

One promising area in alcohol prevention research makes use of information about the effects of alcohol stored in memory, often referred to as *alcohol expectancies*. Recent conceptualizations of expectancies have advanced the concept that expectancies can be "seen as a functional approach to adaptation and survival that has been manifested in multiple biological systems using different structures and processes" (Goldman, in press). Such expectancies may prove to be crucial in primary alcohol prevention because expectancies about the affective and behavioral effects of alcohol may serve as a common pathway between antecedent variables and actual drinking (Goldman, Brown, Christiansen, & Smith, 1991; Stacy, Widaman, & Marlatt, 1990). Support for a causal relationship between alcohol expectancies and alcohol consumption comes from studies that have found that expectancies exist prior to drinking experience (e.g., Dunn & Goldman, 1996; Kraus, Smith, & Ratner, 1994), predict drinking initiation (e.g., Christiansen, Smith, Roehling, & Goldman, 1989), differentiate light-drinking and heavy-drinking children and adults (e.g., Dunn & Earleywine, 2001; Dunn & Goldman, 1998, 2000; Rather & Goldman, 1994; Rather, Goldman, Roehrich, & Brannick, 1992), and mediate the influence of antecedent variables on alcohol use (Goldman & Darkes, 1997; Sher, Walitzer, Wood, & Brent, 1991; Stacy, Newcomb, & Bentler, 1991). Furthermore, manipulation of expectancies has been shown to consequently decrease drinking significantly in heavy-drinking college students (Darkes & Goldman, 1993, 1998; Dunn, Lau, & Cruz, 2000).

Numerous studies have focused on memory processes to gain a better understanding of the relationship between stored information about drugs and actual substance use. Stacy and colleagues (Stacy, 1997; Stacy, Dent, Sussman, & Raynor, 1990; Stacy, Leigh, & Weingardt, 1994; Stacey, Newcomb, & Bentler, 1995) have used association measures to successfully demonstrate a clear and consistent relationship between memory processes and use of alcohol, marijuana, cocaine, and smokeless tobacco. Goldman and colleagues (Goldman, 1989, in press; Goldman, Del Boca, &

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Darkes, 1999; Goldman & Rather, 1993) have pursued a different but complementary approach to studying memory processes and have focused primarily on alcohol use. They have asserted that expectancies could be conceptualized as units of information about the effects of alcohol acquired in childhood and young adulthood. Furthermore, this information may be stored in an associative memory network (and at numerous other levels in the nervous system ranging from individual neurons to higher order cognitive processes) and subsequently influence an individual's decision to drink. Alcohol expectancies may be represented in associative networks by information nodes that are linked together on the basis of intrinsic meaning and learning history (Collins & Loftus, 1975; Rather et al., 1992). It has been hypothesized that the strength of associations between nodes in the network represent the strength of associations between units of information about the effects of alcohol (Goldman, 1989). Additionally, higher order concepts are formed when activation spreads from node to related node in response to particular stimuli (Goldman & Rather, 1993).

A memory framework is a useful working model because such models can be formalized through mathematical procedures such as multidimensional scaling (MDS). These statistical procedures provide a graphic or pictorial representation of stimulus items, which are "mapped" relative to each other in multidimensional space (Goldman & Rather, 1993). The space between stimulus items represents psychological similarity or difference between those items. In other words, items closer to each other in the stimulus configuration are more likely to be activated together. These scaling procedures are particularly helpful in that they provide insight into the complex relationships among different expectancies and how these expectancies may combine and operate to affect drinking behavior (Rather et al., 1992).

Individual differences scaling (INDSCAL), a variant of MDS, has been used to model the organization and activation of expectancy information in the memory of children (Dunn & Goldman, 1996, 1998) and adults (Dunn et al., 2000; Dunn & Earleywine, 2001; Rather et al., 1992; Rather & Goldman, 1994). Children tend to organize expectancy information along the same dimensions as adults (i.e., positive–negative and arousal–sedation). However, the expectancies most likely to activate changed as a function of age. For younger children (2nd grade), it was found that alcohol expectancies were organized almost entirely along a positive–negative dimension and that negative expectancies were more likely to activate than positive ones. On the other hand, older children (4th and 5th graders) were more likely to expect positive and arousing outcomes from drinking (Dunn & Goldman, 1996). In turn, evidence suggests that such changes in alcohol expectancy information may influence the initiation and development of drinking as children age into adolescence (e.g., Miller, Smith, & Goldman, 1990). In a study that modeled activation patterns of children in 3rd through 12th grade in relation to drinking, it was found that higher drinking children in each grade were more likely to activate positive and arousing expectancies in memory than lower drinking children (Dunn & Goldman, 1998). These MDS findings were subsequently validated through other means of tapping memory processes (Dunn & Goldman, 2000). In addition, INDSCAL has been used to show that alcohol expectancy activation patterns of children are malleable (Dunn & Yniguez, 1999), that changes in likely activation patterns predict subsequent changes in actual alcohol use (Dunn et al., 2000), and that likely expectancy activation patterns vary in relation to the ascending or descending limb of the blood alcohol curve (Dunn & Earleywine, 2001). Specifically, heavier drinkers were more likely to activate positive and arousing expectancies experienced as blood alcohol levels increase (the ascending limb of the blood alcohol curve), whereas lighter drinkers were more likely to activate negative and sedating expectancies experienced as blood alcohol levels fall (the descending limb of the blood alcohol curve). Finally, INDSCAL has been applied to show that expectancy activation patterns vary in relation to use of other substances including marijuana (Linkovich-Kyle & Dunn, 2001), MDMA (Harper, Dunn, & Earleywine, 2001), and cigarette smoking (Linkovich-Kyle & Dunn, 1998) and to show that activation patterns vary in relation to eating (Tantleff-Dunn, Gokee, & Dunn, 2001) and body comparison processes (Fisher, Dunn, & Thompson, in press).

In the studies noted above that used INDSCAL to model alcohol expectancies, it was consistently found that less emphasis on positive and arousing effects and greater emphasis on negative and sedating effects corresponded to less alcohol use, and in one study (Dunn et al., 2000), this pattern of expectancy emphasis actually predicted future decreases in alcohol use. In concert, these findings indicate that prevention approaches developed to undermine the anticipation of positive effects of alcohol may be more effective than traditional knowledge-based prevention approaches. The efficacy of this concept has already been demonstrated in a secondary intervention effort described as an "expectancy challenge" (Darkes & Goldman, 1993, 1998; Dunn et al., 2000). In this series of studies, heavy-drinking college students were exposed to an intervention that challenged their expectancies of positive arousal in relation to alcohol use. In all three studies, the expectancies of men were changed and their drinking subsequently decreased. In one study, it was shown that decreased activation of positive and arousing consequences in memory predicted subsequent decreases in alcohol use (Dunn et al., 2000). In the present study, we attempted to extend the expectancy challenge approach for the first time to primary prevention. We compared a newly developed interactive classroom exercise designed to alter the expectancy processes of fourth-grade children with a traditional alcohol information control group and an assessment-only control group. Fourth graders were selected as the target population for the present study on the basis of previous studies that had identified a developmental shift toward positive alcohol expectancies that is most pronounced between the third and fifth grades (Dunn & Goldman, 1996, 1998, 2000; Miller et al., 1990). Expectancy processes were empirically modeled before and after treatment to assess the impact of these interventions on expectancy activation patterns in memory. It was hypothesized that students exposed to the alcohol expectancy modification condition, relative to students in the control conditions, would exhibit a decreased emphasis on the arousal–sedation dimension and an increased emphasis on the positive–negative dimension, which is consistent with a decreased likelihood to drink in the future (Dunn & Goldman, 1998; Dunn et al., 2000). Additionally, it was anticipated that the association paths of children who participated in the expectancy modification exercise would change in a pattern similar to that observed in the heavy-drinking college men, with negative-sedating expectancies (such as feeling sleepy, tired, and dizzy) becoming more likely to activate after exposure to the expectancy modification alcohol prevention exercise.

Method

Participants

Participants were 216 fourth-grade students (49% girls and 51% boys) from two Central Florida public elementary schools. Detailed demographics for each ethnic group by experimental condition are presented in Table 1. Chi-square analyses conducted to assess equivalence of ethnicity across experimental groups indicated no significant differences between groups, $\chi^2(8, N = 216) = 5.43$, $p = .711$. An active informed consent procedure was used in which parents were informed of the research and were asked to provide permission for their child to participate in the study. Only students who returned parental permission forms participated. Ninety percent of parents and students provided consent and assent to participate. Of those children, 87% completed pre- and posttest measures. Chi-square analyses indicated no significant differences on initial test data between these participants and participants with missing data. All data were collected in classroom settings.

Measures

Children's Memory Model-Based Expectancy Questionnaire (MMBEQ). Expectancies were assessed using the MMBEQ, a memory model-based instrument developed in previous work (Dunn et al., 2000; Dunn & Goldman, 1996, 1998; Dunn & Yniguez, 1999). This measure consists of 41 expectancy words or phrases that can be readily mapped into network format with MDS techniques and has been used to differentiate between heavier and lighter drinking children and adults (Dunn et al., 2000; Dunn & Goldman, 1998). To ensure that each participant understood each question, the entire instrument, including the definition of each expectancy word, was read aloud by a survey administrator according to an established protocol. Students were asked to indicate on a 4-point Likert scale how often "people" feel the alcohol expectancy effect depicted by each word in the instrument when they consume alcohol. (See Figure 1 for an item example.) Coefficient alpha was .69 for the present sample, .78 for a sample of 4th and 5th graders ($n = 362$), .79 for a sample of 6th, 9th, and 12th graders ($n = 1{,}003$), and .95 for a sample of college undergraduates ($n = 243$; Dunn et al., 2000). Test–retest reliability based on the assessment-only participants in the present study was .74 over 2 weeks.

Children's Drinking Habits Questionnaire. Drinking was assessed with the following questions on quantity and frequency: "How often do you drink alcohol?" and "How much alcohol did you have the last few times you drank?" The validity of such self-reports of drinking behavior has been demonstrated among adults (e.g., Babor, Brown, & Del Boca, 1990; Sobell & Sobell, 1990) and children (Smith, McCarthy, & Goldman, 1995). Participants were instructed to report all alcohol consumption, even if it was just a sip. Individual items and percentages of students who endorsed each item are presented in Table 2. A one-way analysis of variance conducted to assess equivalence of alcohol consumption across experimental conditions indicated no significant drinking differences between groups, $F(2, 429) = .674$, $p = .511$. This measure also included demographic questions regarding age, gender, and ethnicity.

Procedure

Students were informed of the upcoming research project, and written information on the study was distributed to be taken home to parents. Parents were informed that their child's classroom may be selected to receive one of two one-session alcohol prevention presentations (expectancy modification or traditional alcohol information) or selected for an anonymous survey. Classrooms were then randomly assigned to one of three treatment conditions (expectancy modification, traditional alcohol information, or assessment-only control).

Pretest meeting with all conditions. At least 2 weeks after permission slips were given to students to take home to parents, research assistants visited classrooms to administer pretest expectancy measures. The pretest session with each participating class consisted of us administering the pretest questionnaires (the children's expectancy questionnaire and the demographic/drinking measure) and briefly introducing the purpose of our visit. Students in the expectancy and traditional knowledge conditions were informed that the next visit would consist of a brief presentation in which they would engage in interactive games and discussions involving alcohol-related information. The assessment-only control group was informed of the next visit to complete a survey and thanked for participating in our study.

Expectancy modification condition. One week after the pretest data collection visit, the primary researcher visited the classrooms assigned to the expectancy modification condition. The purpose of this visit was to implement a strategy designed to increase participants' attention to the sedating effects of alcohol and undermine the anticipation of arousing effects believed to be associated with alcohol use. The protocol designed for the expectancy modification condition was based on the expectancy challenge protocol of Darkes and Goldman (1993, 1998). The expectancy modification presentations opened with the presenter eliciting students' beliefs about the effects of alcohol and why they think "people" drink. Students were then shown slides of images (e.g., clip art) depicting effects commonly believed to be associated with alcohol. This exercise served as the starting point of a brief discussion regarding the pharmacological (or "real") effects of excessive alcohol consumption (see Appendix).

Table 1
Participant Demographics by Experimental Condition

	Expectancy modification		Traditional alcohol information		Assessment-only control		Total	
Variable	%	*n*	%	*n*	%	*n*	%	*n*
Gender								
Male	32	35	35	38	34	37	51	110
Female	37	39	32	34	31	33	49	106
Ethnicity								
Caucasian	66	48	78	56	67	47	70	151
Hispanic	15	11	10	7	14	10	13	28
African American	6	4	3	2	7	5	5	11
Asian American	1	1	1	1	4	3	2	5
Other/mixed	12	9	8	6	7	5	9	20

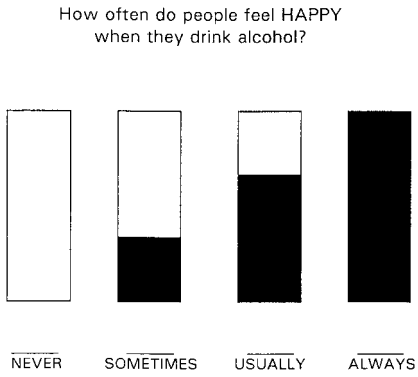

Figure 1. Sample expectancy questionnaire item.

At no point during the presentation were students encouraged to "say no" to alcohol or to believe that drinking is wrong. Instead, the emphasis was on challenging commonly held beliefs about positive social and arousing effects of alcohol (e.g., feeling happier, funnier, more social, more outgoing, and friendlier). We explained that people expect positive effects from alcohol and that most positive effects of alcohol (e.g., feeling more fun, social, energetic, happy) are not necessarily pharmacological (or real) effects. They also learned that people often drink excessively in pursuit of positive and arousing effects and that the real effects of alcohol (especially if consumed in large quantities) are sedation, tiredness, and dizziness because alcohol is a central nervous system depressant. The extent to which people experience positive effects from alcohol is directly related to their expectancies or beliefs. Additionally, we highlighted that individuals often consume alcohol in the presence of a variety of positive stimuli (e.g., with friends or family, at parties, at celebrations) and that perhaps the positive effects associated with alcohol are not a result of the pharmacological properties of alcohol but of the environment in which it is consumed. As a result, individuals have a good time at a party not because they consumed alcohol but because they were surrounded by friends, music, and other positive stimuli. However, because they were drinking alcohol, they may attribute the positive effects to alcohol. We then encouraged students not to make the same error. Once the real and "believed" effects of alcohol were presented and discussed, the class was divided into two teams to play a quiz game in which the objective was to correctly identify an effect of alcohol as real (pharmacological effect) or believed (expectancy effect). Incorrect responses during the game served as an opportunity for discussion of real effects of alcohol.

Traditional alcohol information condition. As in the alcohol expectancy modification condition, 1 week after the pretest data collection visit, the primary researcher visited the classrooms assigned to the traditional alcohol information condition. However, unlike the alcohol expectancy modification condition, the traditional alcohol information presentation emphasized the negative and dangerous effects of alcohol. To maintain similarity between both alcohol prevention conditions, the presentation began with the presenter eliciting students' beliefs regarding the negative consequences associated with alcohol abuse. This exercise served as the starting point of a brief presentation regarding the harmful consequences associated with alcohol abuse. Similarly, the presenter used slides of pictures depicting dangerous or hazardous consequences associated with alcohol abuse such as auto accidents, cirrhosis of the liver, and dependence. Once the hazardous consequences of alcohol were discussed, the classroom was divided into two teams to play a quiz game in which the objective of the game was to recognize the negative consequences associated with alcohol abuse.

Posttest meeting with all conditions. One week after receiving the alcohol prevention presentations, research assistants returned to the classrooms to administer posttest measures. Participants in the assessment-only control condition completed the posttest measures 2 weeks after the pretest meeting. After completion of the posttest measures, students in the expectancy modification and traditional alcohol information conditions were encouraged to remember the alcohol-related information they had acquired the previous week and encouraged to make use of that information in future occasions when they may be faced with the opportunity and/or decision to consume alcohol. Finally, all participants were thanked for their participation in the research study.

Table 2
Responses of Participants to Drinking Frequency and Quantity Questions

	Condition						
	Expectancy challenge		Information-only control		Assessment-only control		
Item	%	*n*	%	*n*	%	*n*	Total
Frequency of drinking							
Never had a drink	74.3	55	72.2	52	78.6	55	162
<4 drinks in life	16.2	12	16.7	12	12.9	9	33
1–2 times/year	6.8	5	5.6	4	1.4	1	10
3–8 times/year	0	0	2.8	2	1.4	1	3
1–2 times/month	1.4	1	1.4	1	1.4	1	3
1 time/week	1.4	1	0	0	1.4	1	2
2 times/week	0	0	1.4	1	1.4	1	2
Almost daily	0	0	0	0	1.4	1	1
Total		74		72		70	216
Quantity (no. of drinks/occasion)							
None	73.0	54	72.2	52	82.9	58	164
≤ 1 drink	23.0	17	23.6	17	11.4	8	42
Usually 2	4.1	3	2.8	2	1.4	1	6
Usually 3	0	0	0	0	2.9	2	2
Usually 4	0	0	0	0	1.4	1	1
Usually ≥ 7	0	0	1.4	1	0	0	1
Total		74		72		70	216

Results

Configuration of Alcohol Expectancies in Memory

As in previous work (Dunn et al., 2000; Dunn & Earleywine, 2001; Dunn & Goldman, 1996, 1998; Dunn & Yniguez, 1999; Rather & Goldman, 1994), INDSCAL was used to map alcohol expectancies into a memory network format, in which expectancies can be represented by nodes that are closely or more distantly linked. INDSCAL analyzes proximity matrices consisting of a measure of the relatedness for every possible combination of expectancy words. Additionally, it provides a pictorial representation of those expectancies that are mapped relative to each other in multidimensional space. An important feature of INDSCAL is that it simultaneously analyzes matrices of more than one group and computes a stimulus configuration that best represents the entire sample included in the analysis.

Proximity matrices for each experimental condition and assessment time were used as input for the INDSCAL analysis to produce a stimulus configuration representing all groups. A two-dimensional solution (see Figure 2), accounting for 86.0% of the variance (stress = .19) was considered optimal on the basis of Davison's (1992) technique of dimension selection. Stress and R^2 are indices of the fit of the dimensional solution to the original data matrix; low stress and high R^2 values indicate good fit. A three-dimensional solution offered only a small increase in variance accounted for (2.8%). As in previous work with adults (Dunn et al., 2000; Rather & Goldman, 1994) and children (Dunn & Goldman, 1996, 1998; Dunn & Yniguez, 1999), the two dimensions

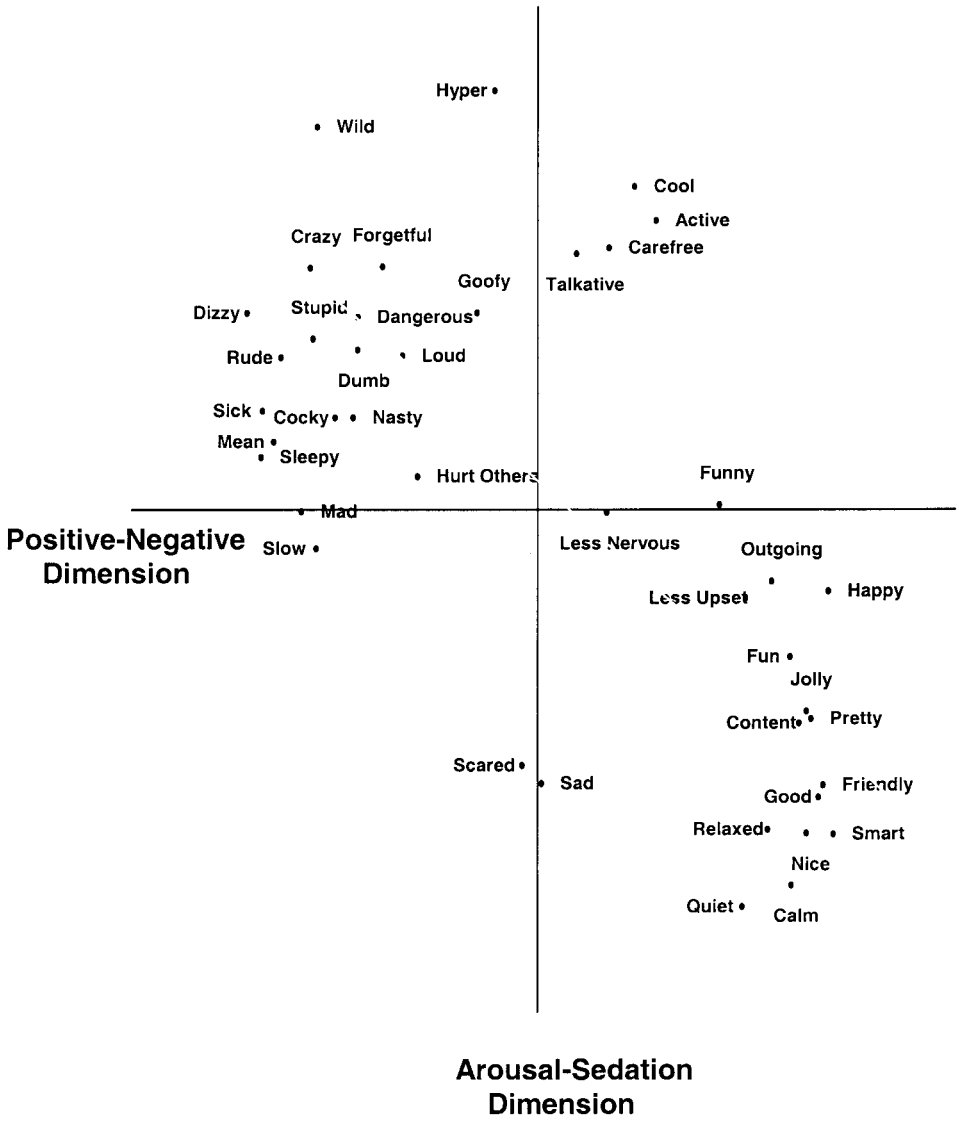

Figure 2. Individual differences scaling stimulus configuration for alcohol expectancy words representing nodes of meaning within a hypothetical expectancy network. The horizontal dimension represents evaluation (positive–negative) and the vertical dimension represents arousal–sedation.

could best be described as representing positive–negative and arousing–sedating effects of alcohol.

Differences in Dimensional Importance

INDSCAL provides a measure of dimension emphasis for each group of participants in the analysis (group weights). The higher the group weight for a particular dimension, the greater the emphasis placed on that dimension for each of the alcohol prevention conditions at each of the measurement times. Because proximity matrices are considered stable when computed from at least 25 individuals (i.e., unlikely to change with the addition of more cases), analyses were not conducted at the classroom level or on groups of children with varied drinking experience. A total of 12 group weights were computed on the basis of responses to the memory-based expectancy measure, 1 group weight on each dimension for each experimental condition (expectancy modification, traditional alcohol information, assessment-only control) at each assessment period (pretreatment and posttreatment). Examination of the plot of each pair of group weights (one weight for each dimension) for each group (depicted in Figure 3) indicated an increased emphasis on the positive–negative dimension and a decreased emphasis on the arousal–sedation dimension in the expectancy modification and the traditional alcohol information groups, with the expectancy modification group exhibiting the greatest amount of change in alcohol expectancies. Specifically, as depicted in Table 3, the importance placed on the positive–negative dimension increased substantially (from .72 to .95) in the expectancy modification condition, whereas the increase was comparatively small (from .75 to .84) in the traditional alcohol information condition. Conversely, the importance of the arousal–sedation dimension decreased considerably (from .59 to .11) in the expectancy modification condition, whereas the emphasis changed considerably less (from .52 to .41) in the traditional alcohol information condition. The decreased emphasis on the arousal–sedation dimension and increased emphasis on the positive–negative dimension is consistent with a decreased likelihood to drink in the future (Dunn & Goldman, 1998; Dunn et al., 2000). As expected, emphasis on the positive–negative and arousal–sedation dimensions did not change noticeably in the assessment-only group (from .65 to .63 and from .65 to .67, respectively). Although INDSCAL analyses are nonmetric analyses for which there are no statistical significance tests, we have ample evidence to indicate that the magnitude of the group weight differences found is behaviorally meaningful for children's drinking behavior. Specifically, in Dunn and Goldman (1998), it was found that increases in the arousal–sedation dimension and decreases in the positive–negative dimension occurred as children in 3rd, 6th, 9th, and 12th grades consumed more alcohol. For example, the difference in the importance of the arousal–sedation dimension between higher and lower drinking sixth graders was .12. Likewise, the difference in the importance of the positive–negative dimension between lower and higher drinking sixth graders was .08. In another study (Dunn & Goldman, 1996), the difference in the importance of the positive–negative dimension between 2nd graders and 5th graders was .28, and the difference in the importance of the arousal–sedation dimension between 2nd graders and 5th graders was .42. These differences represented a substantial developmental shift that occurs across this age range. In the present study, the difference in the importance of the positive–negative dimension for the expectancy modification group across time was .23, whereas for the traditional alcohol information groups it was .09. Further, the present study indicated a decrease in emphasis on the arousal–sedation dimension of .48 in the expectancy modification condition and a decrease of .11 in the traditional intervention condition. Therefore, the changes in dimensional importance in the present study were comparable to a 3-year developmental difference in a previous study (Dunn & Goldman, 1996) and were greater than differences between children with statistically significant differences in drinking (Dunn & Goldman, 1998).

Table 3
Subject Weights for Each Group by Dimension

Treatment condition	Dimension 1 (positive–negative dimension)	Dimension 2 (arousal–sedation dimension)
Pretest expectancy modification	.72	.59
Posttest expectancy modification	.95	.11
Pretest traditional alcohol information	.75	.52
Posttest traditional alcohol information	.84	.41
Pretest assessment-only control	.65	.65
Posttest assessment-only control	.63	.67

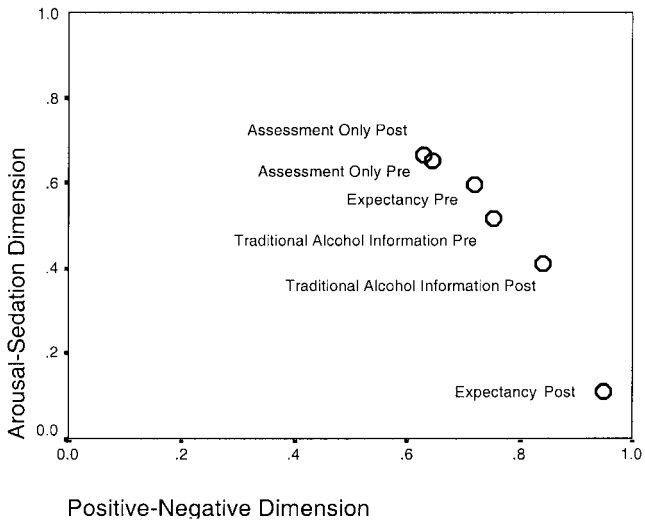

Figure 3. Individual differences scaling participants' weights on the positive–negative dimension and the arousal–sedation dimension for each alcohol prevention condition and assessment time. Post = posttest, pre = pretest.

To assess the direction of the change in dimensional emphasis, we examined the means of each expectancy effect for each of the groups being compared at pretest and posttest. Higher means were found for sedating expectancy effects (e.g., *slow, sleepy, dizzy, quiet*) and lower means were found for arousing expectancy effects (e.g., *active, hyper*) for the expectancy modification group from pre- to posttest. Furthermore, means for positive expectancies (e.g., *happy, fun, outgoing, cool*) were lower and means for neg-

ative expectancies (e.g., *mean, nasty, mad, hurt others*) were higher after participating in the expectancy modification condition. Similar changes were found in the expectancy means in the traditional alcohol information condition, albeit not as large as in the expectancy modification condition. In short, examining the means for the expectancy words ensured that the change in dimension emphasis, as depicted by INDSCAL group weights, was toward the hypothesized end of the dimension (i.e., the negative end of the positive–negative dimension and the sedating end of the arousal–sedation dimension).

Preference Mapping (PREFMAP) Analyses

Estes (1991) proposed that memory networks could be modeled using points in multidimensional space and plotting vectors representing paths of activation within cognitive space. PREFMAP is a multiple regression procedure that places a vector through a stimulus configuration that can be used to model association pathways through hypothetical expectancy networks. In previous alcohol expectancy research, studies using PREFMAP have indicated that association paths are related to drinking level in children (Dunn & Goldman, 1996, 1998) and in adults (Dunn et al., 2000; Dunn & Earleywine, 2001; Rather et al., 1992). Specifically, results indicated that as children get older and gain more drinking experience, they begin to associate alcohol with more positive and arousing outcomes (e.g., feeling "cool"). Similarly, heavier drinking adults are more likely to activate positive and arousing effects associated with drinking than lighter drinkers, who are more likely to activate sedating effects. Most recently, likely paths of association of heavy-drinking college men changed toward negative and sedating expectancies after participating in an expectancy challenge program (Dunn et al., 2000). Further, changes in expectancy activation predicted a subsequent significant decrease in alcohol consumption. Therefore, if the brief expectancy modification exercise had an impact on children's alcohol expectancies in a way that would change their likelihood to drink in the future, it should be reflected in their likely paths of activation.

To plot paths of association in the present study, we computed mean frequency of occurrence ratings for each expectancy word for each of the six groups (expectancy modification, traditional alcohol information, and assessment-only control at pre- and posttest). These means were used by PREFMAP to plot vectors through the INDSCAL stimulus configuration. Resultant *R*s were between .988 and .997 for each vector, and the overall root-mean-square was .994, indicating excellent fit of the PREFMAP vectors to the data. Examination of the PREFMAP vectors for each group depicted in Figure 4 indicated that the association paths of children who participated in the expectancy modification exercise were rotated toward the negative end of the positive–negative dimension and were less likely to contain positive and arousing expectancies after intervention. Although the PREFMAP vector of children who participated in the traditional alcohol information condition was also rotated toward the positive–negative dimension, the rotation was smaller in magnitude in comparison to the expectancy modification condition. Further, there was virtually no change in the PREFMAP vectors from pretest to posttest among the assessment-only control students. This lack of change indicates good test–retest reliability for the MMBEQ and good reliability for our memory modeling procedures. As with the INDSCAL group weights, we have confidence that the PREFMAP vector rotations are behaviorally meaningful based on prior work. For example, in Rather et al. (1992), PREFMAP vectors representing adults with different drinking habits were separated by 32°, 21°, and 22°, respectively, and were considered behaviorally meaningful because they corresponded to differences in drinking levels that were also statistically significant. Similarly, in Dunn et al. (2000), heavy-drinking college men exhibited a 41° rotation toward the sedation end of the arousal–sedation dimension after participation in an expectancy challenge intervention. These participants also exhibited a statistically significant decrease in alcohol consumption (they drank 40% less) after exposure to the expectancy challenge intervention. In contrast, heavy-drinking college women exhibited a 6° vector rotation, and there were no statistically significant changes in their drinking. In the present study, the expectancy modification group exhibited a 37° rotation after exposure to the presentation, whereas the traditional alcohol information condition exhibited a 5° rotation. Similar rotational differences also have been found between children with statistically significant differences in drinking (Dunn & Goldman, 1998). Therefore, the correspondence of the present results with previous findings that were linked to statistically significant differences in drinking supports our conclusion that our results are very likely to be behaviorally meaningful.

Spread of activation through the hypothetical memory network can be modeled by moving a perpendicular line down each PREFMAP vector starting at the arrowhead, a technique that has been validated using the method most recommended by memory researchers to tap uncontaminated memory contents (Dunn & Goldman, 2000). Use of this technique suggested that the first five expectancies most likely to activate in the expectancy modification condition before the intervention were *wild, dizzy, crazy, hyper,* and *rude*. In contrast, moving down the preference vectors at posttest indicated that the five expectancies most likely to activate were *dizzy, sick, mean, rude,* and *sleepy*. Although some of the same expectancies *(dizzy* and *rude*) appeared among the first to activate before and after intervention, negative-sedating expectancies (*sick, mean,* and *sleepy*) became more likely to activate after treatment. Additionally, moving further down the preference vectors at posttest, positive expectancies such as *talkative* and *cool* were more likely to activate later in the sequence of activation in comparison to the path of activation at pretest. Therefore, it appeared that participating in a brief alcohol expectancy modification exercise led to a greater likelihood of activating negative and sedating expectancies in memory, a pattern that is consistent with a decreased likelihood of future alcohol consumption (Dunn et al., 2000). Although we cannot conclude that the expectancy patterns of the three groups were identical at pretest, the changes in both treatment groups were in the hypothesized direction and were large enough in magnitude to be consistent with differences found in our previous work that corresponded to meaningful differences in actual drinking behavior.

Discussion

Consistent with earlier findings (Dunn & Goldman, 1996, 1998), the findings of the present study demonstrated that the alcohol-related expectancies of fourth graders could be described

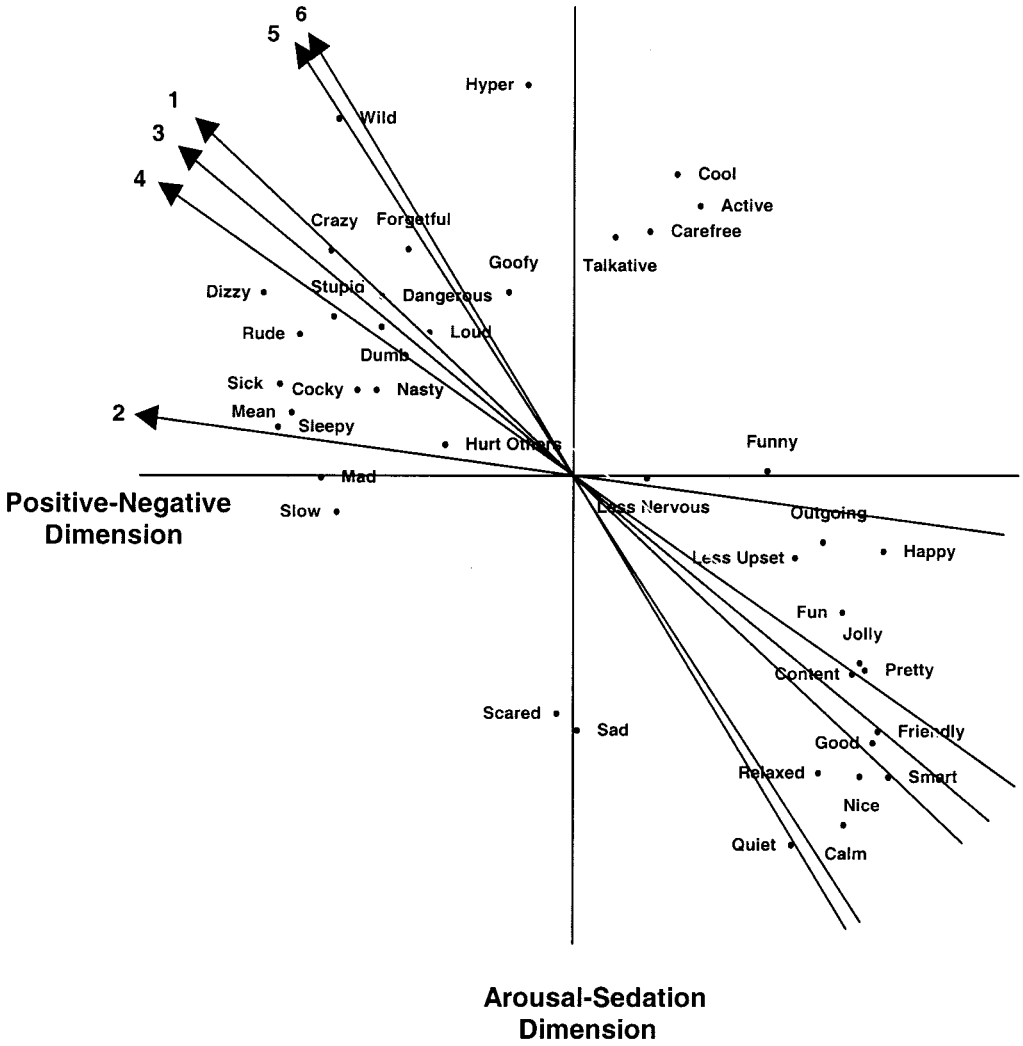

Figure 4. Individual differences scaling stimulus configuration with preference mapping vectors representing possible paths of association or activation through a memory network before and after participation in an expectancy challenge program. Vector 1 represents the expectancy modification condition at pretest, Vector 2 represents the expectancy modification condition at posttest, Vector 3 represents the traditional alcohol information condition at pretest; Vector 4 represents the traditional alcohol information condition at posttest, Vector 5 represents the assessment-only control condition at pretest, and Vector 6 represents the assessment-only control condition at posttest.

as a circumplex containing two primary dimensions (positive–negative and arousal–sedation). Although alcohol expectancies are primarily negative among young children, they become more positive and arousing as children become older and gain drinking experience. Given this natural tendency for expectancies to become more positive with age and the potential causal relationship between alcohol expectancies and alcohol consumption, prevention curricula emphasizing negative and sedating effects have been suggested as a viable alternative to the traditional alcohol information programs implemented in most schools (Dunn & Goldman, 1996, 1998, 2000; Dunn & Yniguez, 1999; Miller et al., 1990).

Also consistent with a previous expectancy challenge that measured expectancy change using memory-model-based measures (Dunn et al., 2000), the findings of the present study indicated that participants in the expectancy modification condition placed greater emphasis on the positive–negative dimension and less emphasis on the arousal–sedation dimension after participating in a single-session alcohol prevention presentation. In addition, participation in the expectancy challenge was associated with an increased likelihood to activate negative and sedating expectancies. These changes suggested that the developmental clock was turned back approximately 3 years in relation to expectancies. Although small expectancy changes in the desired direction were evident in the traditional alcohol information condition, these changes were much more pronounced in the expectancy modification condition. These findings are encouraging in light of previous research that found that children and adults who emphasize the positive–negative dimension rather than the arousal–sedation

dimension and activate negative and sedating expectancies are less likely to use alcohol. Further, these findings suggest that expectancy challenge interventions that have been successful at modifying and subsequently decreasing alcohol consumption in heavy drinking college students (Darkes & Goldman, 1993, 1998; Dunn et al., 2000) may be useful in the continued development of theory-based alcohol prevention curricula for elementary school students. Further, development and dissemination of such theory-based prevention curricula (e.g., Botvin et al., 1990; Ellickson & Bell, 1990; Graham et al., 1990; Sussman et al., 1999) are essential given the lack of effectiveness of some popular prevention programs implemented in schools today.

The lack of tests of statistical significance in the present study may seem unusual to readers who are unfamiliar with memory-modeling techniques. We are more fortunate than most users of memory-modeling techniques, however, because we have a substantial body of previous work to verify the behavioral significance of our findings (e.g., see Dunn et al., 2000; Dunn & Earleywine, 2001; Dunn & Goldman, 1996, 1998, 2000; Dunn & Yniguez, 1999; Rather et al., 1992; Rather & Goldman, 1994), and we would argue that behavioral significance is the ultimate goal. Given the similarity in degree rotations and dimension weight differences among previous studies and the present study, and the fact that these differences were associated with statistically significant differences in drinking, we can conclude that the changes in expectancies after participation in the expectancy modification are likely to behaviorally meaningful or significant. Across a substantial body of literature (based on eight published studies), expectancy organization and activation patterns as represented by INDSCAL and PREFMAP meet criteria to be considered a potential causal variable in relation to drinking behavior. Expectancies exist before drinking onset, activation patterns vary with use habits, and activation changes predict subsequent drinking changes.

The present study also contributes to a growing body of literature supporting the effectiveness of expectancy challenge procedures (Darkes & Goldman, 1993, 1998; Dunn et al., 2000) in modifying expectancy processes to make negative and sedating expectancies more salient and positive and arousing expectancies less salient. Further, the results of this study suggest that experiential expectancy challenge strategies may be successfully modified and implemented in a classroom setting. Until now, effective expectancy challenge procedures with college students have involved a bar-laboratory setting and administration of beverages that contain alcohol. If a modified expectancy challenge (one that is implemented outside of the laboratory) produces similar expectancy changes and corresponding decreases in drinking, more individuals could benefit from the empirically validated expectancy challenge drinking reduction interventions.

The present findings require replication over a longer follow-up, collection of alcohol consumption information over a time period and age adequate for drinking differences to emerge, and replication with children of diverse ethnicity and varying risk status, such as individuals with a positive family history of alcoholism. Doing so would rule out the possibility that the results of the present study are not merely a manipulation check. Collecting alcohol consumption data in conjunction with alcohol expectancy measures would be useful in more clearly making the connection between expectancy changes and drinking changes, as has been demonstrated in expectancy challenge interventions with college students (Darkes & Goldman, 1993, 1998; Dunn et al., 2000). In these studies, changes in expectancies were associated with significant decreases in alcohol consumption, and the expectancy challenge in the current study is based on the expectancy challenge protocol that led to those changes. Additionally, although this expectancy modification strategy successfully altered participants' expectancy processes, additional research is necessary to assess the longevity of such changes. Furthermore, a meaningful assessment of change in alcohol use was not possible in the present study because of the length of follow-up necessary to detect drinking changes in young children and the low drinking prevalence among this population. Therefore, in future studies, it would be useful to assess the longevity of changes in alcohol expectancies as children begin to have more experience with alcohol. Specifically, it would be useful to assess the extent to which the expectancy training provided interferes with the "positive experiences" often expected as a result of consuming alcohol. Additionally, because the present study relied on a single outcome measure, future studies should rely on additional outcome measures to minimize the potential for bias in interpreting the effectiveness of the intervention. Changes in likely activation modeled from responses to the MMBEQ, however, have been linked to statistically significant changes on other expectancy measures (Dunn et al., 2000). Finally, future studies must practice care in ensuring that there are no large differences in class sizes because larger classes have more impact than smaller ones when calculating proximity matrices. Fortunately, however, there was very little difference in classroom sizes in the present study. In MDS analyses, small variations in classroom size (as in the present study) are not sufficient to impact the results in a meaningful way because proximity matrices are very stable when composed from groups as large as those in this study.

In conclusion, the present study represents an initial step in modifying, implementing, and evaluating an expectancy challenge exercise for use with a fourth-grade population based on the expectancy challenge program that has been successfully used with college-age drinkers (Darkes & Goldman, 1993, 1998; Dunn et al., 2000). The present work indicates that a promising approach to prevention may involve altering expectancy processes that undermine the anticipation of positive and arousing expectancies. Further, these findings underscore the importance of continuing to develop and implement theory-based prevention curricula that may enhance the effectiveness of alcohol use prevention programs.

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Appendix

Summary of Components for Alcohol Presentation Conditions

Alcohol expectancy modification session	Traditional alcohol information session
Introduction	Introduction
Students identify drinks that contain alcohol	Students identify drinks that contain alcohol
How does consuming too much alcohol make people feel?	What are some consequences associated with drinking too much alcohol?
Students identify how they believe alcohol affects people	Students identify negative consequences associated with alcohol use
Real effects of excessive-drinking (emphasis on sedating negative effects)	Health consequences of excessive drinking
Increased tiredness and sleepiness	Damage to the liver
Decreased motor coordination	Damage to the heart
Increased dizziness	Damage to the digestive system
Increased feelings of nausea	Decreased ability to drive
Believed effects of alcohol consumption	Alcohol dependence
Increased friendliness or sociability	Ways of staying away from alcohol
Increased energy	Saying "no" and walking away
Increased perception that one is "cool"	Telling an adult (parent or teacher)
Increased fun	Getting involved in positive activities
Review game	Review game
Students play alcohol expectancy review game	Students play consequences of alcohol review game

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