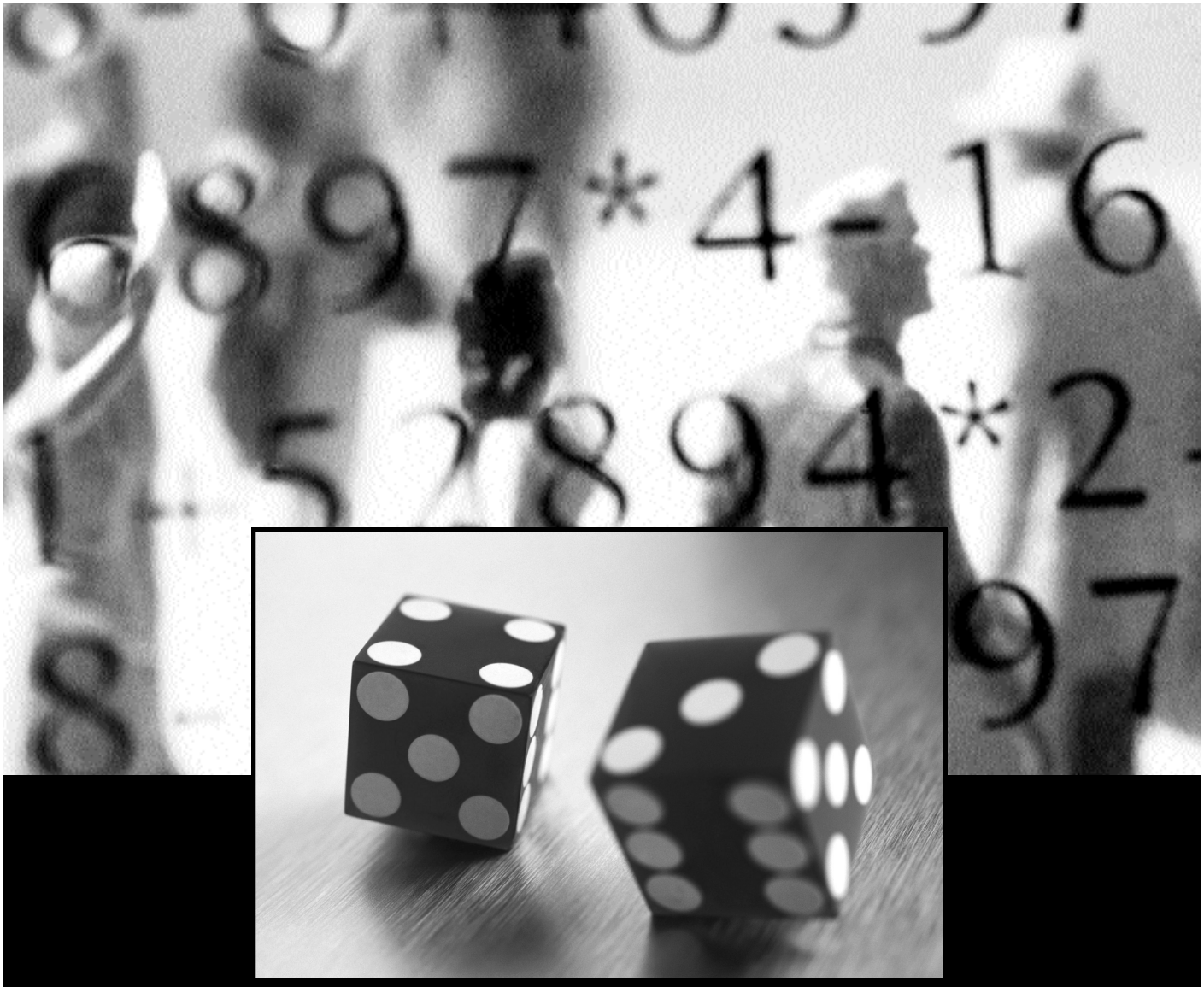

FACING THE ODDS

THE MATHEMATICS OF GAMBLING AND OTHER RISKS

Harvard Medical School's
Division on Addictions

Massachusetts Council on
Compulsive Gambling

Version 3.0

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BRIEF CURRICULUM SUMMARY

The purpose of this curriculum is to enhance students' interest in mathematics and provide the knowledge and skills that can help students to think more critically. This curriculum aims to make mathematics more meaningful to students and more relevant to their daily lives by introducing concepts of probability and statistics through the use of gambling- and media-related topics. With the proliferation of gambling opportunities throughout America, young people have exposure to and inherent curiosity in gambling-related matters; this curriculum uses this curiosity to present important mathematical concepts. For example, students will learn about randomness and chance as these concepts relate to probability and gambling, the probability of winning the lottery, and the use of statistics in the media and everyday life. This curriculum will also help students to develop critical thinking and number sense skills and to apply these skills to media, advertising, and gambling issues. In particular, students will learn to make decisions and choices about gambling activities based on mathematical reasoning. Contemporary research shows that gambling behavior is prevalent among youth and that a proportion of young people are experiencing problems related to gambling. This curriculum provides an opportunity for students to learn about mathematics through relevant contemporary social issues. It also has the potential to increase student interest in mathematics and concurrently to diminish the likelihood of the development of addictive behaviors.

INTRODUCTION FOR TEACHERS

At the beginning of the twentieth century, no one could have predicted the forthcoming advances in science. During this century, the world and our understanding of it have changed dramatically. The body of knowledge that determines how we understand and relate to the world has been growing at an incredible pace. In addition, with the advent of computer technology and its acceleration of the growth of knowledge, the information explosion is just beginning. America's youth have not kept pace with the scientific development of their counterparts around the world. The science and mathematics performance of American high school students has slipped relative to many other nations. Scientific knowledge influences almost every aspect of contemporary American life. Levels of science and mathematics knowledge, therefore, can determine in part how young people develop and mature.

America's youth have not kept pace with the scientific development of their counterparts around the world.

(Beaton et al., 1996)

American youth confront substance abuse and other addictive behaviors in every sphere of their development. Alcohol, tobacco, other drugs, and gambling have the potential to undermine the developmental integrity of America's young people; however, scientific and mathematical literacy has the potential to promote the healthy development of America's youth.

This curriculum on probability, statistics, and number sense was developed in an attempt to increase young people's mathematics literacy while concurrently preventing or reducing their participation in a potentially addictive behavior. For the purposes of this curriculum, mathematics is seen as a subset and an integral part of science. During needs assessment research with a random sample of middle school students, this group of students reported a widely held interest in learning about science and addictive behaviors. In particular, the students expressed interest in the content of addiction and the experimental process of science. By integrating these two apparently distinct areas, we believe that the intellectual, psychological and social health of America's young people can be improved.

American youth confront substance abuse and other addictive behaviors in every sphere of their development.

Facing the Odds: The Mathematics of Gambling and Other Risks is part of a larger Harvard Medical School Division of Addictions initiative developed to address the science learning needs of America's young people. The results to date have been exciting and we welcome you to an adventure in learning.

Contemporary American Crises: Science Education and Addiction

At the pre-college level, science and mathematics education is in the midst of a national crisis. The National Commission on Excellence in Education (1983) and the Pre-College Education in Mathematics, Science and Technology (1983) report that the nation's population has a dismally low level of scientific literacy. Indeed, only 20% of American adults have the requisite knowledge to be considered scientifically literate (Miller, 1989). Perhaps more disturbing, the National Science Foundation (1992) reports that pre-college science education does not contribute significantly to scientific literacy. Student interest in science and mathematics is waning because young people are unable to view these subjects as relevant to either their everyday life or their future. For American youth, contemporary life presents many hazards. As described earlier, alcohol, substance abuse, gambling and other addictive behaviors present pervasive developmental hazards. With only a few exceptions (e.g., Botvin & Botvin, 1992, Ellickson & Bell, 1990), the majority of substance abuse prevention programs have demonstrated little long-term impact. To examine both of these contemporary social problems, we have completed an extensive science education and substance abuse education needs assessment (Shaffer et al., 1995a). Using a randomly selected sample of middle school students from the Merrimack Valley area of Massachusetts, this research revealed that a range of students were interested in learning about science, mathematics, and the addictive behaviors. Consequently, we have integrated the study of addiction with mathematics to yield an innovative and socially relevant curriculum for middle school children.

The Facing the Odds Curriculum: The Purpose

The purpose of this integrated middle school mathematics curriculum is to teach the knowledge and skills necessary to help young students to think more critically. The strategy for this endeavor is to make science more meaningful by making it more relevant to the daily lives of students. In *Facing the Odds*, students will be exposed to critical thinking exercises by studying the mathematical principles behind gambling. Contemporary research shows that gambling behavior is highly prevalent among young people. For example, in a study of 1,103 adolescents in New York state (Volberg, 1998), 75% of the adolescents reported that they had gambled during the past year, and 86% reported that they had gambled in their lifetime. In another study of 1,549 Massachusetts middle school students, Shaffer et al. (1995b) revealed that

over 58% of 5th through 8th grade students had gambled during the past year.

Research also shows that a significant proportion of young people are experiencing problems related to gambling. Shaffer, Hall & Vander Bilt (1997) reported that approximately 5.6% of adolescents (within a 95% confidence interval of 3.2% to 8.4%) could be classified as Level 3 (pathological) gamblers and another 14.8% (within a confidence interval of 9.0% to 20.7%) could be classified as Level 2 ("problem") gamblers. Providing an opportunity for students to learn about science and mathematics through relevant issues holds the promise to increase student interest in science and mathematics and concurrently to prevent the development of addictive behaviors.

This curriculum takes a very different approach to addictive behaviors than most traditional prevention-oriented drug and alcohol curricula. Evidence from research (e.g., Ennet, Tobler, Ringwalt, & Flewelling, 1994; Pellow, & Jengeleski, 1991) suggests that health classes that teach the hazards associated with drug use are not effective: students do not diminish their involvement with psychoactive substances as a result of experiencing these classes. Unlike these traditional approaches, which usually emphasize the health benefits associated with avoiding addictive behaviors or attach particular values to behaviors (i.e., good vs. bad drugs), this curriculum focuses on *science* and *mathematics*, using gambling and the media as the means of presenting these concepts. For example, this program teaches probability by having students calculate their chances of winning the lottery. Unlike alcohol and substance abuse, gambling probably has not been integrated into prevention-oriented programs in most school systems in the past. Rather than focusing on the value- or health-oriented aspects of compulsive gambling and identifying gambling as another illicit activity, this curriculum reveals the mathematical realities of various gambling activities and attempts to reinforce critical, probabilistic and statistical thinking. By encouraging critical thinking skills, we hope to decrease the unrealistic attractiveness of gambling to adolescents; with this curriculum, we are hypothesizing that improved critical thinking skills will delay the onset of gambling, diminish the amount of youth gambling, and minimize the harm associated with gambling. This approach is supported by research (Vagge, 1996), which has revealed a significant connection between gambling behavior and knowledge of math: the more a student believes gambling involves skill (i.e., the lower the understanding of probability constructs), the more likely that student is to be a pathological gambler. This research also showed that the belief that gambling involves skill was significantly associated with higher frequency of gambling and larger wagers among adolescents. This curriculum can provide young people with the critical thinking and mathematical skills necessary to make informed decisions and choices about gambling.

In addition, this curriculum presents some important and relatively under-represented mathematics topics (e.g., probability, statistics). These topics are important to teach, and are expected to be more interesting to students because these topics can be related to a variety of aspects of students' everyday lives.

It is our hope that integrating the study of gambling with specific, relevant hands-on models will increase students' interest in mathematics studies. The strategy of using information related to addiction to enhance teachable moments in a traditional curriculum is quite different from conventional health education tactics that primarily help students understand the adverse effects of various addictive behaviors. This approach can stimulate students' capacity for critical thinking and their ability to evaluate real-life situations objectively.

This approach can stimulate students' capacity for critical thinking and their ability to evaluate real-life situations objectively.

Students exposed to the *Facing the Odds* curriculum will have the opportunity to practice the scientific method and critical thinking skills; more specifically, they will practice hands-on mathematics by learning about probability and gambling. Research shows that students who are more interested in mathematics have lower levels of gambling involvement, have fewer friends who gamble, and perceive gambling to be more dangerous compared to their peers who are not interested in mathematics (Shaffer et al., 1995a; Shaffer et al., 1995b). Thus, a primary goal of *Facing the Odds* is to increase student interest and skill in mathematics. As a by-product of this enhanced interest and skill, we expect student participation in potentially addictive behaviors to be delayed (for those not currently involved in these behaviors) or to diminish (for those who are currently involved in potentially addictive behaviors). Future research will be necessary to determine the efficacy of this curriculum in accomplishing these goals.

Facing the Odds provides teachers with the necessary hands-on activity guides and background materials that are integral to this program of mathematics education. We encourage teachers to think of this curriculum as a mathematics course that fashions gambling as the thematic and illustrative vehicle to educate middle school students about the essential areas of mathematics required by contemporary educational standards. We do not view the study of mathematics or this curriculum as a course in gambling, even though these areas overlap.

Important Note for Teachers:

You and other teachers in your school system should be aware that gambling can lead to psychological, social, financial, and work- or school-related problems, and that adolescents are more vulnerable to these problems than adults. There is a good chance that some students in your mathematics class are currently experiencing these problems and that others have family members who are experiencing these problems. We recommend that you speak with school administrators, counselors, and nurses before teaching this curriculum so that you are prepared to offer resources to students who may be experiencing these problems.

Facing the Odds: Strategies

Each chapter contains a variety of hands-on activities designed to engage students in the process of learning and reinforce newly acquired knowledge. These activities include data collection, data analysis, case studies and other research activities about mathematics and gambling. The goal of every activity, data collection method, result, and follow-up question is to reinforce what has been, or is about to be, learned. The reinforcement of learning is accomplished through the hands-on activities and the development of critical thinking skills. It is not necessary to use every activity; you should evaluate the range of hands-on activities and select those that best suit the needs of your students within your teaching environment.

Engage students in the process of learning and reinforce newly acquired knowledge.

This curriculum provides strategies that will encourage students to learn to think critically about the subject matter. You should encourage students to think logically and critically about the evidence as it is presented. To expand critical thinking skills, *Facing the Odds* encourages students to act as scientists and consider alternative explanations of existing data.

This curriculum attempts to elicit students' preconceptions and misconceptions as tools for thinking and learning. Affirming the students' knowledge and addressing their preconceptions prior to introducing new material is an important part of the learning process.

Affirming the students' *knowledge* and addressing their *preconceptions* prior to introducing new material is an important part of the learning process.

Finally, *Facing the Odds* includes assessment instruments that can be used to measure students' learning. These assessment tools can help you to improve instruction and evaluate how well students have been able to grasp the concepts presented in this

curriculum. The Massachusetts State Science Frameworks (1995) view learning as "... a journey, and teaching as a series of choices about schedule, itinerary, road, and vehicle, ... assessment lets teachers and students know where students have been, where they are along the way, and where they might go next. The goal of assessment is to provide teachers with information about students' evolving understanding, skills, and knowledge, so that they can give feedback to students, and together make decisions about where to go next in the learning" (p. 34). One prospective index of student performance is the use of portfolios. Within the *Facing the Odds* curriculum, portfolios can serve as the repository of evidence of a student's mathematical literacy. In this context, we consider a portfolio as an expanded "lab" notebook. This body of cumulative work can contain worksheets, projects, notes on an oral presentation, data sets, data analyses, conceptual interpretations with alternative explanations of collected data — whatever you deem appropriate. The *Facing the Odds* curriculum encourages you to use student portfolios as helpful indicators of progress. Since portfolios are cumulative by design, these documents can be used to reflect student progress over the entire academic year, recent experiences, or study segments that highlight specific student achievements.

Using the *Facing the Odds* curriculum

Each section of the curriculum contains an *Objectives* section that outlines the objectives of the section, states the rationale for presenting the material, and presents background material for teachers. This section provides the necessary information for you to review or become newly informed about the relationship between traditional middle school mathematics topics and gambling.

You should take what you need from this curriculum, and leave the rest.

Teachers implementing this *Facing the Odds* curriculum likely will have varying levels of expertise in the content areas presented in this curriculum. Therefore, the *Facing the Odds* background material may seem too detailed for some teachers and perhaps less than sufficient for others. Teachers should take what they need from the curriculum and leave the rest. Remember, the spirit of the *Facing the Odds* curriculum is to illustrate and enhance traditional mathematics by presenting information and analogies associated with a complex contemporary social problem that young people have identified as significant and of considerable interest (e.g., Shaffer et al., 1995). Therefore, teachers must develop a working knowledge of each content area to fully integrate the gambling material into the more traditional mathematics curriculum. Thoroughly reading each chapter will enhance every teacher's ability to present and convey these concepts. These background materials likely will prove helpful for teachers as they develop classroom presentations and illustrate mathematical concepts with gambling phenomena.

Interpreting the Symbols

- ■ This symbol in the curriculum alerts the teacher that a visual (i.e., overhead) corresponding to the text is available. Reproductions of these visuals exist at the back of this curriculum.
- ♣ The club symbol designates exercises for the students. Some exercises exist in a group of several smaller questions. Some are longer. You can decide what format works best for the exercises. They are appropriate for in-class teaching; however, you may find that they work well as homework for certain students or groups of students.
- ♠ The spade symbol marks a worksheet. As is the case with the exercises, you can decide whether worksheets are best taught in class or used as homework.

On Method: Teaching the *Facing the Odds* Curriculum

The purpose of the *Facing the Odds* curriculum is to make mathematics studies applicable to students' everyday lives. This relevance will help students to become more engaged in the process of learning. Using gambling as a central and repeating theme will increase the relevance of mathematics for young people, who require real world applications to enhance and sustain their learning skills and interests. This strategy will enhance the teaching of mathematics because it encourages students to explore phenomena and ideas pertinent to their daily lives. Furthermore, teachers can provide a relevant and repeating set of conceptual analogies that illustrate mathematical concepts and principles. Finally, students will experience increased levels of motivation to solve problems by exploring real world issues that are relevant; this experience will in turn stimulate the development of critical thinking skills. As a consequence of this confluence of experiences, we expect that students will increase their interest in mathematics and reduce the onset of problematic gambling behaviors. The *Facing the Odds* curriculum will prepare students to take on the rigors of a high school mathematics program.

As You Begin...

The *Facing the Odds* curriculum is a unique document. We designed it to bridge middle school mathematics with the real world within which students live. This curriculum challenges us to take the spirit of mathematics, mix it with imagination and adventure, and begin an exciting journey into the unknown.

CURRICULUM BACKGROUND AND OVERVIEW

Objective

The objective of *Facing the Odds* is to introduce concepts of statistics and probability through the use of lessons and exercises using the activity of gambling as a tool. Students will learn how to calculate probability; they will learn about randomness and chance as these concepts relate to probability. In addition, students will learn about the use of statistics in the media and everyday life. This curriculum unit will help students to develop critical thinking and number sense skills. Students will learn to apply these skills to media, advertising, and gambling issues. In particular, students will learn to make decisions and choices about gambling activities based on mathematical reasoning.

♣ ♦ ♥ ♠

Student Prerequisites

The content in this curriculum requires that students understand concepts related to fractions, decimals, and percents, including the conversion of fractions to decimals and decimals to percents. Teachers may want to review these concepts prior to presenting this curriculum.

Teacher Background: Probability and Number Sense

As Crites (1994) notes, probability and number sense are two topics that have been identified by the National Council of Teachers of Mathematics (1989) as areas that should receive increased emphasis in mathematics curricula. In addition, the National Research Council's report *Everybody Counts* (1989) stresses the importance of these two areas:

> To function in today's society, mathematical literacy (of which number sense is a component) is as essential as verbal literacy. [But] numeracy requires more than just familiarity with numbers. To cope confidently with the demands of today's society, one must be able to grasp the implications of many mathematical concepts — for example, chance (p. 8, cited in Crites (1994), p. 203).

Additional support for the inclusion of probability and number sense in math curricula can be found in *Reshaping School Mathematics* (Mathematical Sciences Education Board, 1990) and

in *Essential Mathematics for the Twenty-first Century* (National Council of Supervisors of Mathematics, 1989).

This curriculum attempts to present mathematical material in an integrated, engaging style. Hands-on activities encourage students to internalize a specific mathematical concept so it is relevant to their lives outside of the mathematics classroom. Exercises and problems are provided to enable students to work individually and in small and large group arrangements.

Education Standards

This curriculum satisfies the National Council of Teachers of Mathematics (1989) standards listed below. These standards outline the content of the mathematics curriculum that should be included in grades 5 to 8:

1. The mathematics curriculum should include numerous and varied experiences with problem solving as a method of inquiry and application so that students can formulate problems from situations within and outside mathematics and acquire confidence in using mathematics meaningfully.
2. The mathematics curriculum should include the investigation of mathematical connections so that students can apply mathematical thinking and modeling to solve problems that arise in other disciplines.
3. The mathematics curriculum should include the continued development of number and number relationships so that students can understand, represent, and use numbers in a variety of equivalent forms in real-world and mathematical problem situations, understand and apply ratios, proportions, and percents in a wide variety of situations, and investigate relationships among fractions, decimals, and percents.
4. The mathematics curriculum should include exploration of statistics in real-world situations so that students can systematically collect, organize and describe data; construct, read, and interpret tables, charts and graphs.
5. The mathematics curriculum should include explorations of probability in real-world situations so that students can model situations by devising and carrying out experiments or simulations to determine probabilities; make predictions that are based on experimental or theoretical probabilities; develop an appreciation for the pervasive use of probability in the real world.

Gambling in the United States

During the 1980s and 1990s, the proliferation of American gambling has been extraordinary. In addition to the recent availability of riverboat, Native American, and urban casinos, the lottery has become a staple of American gambling. In spite of warnings from scholars (Eadington, 1992; Shaffer, 1989) and social policy makers about the potential adverse consequences,

state-sponsored gambling's ability to generate revenue without increasing taxes has shifted American morality not only to tolerate but to endorse legalized gambling. Between 1974 and 1996, the total amount of money legally wagered in the United States increased from $17.3 billion to $586.5 billion (Commission on the Review of the National Policy Towards Gambling, 1976; Christiansen, 1997). Between 1975 and 1985, the national per capita sales of lottery products alone increased from $20 to $97 (Clotfelter & Cook, 1989). By 1994, the national per capita lottery expenditure had risen to $120 (McQueen, 1997). Figure 1 illustrates the increase of per capita lottery expenditure during the last two decades.

Figure 1:
National Per Capita Lottery Expenditure

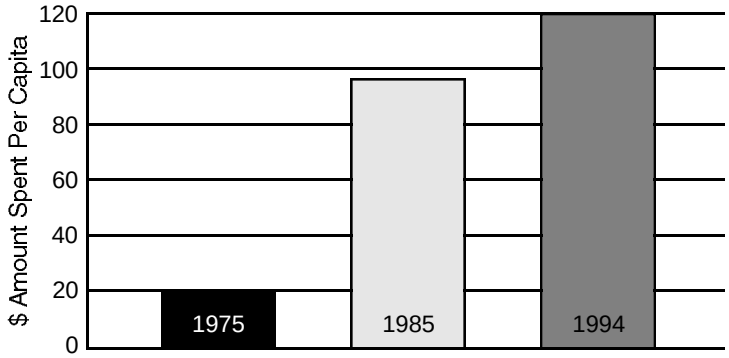
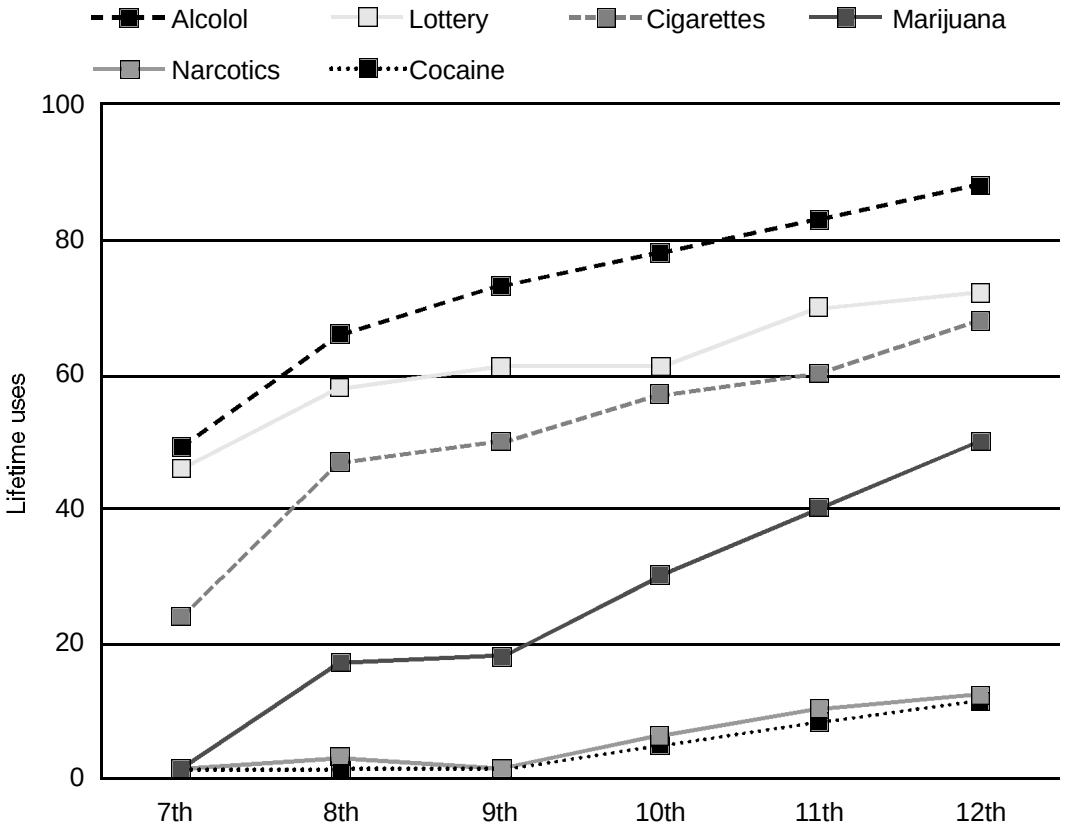


Figure 1 Grades 7-12 (Massachusetts Department of Public Health, Addiction Research Foundation and MCCG), N=2119 (drugs), N=1966 (lottery)

Figure 2: Lifetime Prevalence of Drug and Lottery Use



Problem Gambling Among Adolescents

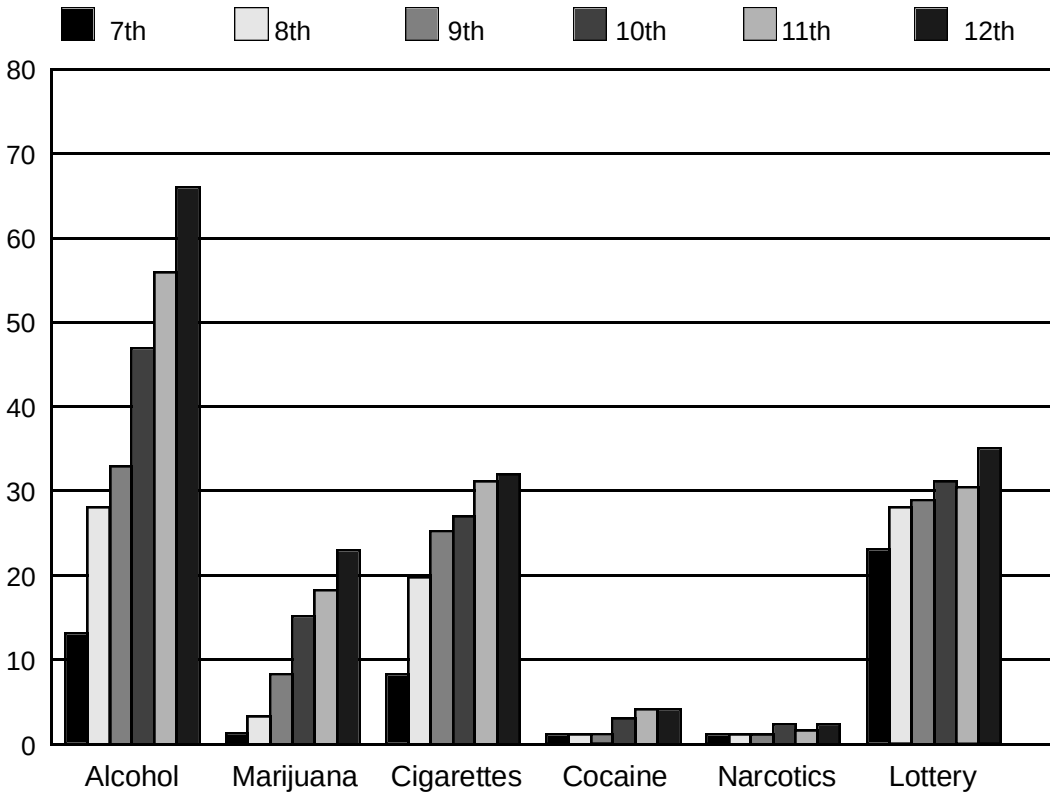
Young people in the United States today are the first generation in more than a century to grow up in a climate where gambling is not only legal but avidly encouraged and culturally approved; lottery numbers are often reported with headline news and the weather. Many new types of gambling have become available to young people during the past several decades. Though officially gambling is illegal to those under 18 years of age in most states, many forms of gambling are easily accessible to those who wish to gamble. Adolescents have responded to this new climate of gambling, not surprisingly, by gambling more today than ever before. In fact, the prevalence of **pathological gambling**[1] is higher among adolescents than in the general adult population (Shaffer, Hall, & Vander Bilt, 1999).

There are many ways to gamble. Two students playing basketball in the gym after school could bet a dollar on whether one would make a three-point shot. A tenth-grader could be forming a betting pool for wagers on the outcome of sporting events. Students could be playing poker on Saturday nights for pennies, or for bigger money. An eighth-grader could try to buy a lottery ticket with leftover change from buying a pint of ice cream at the local convenience store. A group of high school seniors could drive to a casino and take a chance on being admitted. Although the legal age to enter a casino is 21, 64% of underage students at one Atlantic City high school reported gambling at casinos (Arcuri, Lester & Smith, 1985). Some students will gamble occasionally, some regularly, but approximately 3.9% are gambling at a level to be considered pathological gamblers (Shaffer, Hall, & Vander Bilt, 1999).

Two studies examined the levels of involvement of Massachusetts's adolescents in various illicit activities, including the lottery (Shaffer, 1994; Shaffer et al., 1995a). Figure 2 reveals that of six illicit activities investigated among students in grades 7 through 12, the lifetime prevalence of involvement with the lottery is exceeded only by the lifetime prevalence of alcohol use (Shaffer, 1994).

[1]Note: In the course of this text some words will be **bold-faced**. These words are defined in the glossary.

Figure 3: Current* Drug & Lottery Use Patterns

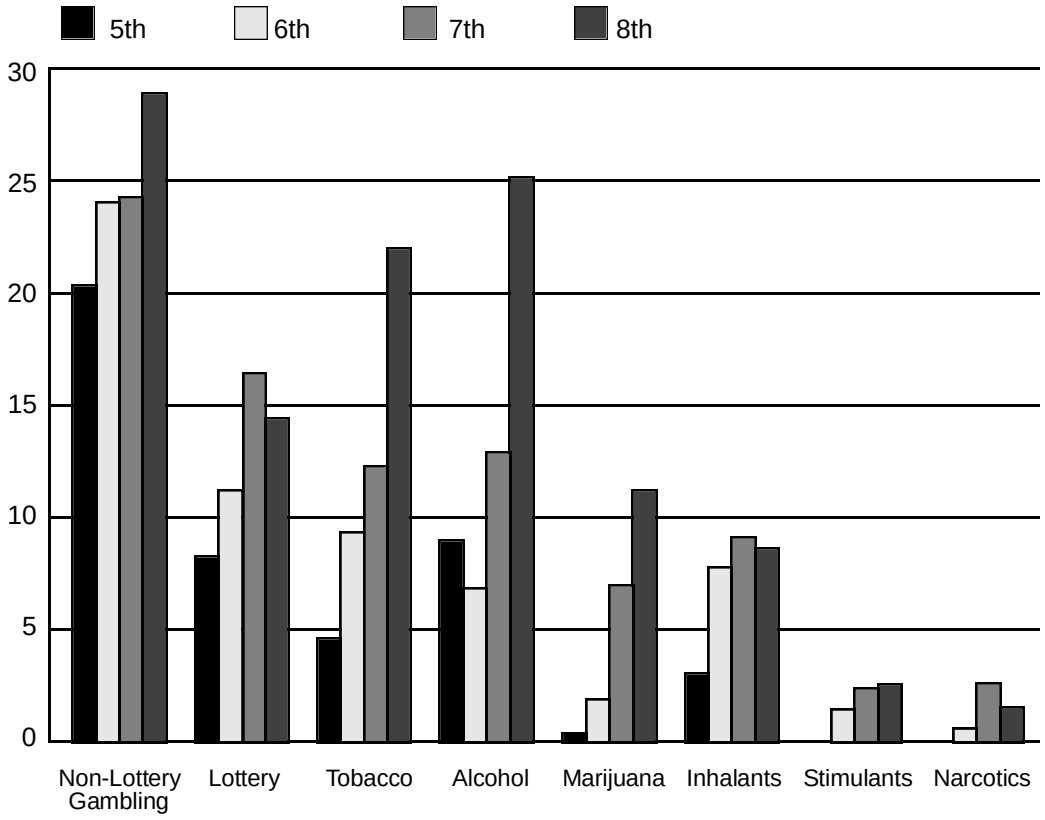


*Used at least once in 30 days prior to survey.
Data from Massachusetts Department of Public Health, Addictions Research, and MCCG

Figure 3 illustrates a similar pattern for current involvement (i.e., within the past 30 days) with these six activities. Current prevalence rates are more accurate indicators of existing psychosocial problems than are lifetime rates.

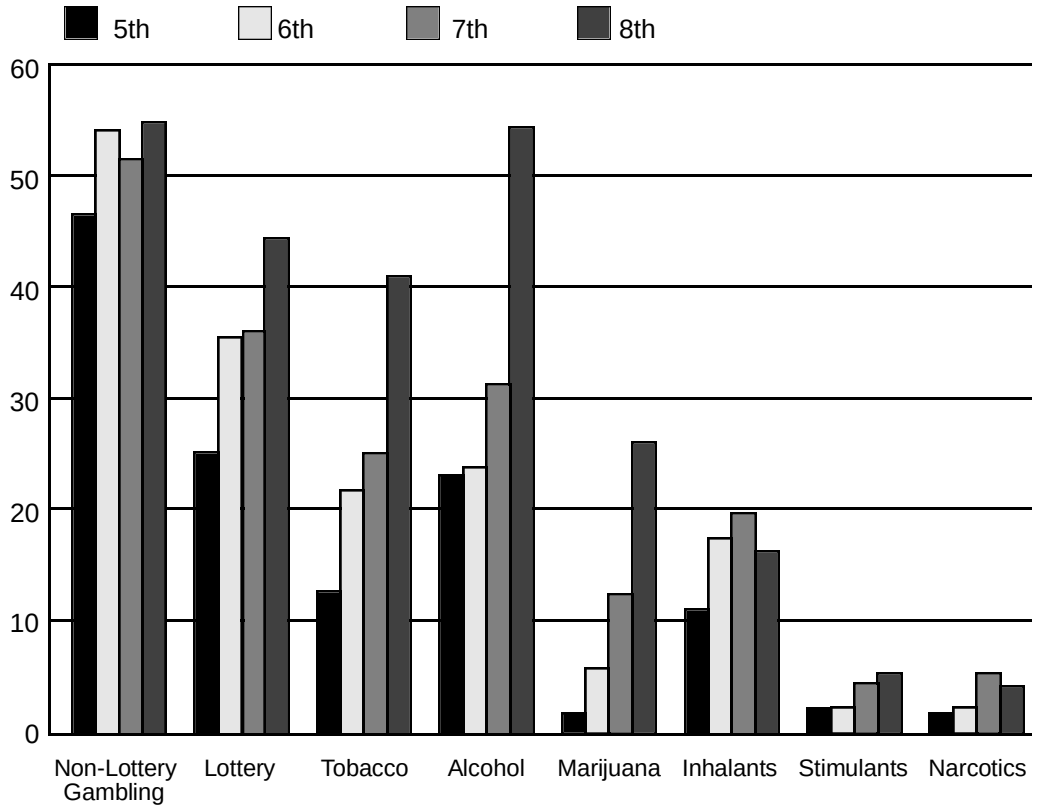
A study of middle school students (i.e., 5th through 8th grade students) investigated gambling activity in two categories: gambling on the lottery and gambling on other events (e.g., sports betting, card games). This study revealed that among younger children, both current and lifetime rates of involvement with gambling on events other than the lottery are higher than the rates of involvement with seven other illicit activities, including the lottery (Shaffer et al., 1995a).

Figure 4: Current Patterns of Gambling & Substance Use Among Middle School Students



Figures 4 and 5 illustrate this pattern. These adolescents' involvement in sports betting, card games, and other gambling activities exceeds their involvement in the lottery and may, in fact, provide the gateway activity not only to other gambling experiences but to substance abuse as well.

Figure 5: Lifetime Gambling & Substance Use Patterns by Grade



Shaffer, Hall, Walsh, & Vander Bilt (1995) also examined the adverse social and emotional consequences of gambling for adolescents. The pathological student gamblers in this study's sample experienced a variety of problems.

Of Students Studied and Considered To Be Pathological Gamblers …

- 89% were preoccupied by gambling;
- 85% **chased their losses**;
- 79% lied to conceal their gambling;
- 79% committed illegal acts to finance gambling;
- 71% had problems at home, work, or school due to gambling;
- 71% got in trouble at work or school because of gambling;
- 68% neglected their home, work, or school obligations for at least two consecutive days because of gambling;
- 68% jeopardized or lost a significant relationship, job, or educational or career opportunity because of gambling;
- 64% felt pressure to gamble when they did not gamble;
- 64% were unable to stop when they wanted;
- 61% felt social, psychological, financial pressure to increase the amount gambled;
- 54% had been arrested because of gambling;
- 43% felt guilty about their gambling; and
- 39% had sought help for their gambling problems.

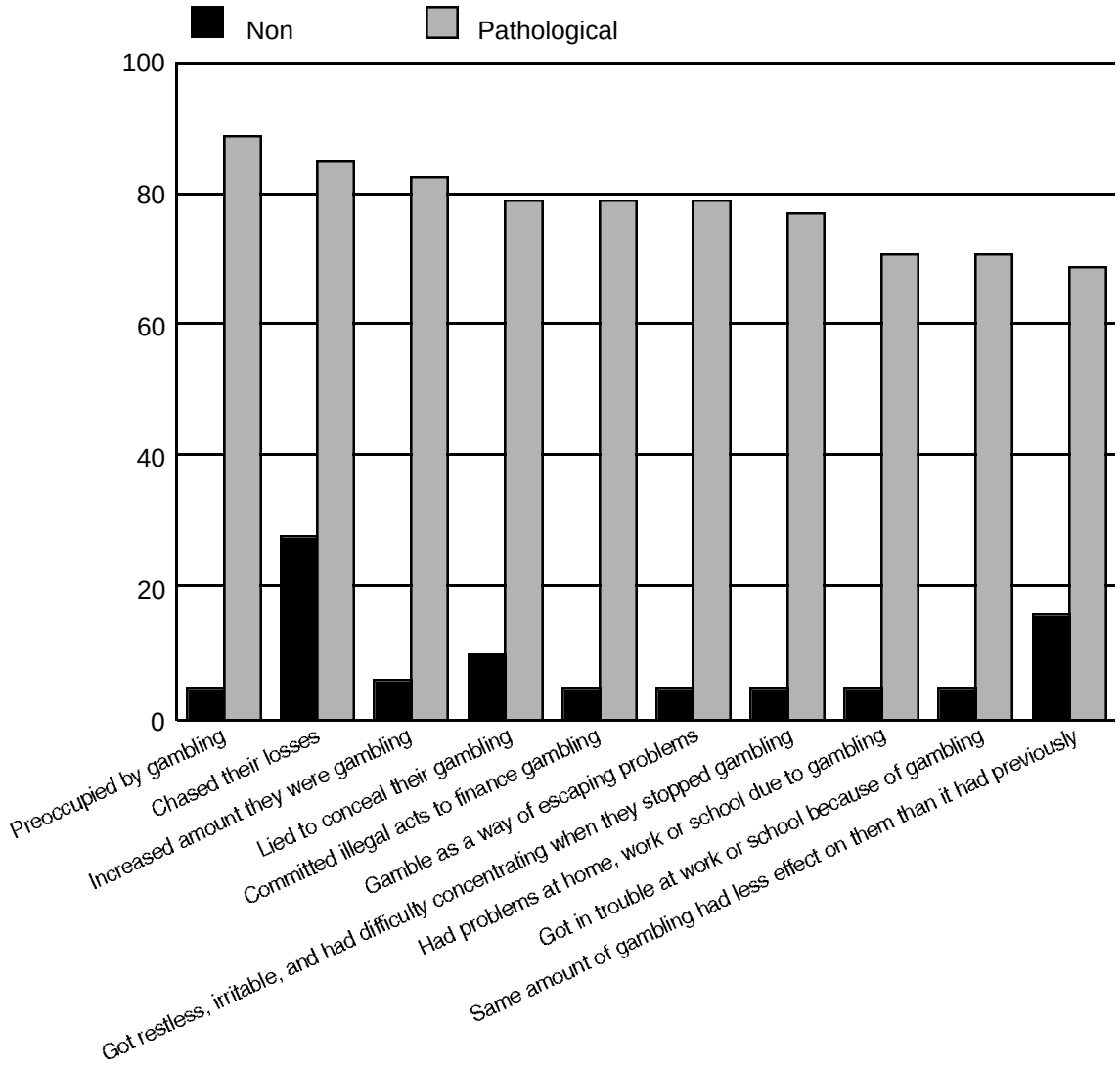
Shaffer, Hall, Walsh, & Vander Bilt (1995)

These adolescents also reported symptoms that represent neuro-adaptive patterns, much like those observed among people with substance dependence disorders. For example:

- 69% reported that the same amount of gambling had less effect on them than it had previously, and
- 83% increased the amount they were gambling to get the same effect as they had experienced at a lower level of betting.

Both of these symptoms represent tolerance symptoms. Like the chemically dependent who have withdrawal signs and symptoms, pathological gamblers can make their symptoms go away by gambling again. Of the pathological gamblers in this sample, 77% got restless, irritable, and had difficulty concentrating when they stopped gambling, and 54% continued to gamble to make withdrawal symptoms go away. Like psychoactive stimulant abuse, gambling influences the central nervous system in a powerful way. Adolescent pathological gamblers can escape feelings of depression by continuing to gamble: 79% of the pathological gamblers in this sample reported that they gamble as a way of escaping problems or relieving feelings of helplessness, guilt, anxiety, or depression. Figures 6 and 7 illustrate the symptom patterns often experienced by pathological gamblers as a result of their disorder.

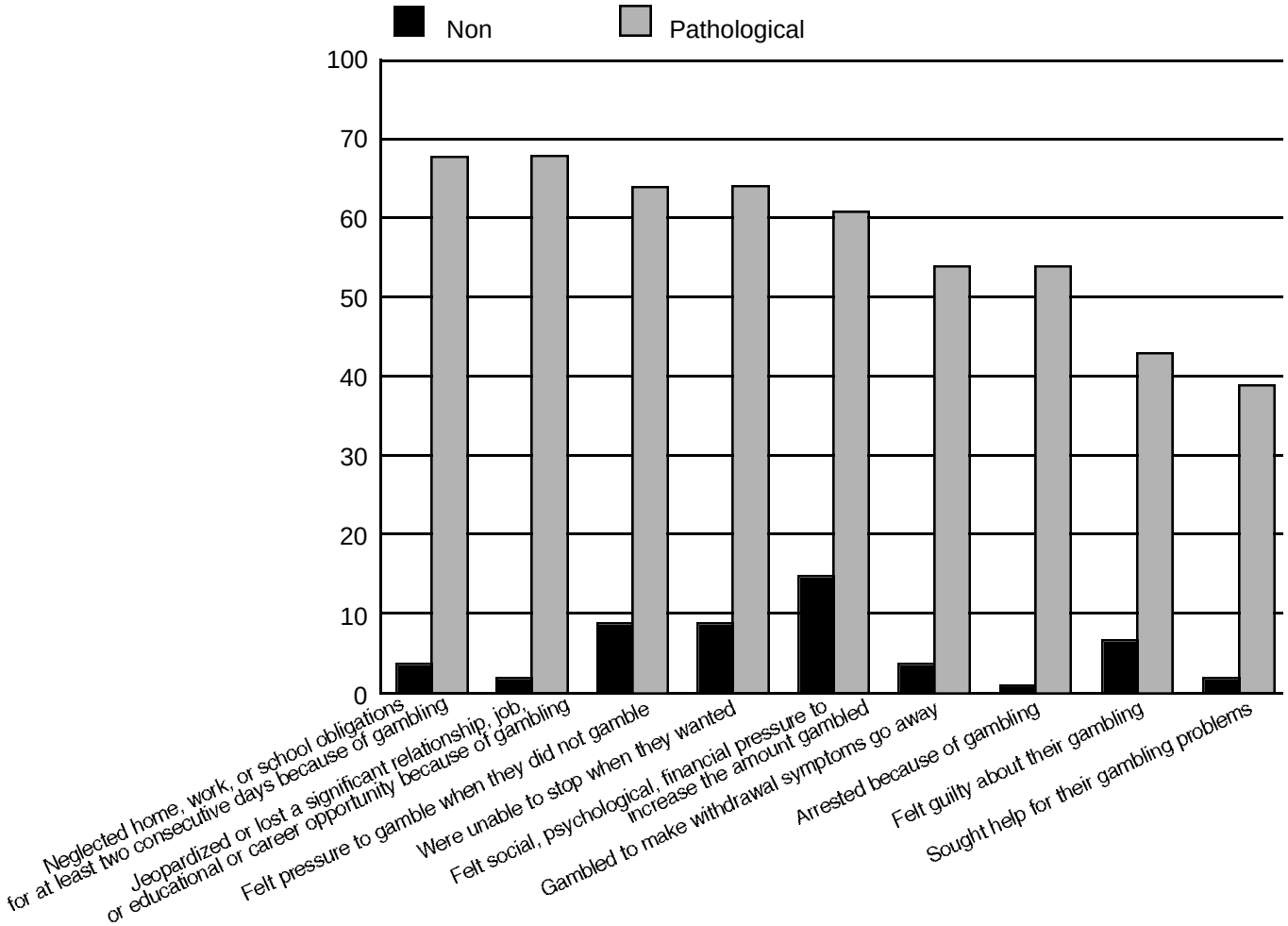
Figure 6: Pathological vs. Non-Pathological High School Gamblers



All differences p<.01, N = 472

However, pathological gamblers are not the only people who experience problems related to their gambling. Figures 6 and 7 also reveal the levels of these very same problems among young people who are not pathological gamblers. For example, 28% of youthful gamblers who do *not* meet diagnostic codes report "chasing" their losses. An alarming 16% of these young people report having experienced some physiological symptoms (i.e., tolerance) related to their gambling. For *non-pathological* student gamblers (i.e., students unlikely to be identified by screening or other diagnostic tools) the prevalence of psychological distress related to gambling is similar to the rates of alcohol dependence.

Figure 7: Pathological vs. Non-Pathological High School Gamblers



Most pathological gamblers start gambling when they are adolescents (Gaboury & Ladouceur, 1993). Considering that both the opportunities for gambling and the prevalence of adolescent gambling are on the rise, it is necessary to provide middle school students with the tools they need to make wise decisions about their gambling activities. Although only a small percentage of adolescents will struggle with pathological gambling, a much larger percentage of adolescents will face some level of psychological distress due to gambling. One of the best strategies for prevention and early intervention for the majority of adolescents could be the development of a sharp inquiring mind and the application of a few mathematical principles. One of the seven recommendations that emerged from the North American Think Tank on Youth Gambling Issues was that curricula and programs be developed to educate parents, children, and teachers about the issue of youth gambling (Shaffer, George & Cummings, 1995, p. 2). This curriculum represents a first step toward that goal.

Important Note for Teachers:

You and other teachers in your school system should be aware that gambling can lead to psychological, social, financial, and work- or school-related problems, and that adolescents are more vulnerable to these problems than adults. There is a good chance that some students in your mathematics class are currently experiencing these problems and that others have family members who are experiencing these problems. We recommend that you speak with school administrators, counselors, and nurses before teaching this curriculum so that you are prepared to offer resources to students who may be experiencing these problems.

PREFACE EXERCISE

Objective

The objective for this section is to:

- Allow students to identify their areas of interest in applying mathematics to gambling and everyday life.
- Provide an opportunity for students to express their feelings and opinion about having input on curriculum content.

♣ ♦ ♥ ♠

It is critical that investigators (any curious truth-seekers) feel an interest in their area of study. Students who are given the opportunity to reflect on topics and the opportunity to satisfy their own curiosity in regard to mathematical applications will have the germinal experience and excitement of mathematical understanding. Students with a desire for knowledge, who feel that learning and inquiry satisfy personal interests, will be bolstered and motivated to actively question and seek out answers to their own questions.

Key Concepts

This exercise is expected to provide the teacher and students with a list of topics that are of interest to the students and that can be addressed in the *Facing the Odds*: *The Mathematics of Gambling and Other Risks* curriculum. Teachers can expect topics to be identified that are beyond the scope of the math curriculum. The purpose is to give students the sense that their interest in math and its applications are going to be met. Most topics that are of interest to the students but beyond the scope of the curriculum are valid and worthwhile, and may be met by special projects, a later grade's curriculum, a movie, a Science- or Learning-Channel Special, etc. This exercise is a tool for teachers and students alike. A student with a peaked curiosity and an interest in satisfying it can make teaching much easier and much more rewarding. A teacher able to focus on the specific, identified interests of students, in turn, gains much enthusiasm and motivation from students.

The purpose is to give students the sense that their interest in math and its applications are going to be met.

Student Preparation

While this exercise is designed to draw out students' interests and no advance preparation is necessary, the process can be facilitated if the students are given some background information at the start of the exercise. A two- to three-minute teacher introduction about the prevalence of gambling behavior and problem gambling among youth in schools, by family members in the home, and social concerns relevant to the students' locale is suggested (this information can be obtained from the introduction to this curriculum).

Finally, for developing the students' association with the subject of gambling, teachers might want to cite current media stories related to gambling-related issues that students can appreciate to foster this process. It is important that the topics be relevant to each student: asking students to think about (but not identify) someone they know who gambles allows seemingly academic topics to become alive, real and pertinent.

Teacher Preparation

It is assumed that teachers delivering this curriculum will have made themselves amply comfortable with the material included in the Introduction and the Curriculum Overview.

As educators, we are constantly balancing teaching with our own learning, attempting to integrate new information with existing knowledge, all the while trying to stay aware of our own biases, beliefs, prejudices and judgements. This exercise may challenge some teachers' beliefs regarding the extent to which student involvement in curriculum development is appropriate, or to what extent students should be self-directing regarding what it is they want to learn.

The scientific method, in its truest sense, starts with the curiosity of the investigator. In order for students to become engaged they must feel and believe that it is their curiosity that is being supported by teachers, parents, siblings and peers. In this context students must believe that they are being given the opportunity to develop tools that will allow them to continue to explore their worlds through curious eyes long after middle school.

Materials Needed

For Teachers:

- Blackboard and chalk OR …
- Overhead projector and transparencies OR …
- Flip-chart and markers

For Students:

- A notebook or paper for use as a "Mathematics Journal & Log"
- Pens or pencils

Action Steps

Explain brainstorming to the class. For our purposes, brainstorming is the unencumbered release of ideas that come to mind when a topic is suggested.

> One major impediment to effective brainstorming is the "editor" or "filter" that each of us may experience and, therefore, cause us to hesitate when sharing information: "the idea sounds stupid, sounds crazy, isn't good enough, will make other kids think I'm dumb, etc."
>
> Address these concerns at the outset by indicating:
> - all ideas are welcome
> - no idea is a dumb idea
> - everyone's input is valuable — will likely free up energy for brainstorming

Suggest the topic of math in everyday life.

- What questions come to mind that you think math could help you solve?
- What questions come to mind when you think about gambling?

Give students two or three minutes to brainstorm individually and develop ideas on their own. Once students have had the opportunity to brainstorm individually, ask them to raise their hands and describe an area of interest. On the blackboard write down every topic you hear. Repeat the topics as you are writing. These two activities are expected to validate significantly the process of brainstorming.

Once you have recorded twenty or more topics are on the board, congratulate the class for their effort. With this exercise you will have a solid pool of information from which to develop a core-interests list. Inform the class that while all the information on the board is valuable, there is too much to possibly cover all of it. In order to focus on topics of most interest, you will be taking a vote for the top five topics. (The top five choices are expected to be covered in the existing mathematics curriculum or this curriculum).

- Ask each student to write down (ideally in their Mathematics Journal & Log) all the topics from the blackboard or overhead.
- Then ask students to select the top five topics from the board that are of most interest to them for future study.
- Once complete, go to the board and ask students how many voted for the first topic (write

the number of votes by the first topic). Do the same for all ideas on the board until all students have voted five times.

- Identify the five topics with the most votes.

Verify that each student has at least one interest listed in the top five. If there are students who are not interested in any of the top five, you may ask them for their top two choices and let them know that they will be covered over the course of the year. In the unlikely case that none of a student's choices is covered in the curriculum, you have the opportunity to demonstrate how important it is that everyone have a special interest covered in science.

Verify that each student has at least one interest listed in the top five.

After acknowledging that a special effort will have to be made to meet this student's needs, the teacher and student(s) will create a project that meets this particular student's interest needs. Doing this in front of the class is expected to significantly bolster student interest, commitment and involvement as well as providing a first-hand experience that the teacher is motivated and willing to meet students' needs and interests. (Note: if a student suggests a topic that is obviously inappropriate or well beyond the scope of this curriculum, a brief discussion as to why the topic is inappropriate should ameliorate this situation.)

Finally, a typed copy of the selected topics can be prepared and handed out to students to be put in their Mathematics Journal & Log. Also, a large print copy placed in plain view for the duration of the curriculum will allow students to see their progress as their identified areas of interest are addressed. It is a potent teaching strategy to point out at the end of the curriculum the posted list and show how over the course of the curriculum the individual science interests of every student in the class were addressed. Citing each student in an informal manner and the advances they made, especially those who became increasingly interested in science over the course of the year, is expected to cement this key step in the scientific method: identifying areas of interest.

Questions for follow-up

In many cases this exercise may be the first opportunity for students to participate in curriculum development. As is the case with any "first experience," unfamiliar feelings may arise with the students. Take time to inquire about these feelings and the experience the students have had.

- How does it feel being given the opportunity to share your interests?
- Are there any topics that we are going to study that you are interested in now that you were not aware of before we did this exercise?

- Would you like to do this exercise in other courses or do you prefer the teacher to just tell you what we are going to be learning?
- Do you feel more curious about what we are going to do in Mathematics this year because of doing this exercise?
- What one thing did you like most about doing this exercise?

The teacher should process these questions in a way that suits their personal style and covers the need of the class. When complete, move on to Section 1 (page 25).