Running Head: MATHEMATICS OF GAMBLING

Does learning about the mathematics of gambling change gambling behavior?

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Abstract

The present research examined the influence of improved knowledge of odds and mathematical expectation on the gambling behavior of university students. A group of 198 Introductory Statistics students received instruction on probability theory using examples from gambling. One comparison group of 134 students received generic instruction on probability and a second group of 138 non-Statistics students received no mathematical instruction. Six months after the intervention, students receiving the intervention demonstrated superior ability to calculate gambling odds as well as resistance to gambling fallacies. Unexpectedly, this improved knowledge and skill was not associated with any decreases in actual gambling behavior. The implication of this research is that enhanced mathematical knowledge on its own may be insufficient to change gambling behavior.

Does learning about the mathematics of gambling change gambling behavior?

The current generation of youth are the first to have been raised in an environment of extensive legalized and government-sanctioned gambling. Perhaps as a consequence, several surveys have found the prevalence of gambling to be higher in young adults. The lifetime rate of gambling in North American college and university students typically ranges from 70% to 94% (Adebayo, 1998; Devlin & Peppard, 1996; Engwall, Hunter, & Steinberg, 2002; Kang & Hsu, 2001; Ladouceur, Dube, & Bujold, 1994; Lesieur et al., 1991; Oster & Knapp, 1998). A recent nationally representative study of college students in the United States (LaBrie et al., 2003) found a lower prevalence, but this study was limited by low response rates and not asking about all forms of gambling. The rates of problem and pathological gambling are also high among young people. National surveys in the United States (Gerstein et al., 1999), Australia (Productivity Commission, 1999), and Sweden (Volberg et al., 2001) have found the rate of problem and pathological gambling to peak in ages 18 to 24. Similarly, a meta-analysis of all North American prevalence studies found that the 19 study samples of college students appear to have higher overall lifetime rates of problem and pathological gambling (16.4%) than either adolescents (11.8%) or adults (6.1%) (Shaffer & Hall, 2001).

Educational initiatives to prevent problem gambling have recently been undertaken. These efforts have largely been spearheaded by government agencies that provide treatment for substance abuse and problem gambling. Many of these agencies have developed ongoing ‘awareness campaigns’ consisting of 24 hour counselling hotlines; media promotion of responsible gambling; posters/pamphlets in gaming establishments letting people know about the signs of problem gambling and where to go for help; videos on problem gambling; etc. (e.g., AADAC, 2001; Murray, 2003; Jackson et al., 2002). Some jurisdictions (e.g., Australia, Canada, United States) have also introduced gambling prevention programs into the school curriculum. These include: "Don't Bet on It" in South Australia for ages 6 to 9; "Gambling, Minimising Health Risks" in Queensland for levels 5 and 6; "Facing the Odds" in Louisiana for grades 5 to 8; "Wanna Bet" in Minnesota for grades 3 to 8; "Count Me Out" in Quebec for ages 8 to 17; and "Gambling: A Stacked Deck" in Alberta for ages 13 to 18.

A natural fit for teaching critical thinking about gambling are college or university Introductory Statistics courses in which the fundamentals of probability and randomness are taught (e.g., Heiny, 1981; Riniolo & Schmidt, 1999). While it is true that college and university students appear to have some of the highest rates of problem gambling, it is also true that individuals who eventually obtain post-secondary degrees tend to have significantly lower rates of problem gambling (National Research Council, 1999; Abbott & Volberg, 2000; Gerstein et al., 1999) (cf. Productivity Commission, 1999). This speaks to (in part) the educational value of higher education, as there is good evidence that post-secondary education improves general critical thinking ability (e.g., Gray & Mill, 1991; Lehman, Lempert, & Nisbett, 1988; Pascarella, 1999; Prendergast, 1998; Tobacyk, 1984; Tsui, 1999). Thus, college/university students may be well primed to change their gambling behavior in response to a concerted effort to inform them about the negative mathematical expectation of games of chance.

There are two general areas of research that would further support the contention that improved knowledge of gambling probabilities should impact gambling behavior. The first is research demonstrating a positive impact of educating problem gamblers on the nature of randomness, true gambling probabilities, and the errors of thinking underlying gambling fallacies (e.g., Ladouceur, Sylvain, & Boutin, 2000; Ladouceur et al., 1998; Sylvain, Ladouceur, & Boisvert, 1997). The second is research that shows statistically trained college students to be less susceptible to certain specific fallacies (Benassi & Knoth, 1993) and to have better general reasoning skills for everyday problems (Fong, Krantz, & Nisbett, 1993; Kosonen & Winne, 1995; Nisbett et al., 1993).

On the other hand, the literature specific to the impact of improved statistical knowledge on the gambling behavior of university students is not very encouraging. Schoemaker (1979) found that university students who received statistical training made superior choices in a gambling task compared to untrained students. However, Gibson, Sanbonmatsu, & Posavac (1997) found that students explicitly asked to evaluate the probability of a certain sports team winning tended to overestimate the team's actual chances, and subsequently gambled more relative to students not asked to evaluate any specific team. Gibson et al. (1997) attributed this error to the 'confirmation bias' heuristic whereby people tend to seek out evidence in support of a hypothesis, not giving sufficient weight to disconfirming evidence (e.g., Klayman & Ha, 1989). Hertwig et al. (2004) found that students educated about the probabilities of certain events gambled on rare events more than they should compared to students who were given direct experience with these probabilities but did not know the actual odds. This is consistent with research by Kahneman, Slovic, & Tversky (1982) that has shown that, in general, people tend to overestimate the chances of low frequency events occurring. The ability of abstract knowledge to interfere with optimal gambling behavior is also suggested by the findings of Evans, Kemish, & Turnbull (2004). In this study, university students were significantly slower to adjust their gambling behavior to maximize monetary return than less-well educated participants. The investigators proposed that the abstract academic orientation of university students might have interfered with direct learning from experience. Finally, Steenbergh et al. (2004) found that university students who were given an explicit warning about erroneous gambling beliefs and the negative mathematical expectation of gambling gained superior knowledge about these things, but were just as likely to gamble on a roulette game compared to students not given these messages.

The purpose of the present study is to further investigate the impact of improved statistical knowledge on the gambling behavior of university students. The above research is potentially limited by relatively short periods of training, the didactic nature of some of the interventions, and the laboratory based evaluation of gambling behavior. The present research will investigate a much more substantive and 'hands-on' intervention as it impacts 'real world' gambling behavior.

The following specific hypotheses were tested:

1. Students who receive the intervention will demonstrate greater applied skill in calculating basic gambling odds compared to before taking the course and compared to the control groups (H1).
2. Students who receive the intervention will demonstrate more awareness of and resistance to gambling fallacies compared to before taking the course and compared to the control groups (H2).
3. Students who receive the intervention will show a more negative attitude toward gambling compared to before taking the course and compared to the control groups (H3).
4. Students who receive the intervention will show a decrease in gambling behavior outside the classroom (time spent, money spent) compared to before taking the course and compared to the control groups (H4).

5. Students who receive the intervention will show a decrease in problematic gambling behavior at the 6-month follow-up compared to before taking the course and compared to the control groups (H5).
6. Students with the largest improvements in gambling math skill and awareness of gambling fallacies will show the largest decreases in gambling and problem gambling behavior (H6).

Method

The sample consisted of 470 students from the University of Lethbridge, in Lethbridge, Alberta recruited between September 2001 and April 2003.

There are several sections of "Introduction to Probability and Statistics (1770)" taught at the University of Lethbridge. The sections taught by DC in September 2001, September 2002 and April 2003 served as the Intervention group (*n* = 198). The sections taught by JM and DK in September 2001 served as the Math Control group (*n* = 134). An Introductory History class and an Introductory Sociology class served as the Non-Math Control group (*n* = 138). This sample of 470 represents 95% of the 495 students registered in these courses at the time and potentially eligible to participate.

Introduction to Probability and Statistics is composed of 39 fifty-minute lectures and 13 fifty-minute labs. It covers descriptive statistics; graphical representation; probability; discrete and continuous random variables; expectation; binomial, normal and student's t-distribution; large and small sample inference and estimation; and the central limit theorem. All of these topics are covered in both the Intervention and Math Control groups. The Intervention group differed from the Math Control group in the following respects:

1. Five out of 10 probability lectures were devoted exclusively to the probabilities associated with gambling.
2. Four out of 13 labs provided hands-on experience with specific games of chance (roulette, craps, blackjack, or a combination of all three).
3. There was an assigned supplemental text dealing with gambling probabilities: "Can You Win" by Mike Orkin (1991).
4. There was one lecture on the gambling fallacies that often underlie pathological gambling (e.g., Baboushkin et al., 2001; Toneatto et al., 1997; Toneatto, 1999) delivered by RW.
5. The questions on the mid-term and final exams reflected the greater emphasis given to gambling probabilities.

A 30 minute "Gambling Questionnaire" was administered at the beginning of each course. Students were told the questionnaire was designed to assess their general gambling knowledge, attitudes and behavior. They were further informed that completion of the questionnaire was optional as it was part of an approved research investigation rather than as a part of their course. As such, all information collected would be strictly confidential with no one outside the research team having access to the data. Furthermore, all personally identifying information would be destroyed upon completion of data collection.

The Gambling Questionnaire collected demographic information and assessed the following five areas:

1. Knowledge and ability to calculate gambling odds as assessed by the 10 item Gambling Math Skill Scale. This scale assessed a person's knowledge that the house has the edge for every game, ability to calculate odds for certain games of chance, and ability to calculated expected loss after a certain amount of play. The psychometric properties of this scale (as well as the

Gambling Fallacies and Gambling Attitudes Scales) were tested on a sample of 102 first and second year university students. The Gambling Math Skill Scale was found to have excellent one-month test-retest reliability (r = .90) as well as good internal consistency (Cronbach alpha = .81) (Williams, 2003). This scale also correlated .73 with final course grade in Statistics.

2. Gambling fallacies as measured by the Gambling Fallacies Scale, a 10 item scale measuring awareness of and resistance to common gambling fallacies. More specifically, it assessed the person's knowledge of superstitious conditioning, the independence of random events, the illusion of control, the belief that one is luckier than other people, and sensitivity to sample size in probabilistic judgements. It has adequate 1-month test-retest reliability (r = .69) and good internal consistency (Cronbach alpha = .88) (Williams, 2003). It also has very good concurrent validity (in the present study it correlated significantly with problem gambling status on the Canadian Problem Gambling Index). It was also significantly correlated with final course grade in Statistics.
3. Attitude toward gambling as measured by the Gambling Attitudes Scale. This is a three item scale that measures people's belief about the morality of gambling, the likelihood of engaging in it relative to other leisure pursuits, and its harm versus benefit. It has good one-month test-retest reliability (r = .78) and adequate internal consistency (r = .62). It has excellent concurrent and predictive validity as evidenced by the fact it was the strongest predictor of current and future gambling behavior in both Williams (2003) and in the present study.
4. Gambling behavior in the past six months. Specifically, type of gambling engaged in, time spent gambling, and amount of money spent gambling.

5. Problem Gambling as measured by the nine item Canadian Problem Gambling Index (CPGI) (Ferris & Wynne, 2001). The CPGI was designed to assess gambling behavior in general populations and is geared towards the gambling opportunities available in the Canadian context. Psychometric analysis shows that the instrument produces a reasonably high level of reliability (Cronbach alpha = .84; test-retest = .78), and has high levels of criterion and construct validity (correlates .83 with both DSM-IV Pathological Gambling and the South Oaks Gambling Screen) (Ferris and Wynne, 2001). In the present study the usual 12-month time frame was shortened to 6 months.

The Gambling Questionnaire was administered again, six months after the course had ended. E-mails were sent to students offering $15 for completion of the follow-up questionnaire. Students were asked to come to a designated room to complete the questionnaire in person and given several options concerning time and day. Students who had not responded after four e-mail requests were sent the questionnaire as an e-mail attachment and given the option of resubmitting it on-line as an attachment.

Results

Sample

All students filled out the baseline questionnaire who were present the day the questionnaire was administered (95% of all registered students). There were 198 students in the Intervention group, 134 in the Math Control group, and 138 in the Non-Math Control group. Average age of the 470 students was 20.8 (*SD* = 3.6), and 55% were female. Racial/ethnic background was 89% European-Canadian; 9% Asian-Canadian; 1% Aboriginal; and 1% Other. Forty percent of students were Management majors; 31% were Science majors; 12% were Social

Science majors; 9% were Humanities majors; 5% were Education majors; and 4% were Kinesiology/Physical Education majors. Forty six percent of students were in their first year; 21% in second year; 27% in third year; 5% in fourth year, and 2% in their fifth year. This is a very representative sample of the general student body at the university with the exception of university year, where the sample contained a greater proportion of first year students.

Seventy-one percent of students reported gambling in the 6 months prior to the course. The most common types of gambling engaged in were lotteries and instant win tickets (44%), followed by games of skill against other people (34%), gaming machines (29%), and casino table games (26%). Most students who gambled spent very little time and money doing so. The median time spent in the past 6 months was 1.5 hrs and the median amount of money spent was $1. However, a significant minority gambled much more heavily, with 8.5% of students meeting criteria for moderate or severe problem gambling in the past 6 months using the Canadian Problem Gambling Index and another 17.6% being classified as low risk gamblers (Ferris & Wynne, 2001).

Analysis of Multivariate Parametric Assumptions and Data Pre-screening

When missing values comprised less than 5% of the total data set for that variable then values were imputed using SPSS 11.0 Linear Trend at Point. This occurred for age and university year. To reduce the impact of outliers, students older than 27 were recoded as age 27. Variables were screened for normality through significance tests of skewness and kurtosis. Square root transformations were applied to the moderately skewed variables: fallacy score, and gambling math skill score. Logarithmic transformations were applied to the strongly skewed variables: time spent gambling, money spent gambling, and CPGI score. After transformation there were no univariate or multivariate outliers through examination of *z*-scores and

Mahalanobis distances. There was no evidence of significant multicollinearity or singularity of the independent variables in the multiple regression analyses.

Analysis of Baseline Differences and Effects of Attrition

Chi Square tests for the categorical variables and ANOVAs for the continuous variables investigated whether the Intervention, Math Control and Non-Math Control groups differed at baseline on the following variables: gender, age, ancestry, university major, university year, baseline fallacy score, baseline math skill score, baseline attitudes, baseline time spent gambling, baseline money spent gambling, percentage of gamblers, percentage of problem gamblers, and baseline CPGI score. Significant differences among groups were obtained on several variables: gender (fewer males in the Non-Math Control group); ancestry (more Asian students in the Intervention group relative to both other groups); university major (fewer science and management majors in the Non-Math Control group); percentage of gamblers (higher in the Intervention and Math Control groups relative to the Non-Math Control group); percentage of problem gamblers (higher in the Intervention group); and baseline time spent gambling (higher in the Intervention group relative to the Non-Math Control group). Some of these differences can be attributed to the fact that students interested in gambling started preferentially enrolling in the section of Introductory Statistics that contained the intervention. All of these variables were entered as covariates in subsequent analyses. (Note: Analyses were also conducted using just students enrolled in the first section of the Intervention group. The results were the same as those reported below for all three sections of the Intervention group combined).

Seventy-four percent of students (348/470) filled out the follow-up questionnaire 6 months later. Chi Square tests for the categorical variables and ANOVAs for the continuous variables found no statistically significant differences on baseline measures between those subjects who completed the 6-Month-Follow-up Questionnaire and those who were lost to follow-up.

Effects of the Intervention

A mixed design ANCOVA was used to assess the effectiveness of the intervention on each of the following dependent variables: Gambling Math Skill; Awareness and Resistance to Gambling Fallacies; Attitude toward Gambling; Time Spent Gambling; Money Spent Gambling; and average CPGI score. The between-group factor was Group (Intervention, Math Control, Non Math Control) and the within-group factor was Time (Baseline, 6-Month Follow-up). The following variables were entered as covariates: gender, ancestry, university major, percentage of gamblers, percentage of problem gamblers, and baseline time spent gambling. The covariance procedure made adjustments for specific relationships within groups rather than a common relationship over the entire sample. McNemar tests also evaluated whether the proportion of nongamblers and the proportion of problem gamblers changed from baseline to follow-up in any of the three groups. The means and standard deviations for each dependent variable are presented in Table 1.

Gambling Math Skill (H1)

A statistically significant main effect was obtained for Group, $F(2, 330) = 25.4$, $p < .001$, partial $\eta^2 = .13$; but not Time, $F(1, 330) = .1$, $p > .05$, partial $\eta^2 = 0$. There was a statistically significant Group x Time interaction, $F(2, 330) = 30.3$, $p < .001$, partial $\eta^2 = .16$. The percentage of variance accounted for by the covariates (η^2) equalled 6%. Post-hoc t-tests revealed the Group x Time interaction to be due to a significant increase in ability to calculate gambling-related odds from baseline to follow-up in the Intervention group.

Awareness and Resistance to Gambling Fallacies (H2)

A statistically significant main effect was obtained for Group, $F(2, 330) = 3.2$, $p = .05$, partial $\eta^2 = .02$; but not Time, $F(1, 330) = 3.1$, $p = .08$, partial $\eta^2 = .01$. There was a statistically significant Group x Time interaction, $F(2, 330) = 28.6$, $p < .001$, partial $\eta^2 = .15$. The percentage of variance accounted for by the covariates (η^2) equalled 9%. Post-hoc t-tests revealed the Group x Time interaction to be due to a significant increase in awareness and resistance to gambling fallacies from baseline to follow-up in the Intervention group.

Attitude Toward Gambling (H3)

There were no significant main effects for Group, $F(2, 330) = 1.8$, $p > .05$, partial $\eta^2 = .03$; or Time, $F(1, 330) = 0$, $p > .05$, partial $\eta^2 = 0$. There was also no significant Group x Time interaction, $F(2, 330) = 1.0$, $p = .36$, partial $\eta^2 = 01$. The percentage of variance accounted for by the covariates (η^2) equalled 19%.

Time Spent Gambling (H4)

There was no significant main effect for Group, $F(2, 325) = .4$, $p > .05$, partial $\eta^2 = .01$; or Time, $F(1, 325) = 1.0$, $p > .05$, partial $\eta^2 = .01$. There was also no significant Group x Time interaction, $F(2, 325) = 1.4$, $p = .24$, partial $\eta^2 = .01$. The percentage of variance accounted for by the covariates (η^2) equalled 31%. The Group x Time interaction was also nonsignificant when excluding nongamblers from the analysis ($F(2, 190) = 1.8$, $p = .16$). ANCOVAs conducted for each specific type of gambling also found no Group x Time interactions.

Money Spent Gambling (H4)

There was a significant main effect for Group, $F(2, 329) = 3.6$, $p = .03$, partial $\eta^2 = .02$, as well as Time, $F(1, 329) = 4.7$, $p = .03$, $\eta^2 = .01$. However, there was no significant Group x Time interaction, $F(2, 329) = 1.2$, $p = .31$, $\eta^2 = .01$. The percentage of variance accounted for by the covariates (η^2) equalled 18%. The Group x Time interaction was also nonsignificant when excluding nongamblers from the analysis ($F(2, 198) = 1.4$, $p = .24$). ANCOVAs conducted for each specific type of gambling also found no Group x Time interactions.

Average CPGI scores (H5)

There was no significant main effect for Group, $F(2,330) = 1.8$, $p = .16$, partial $\eta^2 = .01$; but there was a significant main effect of Time, $F(1, 330) = 4.4$, $p < .05$, partial $\eta^2 = .02$. There was no significant Group x Time interaction, $F(2, 330) = .5$, $p = .61$, partial $\eta^2 = 0$. The percentage of variance accounted for by the covariates (η^2) equalled 24%.

Proportion of Gamblers and Problem Gamblers (H4, H5)

A McNemar test evaluated whether the proportion of individuals who gambled in the past 6 months changed in any of the three groups from baseline to follow-up. There were no significant changes in any of the three groups: Intervention ($p = 1.0$); Math Control ($p = .82$); Non-Math Control ($p = .72$). Similarly, there was no significant change in the proportion of problem gamblers in any of the three groups from baseline to follow-up: Intervention ($p = .75$); Math Control ($p = 1.0$); Non-Math Control ($p = .50$).

Predictors of Decreases in Gambling and Problem Gambling in the Intervention Group (H6)

A multiple regression with the Intervention Group was performed with change in time spent gambling from baseline to follow-up as the dependent variable. Gender, age, ancestry, university year, university major, baseline attitude, change in attitude, baseline fallacies, change in fallacies, baseline gambling math skill, change in gambling math skill, and the grade they received in the course were the independent variables. Entry of the independent variables was forward stepwise with a $p = .10$ to enter and $p = .15$ to remove. After deletion of 12 cases with missing values, data from 134 students were available for analysis. Change in attitude toward gambling was the only variable that entered the equation (developing more negative attitudes predicted a decrease in time spent gambling). The *R* of .28 was significantly different from zero, $F(1, 133) = 11.5$, $p = .001$. Altogether, 8% of the variability in change in time spent gambling (*R* squared) was predicted by knowing the scores on this variable.

The same analysis was used to investigate factors related to <u>change in money spent gambling from baseline to follow-up</u>. Age was the only variable that entered the equation (older age predicted a decrease in money spent gambling). The *R* of .17 was significantly different from zero, $F(1, 132) =$, $p = .05$. Altogether, 3% of the variability in change in money spent gambling was predicted by knowing the scores on this variable.

The same analysis was used to investigate factors related to <u>changes in CPGI scores from baseline to follow-up</u>. However, a regression equation could not be calculated as no variables were able to enter the model.

Discussion

The present study implemented a substantial intervention designed to improve knowledge of true gambling odds, the impossibility of winning in the long run, and the errors in thinking that underlie gambling fallacies. As expected, this intervention proved effective in improving student's ability to calculate gambling odds as well as awareness of and resistance to gambling fallacies. It is interesting to note that these changes only occurred in Statistics classes that received gambling-specific instruction on probabilities. Statistics classes that received generic information on probability theory did not have an improvement in their ability to calculate gambling-specific odds.

However, the primary purpose of this intervention was to examine the impact this improved knowledge and skill had on actual gambling behavior. The presumption was that if students thoroughly understood and experienced the negative mathematical expectation of gambling games they would gamble less. Unexpectedly, this proved not to be the case. Students receiving the intervention had no significant self-reported decrease in their likelihood of gambling, their likelihood of being a problem gambler, the amount of time they spent gambling, or the amount of money they spent gambling. There was also no significant change in their attitude toward gambling.

To be fair, dramatic decreases in gambling behavior were not necessarily anticipated, as the intervention was not overtly advocating abstinence and it was not intended to be a comprehensive problem gambling prevention program. Also, the majority of students were gambling at nonproblem levels prior to the intervention and continued to do so after the intervention (although there was also no significant change among the 40 students who were problem gamblers). A truer test might be whether students receiving the intervention have a lower future incidence of problem gambling. However, the absence of behavioral change is not very encouraging. Furthermore, the lack of association between changes in gambling math skill or course grade with changes in gambling behavior in the regression analyses provides further evidence that knowledge about gambling odds and mathematical skill may not be that important.

In retrospect, it may be that teaching people about gambling odds is analogous to telling smokers about the harmful effects of smoking or alcoholics about the harmful effects of drinking. Individuals involved in these behaviors are usually already aware of these facts. Knowing something, and having this knowledge alter your behavior are two different things, as evidenced by the earlier cited work of Steenbergh et al. (2004) and the general finding that primary prevention programs tend to be effective at changing knowledge but not behaviour (Durkal & Wells, 1997; Foxcroft et al., 1997; Franklin et al., 1997; Mazza, 1997; Rooney & Murray, 1996; Tobler, 1992). Improved knowledge can sometimes also be a hindrance to optimal behavior. The previously discussed research of Gibson et al. (1997), Hertwig et al. (2004), and Evans et al. (2004) provide good demonstrations of how cognitive biases can result in the misapplication of enhanced knowledge.

The present results should not discourage efforts to continue to educate people about the mathematics of gambling. While knowledge may not directly lead to behavior change, it would seem to be a necessary precursor. What the present results suggest is that mathematical interventions on their own are likely insufficient to change most people's gambling behaviour and that broader based initiatives are required (e.g., Takushi et al., 2004).

In closing, it should be noted that we are not the first ones to have misjudged the impact of improved knowledge. When the mathematical underpinnings of probability theory were developed in the late 17^{th} and early 18^{th} century many scientists and social reformers presumed that 'mathematicians might cure the reckless of their passion for cards and dice with a strong dose of calculation' (Defoe, 1719). However, not only did this not occur, but it took hundreds of years before the new mathematics actually influenced how lotteries, annuities, and life insurance odds were calculated (Gigerenzer et al., 1989). More recently, the earliest substance abuse prevention programs were based primarily on educating people about the dangerous long-term effects of drugs and alcohol. These were ineffective. It was only when people accepted the failure of this approach that truly effective programs teaching specific skills relevant to the problem (e.g., peer-refusal skills for substance use) were developed (CAMH, 1999; Durlak & Wells, 1997; Ellickson & Bell, 1990; Tobler, 1992).

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Table 1.

Changes from baseline to 6 month follow-up on the dependent variables

	Intervention Baseline	Intervention Follow-Up	Math Control Baseline	Math Control Follow-Up	Non-Math Control Baseline	Non-Math Control Follow-Up
Gambling Math Skill (transformed values)	1.6 (.4)	2.2 (.4)***	1.7 (.3)	1.6 (.5)	1.8 (.3)	1.7 (.5)
Gambling Fallacies [1] (transformed values)	2.2 (.4)	1.6 (.5)***	2.1 (.4)	2.0 (.4)	2.0 (.4)	1.9 (.5)
Gambling Attitudes [2]	-2.4 (2.0)	-2.2 (2.1)	-2.4 (2.4)	-2.5 (1.9)	-2.1 (1.7)	-2.3 (1.6)
Time Spent Gambling (transformed values)	.8 (.8)	.7 (.8)	.7 (.7)	.7 (.7)	.5 (.6)	.6 (.7)
Money Spent Gambling [3] (transformed values)	.5 (.8)	.5 (.8)	.7 (.9)	.7 (.8)	.4 (.7)	.4 (.6)
CPGI Score (transformed values)	.2 (.3)	.2 (.3)	.1 (.2)	.2 (.2)	.1 (.2)	.1 (.2)
Percentage Gamblers	74.2%	73.8%	74.6%	77.1%	62.3%	66.4%
Percentage Problem Gamblers	12.1%	13.8%	6.7%	7.3%	5.1%	2.8%

Note. Numbers in brackets are standard deviations.

***p < .001 Group x Time interaction in the ANCOVA

1. Higher values indicate more gambling fallacies.
2. Negative values indicate negative attitudes toward gambling.
3. Higher values indicate more money spent gambling.