Estimating the Prevalence of Disordered Gambling Behavior in the United States and Canada: A Meta-analysis

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December 15, 1997

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This project was funded by a grant from the *National Center for Responsible Gaming (NCRG)*, Kansas City, Missouri. The *National Center for Responsible Gaming* is the first national organization devoted exclusively to funding independent research on problem gambling and underage gambling. The *NCRG* funds basic and applied research projects selected through a rigorous peer review process. The authors accept full responsibility for the content and conclusions of this report.

Executive Summary

During the past two decades, there has been a broad expansion of gambling (e.g., lottery, casino, and charitable) across the United States and Canada. This social and economic development has prompted researchers and policy makers to ask questions about the extent of disordered gambling and about the availability of precise estimates of the prevalence of this phenomenon. This study represents the first comprehensive meta-analysis of disordered gambling prevalence rates in the United States and Canada. Meta-analytic research empirically integrates the findings of previously conducted independent studies; in this case, these studies represent existing research on the prevalence of disordered gambling. The purpose of the present research was to establish more precise estimates of the prevalence of this phenomenon and identify factors that may influence these rates. A meta-analytic strategy permits investigators to make comparisons among population segments so they can draw inferences not possible from an individual study and to examine factors that may influence prevalence rates in new ways that could not have been considered within a single study.

A broad search strategy identified 152 studies for review, representing adults and youth in the general population, college students, adults and youth in treatment or prison settings, and a variety of other "special" populations. Of these 152 primary studies, 120 met the study inclusion criteria. A variety of authors and instruments were involved with the task of estimating the prevalence of disordered gambling.

This meta-analysis revealed conceptual and methodological factors that make determining and understanding the prevalence of disordered gambling complex. The significant collinearity among these independent studies contributed to the difficulty in understanding the meaningfulness of different prevalence estimates. Collinearity refers to multiple patterns of correlation among data. For example, more than half of all disordered gambling prevalence research has been released since 1992. Much of this new research focused on segments of the population who experience higher rates of gambling disorders than the general adult public. This pattern of recent investigation of "higher risk" populations may have created misleading perceptions of increasing rates of disordered gambling. We observed collinear data in other instances: studies with the lowest prevalence rates were those conducted among adults from the general population; these studies also evidenced the largest sample sizes and high-quality methods. Alternatively, treatment population studies evidenced the highest prevalence rates of disordered gambling and the smallest sample sizes. Collinearity emerged as an important factor in understanding the current status of disordered gambling prevalence research and in guiding future research. This meta-analysis includes cautious adjustments for the influence of collinearity to help better judge the meaning of disordered gambling prevalence estimates.

The results of this meta-analysis revealed a number of important findings:

- Disordered gambling is an apparently robust phenomenon that research can identify reliably across a wide range of investigative procedures that vary in quality of method. Robust phenomena tend to be reliable, occurring in almost all study settings; these phenomena may be found with almost any research methodology, even those that are widely disparate.

- The majority of Americans and Canadians gamble with little or no adverse consequence. These people are ***level 1*** gamblers. However, gambling is associated with meaningful negative effects for certain segments of the population. The people who experience the most serious of these consequences are ***level 3*** gamblers. Level 3 gam-

bling refers to disordered gambling that satisfies "diagnostic" criteria and, therefore, is clinically meaningful. Level 3 gambling represents a pattern of disordered gambling that resides on one end of the gambling involvement continuum. This continuum often begins with recreational gambling or gambling that does not produce any adverse reactions (i.e., level 1). ***Level 2*** gambling represents a pattern of gambling that is associated with a wide range of adverse reactions or consequences. Consequently, level 2 gamblers are a more diverse group than their level 3 counterparts. In addition, level 2 gamblers represent people who may be moving in either of two directions: some level 2 gamblers are moving toward an increasingly disordered state, while others are moving toward level 1 gambling. Some level 2 gamblers even may be moving to abstaining from gambling activities. It also is possible that level 2 gamblers may not be moving at all. In this study, we identified both ***lifetime*** and ***past-year*** rates of level 2 and level 3 gambling. A lifetime rate refers to the likelihood that someone will experience disordered gambling at some point during their life.

- In this study, we identified the extent of ***lifetime level 3*** gambling as follows:
  - Among adults from the general population—1.60%, within a 95% confidence interval of 1.35% to 1.85%.
  - Among youth from the general population—3.88%, within a 95% confidence interval of 2.33% to 5.43%.
  - Among college students—4.67%, within a 95% confidence interval of 3.44% to 5.90%.
  - Among adults in treatment—the highest rate among these groups—14.23%, within a 95% confidence interval of 10.70% to 17.75%.
- ***Past-year rates*** provide a better representation of the current state of ***level 3*** gambling than lifetime estimates. Past-year estimates represent the potential number of disordered gambling cases that are active during the past 12 months. We identified the past-year level 3 rates of disordered gambling as follows:
  - Adult general population—1.14%, within a 95% confidence interval of 0.90% to 1.38%.
  - Youth general population—5.77%, within a 95% confidence interval of 3.17% to 8.37%.
- This study indicates that scientists and public policy makers have paid insufficient attention to level 2 gamblers (i.e., those with sub-clinical levels of gambling disorders). While extremely diverse, level 2 gamblers experience a wide range of problems from their gambling. These problems can range from mild to moderate. Level 2 gamblers are much greater in number than their level 3 counterparts, though they experience less distress. In this study, we identified the extent of level 2 lifetime and past-year gambling as follows:
- The ***lifetime level 2*** rates of gambling were as follows:
  - Among adults from the general population—3.85% within a 95% confidence interval of 2.94% to 4.76%.
  - Among youth from the general population—9.45% within a 95% confidence interval of 7.62% to 11.27%.
  - Among college students—9.28% within a 95% confidence interval of 4.43% to 14.12%.
  - Among adults in treatment—15.01% within a 95% confidence interval of 8.94% to 21.07%; as we found with level 3 rates, the level 2 rate was highest among this group.
- The ***past-year level 2*** rates were identified as follows:
  - Among the adult general population—2.80%, within a 95% confidence interval of 1.95% and 3.65%.

- Among adolescents sampled from the general population—14.82%, within a 95% confidence interval of 8.99% and 20.66%.

In addition to estimates of the extent of U.S. and Canadian gambling disorders, this meta-analysis produced a variety of findings that are informative about the nature and distribution of disordered gambling. These findings can be summarized briefly as follows:

- During the past two decades, gambling disorders have evidenced an increasing rate among adults sampled from the general population.
- To date, prevalence research has not demonstrated an increase in the rate of gambling disorders among adolescents or adults sampled from treatment or prison populations during the past two decades.
- Gambling disorders are significantly more prevalent among young people than among the general adult population.
- Gambling disorders are significantly more prevalent among males than females within every population segment considered in this study.
- Individuals with concurrent psychiatric problems display much higher rates of disordered gambling than either adolescents or adults sampled from the general population.
- There was no significant regional variation in the rates of gambling disorders identified across regions of Canada and the United States.
- To date, the overall methodological quality of disordered gambling prevalence research has not improved during the past 20 years.
- Methodological study quality did not influence the magnitude of prevalence estimates.

This study also provided the opportunity to identify and consider a variety of conceptual and methodological problems associated with estimating and interpreting prevalence rates. This discussion includes an examination of the construct validity of disordered gambling. For example, one of the most important issues associated with the study of any psychiatric disorder is the absence of a definitive "gold standard" for determining who has the disorder and who does not. Without a gold standard, it is impossible to determine with confidence whether a screening instrument over- or under- estimates the problem in the general population. The validity of any judgment about the prevalence of disordered gambling must be evaluated by an independent means of assessment. This thorny conceptual and methodological problem reflects the matter of "construct validity." Without independent validation, gambling researchers must begin to consider to what extent gambling disorders may overlap with other psychiatric illness.

This study also identified an interesting characteristic of research in the field of gambling prevalence: overall, the methodological quality of prevalence research did not meaningfully influence estimates of prevalence. Further, according to the methodological quality index employed in this study, the quality of prevalence research has not advanced significantly during the past two decades.

To help advance the field of gambling studies, this meta-analysis encourages investigators to report interval estimates routinely and not just occasionally. This practice is different from the more common custom of representing a prevalence rate by providing a single index, or point estimate, without an associated measure of confidence. Discussions about interval estimation should take a more prominent role in studies of disordered gambling prevalence in general, and around the reporting of point estimates of gambling disorders in particular. This practice will provide legislators, health care planners, and other policy makers with an explicit standard of confidence about each prevalence estimate so that they can better judge its value. In addition

to confidence intervals, we suggest that investigators report specific prevalence rates (e.g., male rates versus female rates) rather than aggregate rates for an entire population.

In addition to methodological matters, the discussion also considers implications of the present findings for future research, public policy, and treatment. This report concludes with a brief consideration of suggested guidelines for the conduct of future prevalence research directed at disordered gambling.

Acknowledgements

A project of this magnitude involves a variety of contributions from many people. This undertaking would not have been possible if it were not for the hard work and thoughtfulness of many different people. Thanks are extended to Mary Foley and Tom Murphy for their work on a pilot version of this project. We appreciate the help of Sheryl H. Bell, Frank Biagioli, Renee Cunningham-Williams, Jeffrey Derevensky, Mark Dickerson, Rosa Dragonetti, Don Feeney, G. Ron Frisch, Dewey Jacobs, Henry Lesieur, Ed Looney, Valerie Lorenz, Reece Middleton, Joe Rinehart, Lee Robins, Jill Rush, Kathy Scanlan, Brian Steeves, Randy Stinchfield, Rachel Volberg, George Wandrak, Ken Winters, Harold Wynne, and Darryl Zitzow in our effort to identify and locate studies for this project. Special thanks are extended to Richard LaBrie, who consistently helped us to understand and apply statistical instruments in a most useful and elegant way. We appreciate the tireless efforts of Greg O'Donohue and Blase Gambino, who joined the team of coders who compulsively abstracted the data necessary for this study. Blase Gambino, Richard LaBrie, Richard McGowan, Peter Reuter, Graham Colditz, James Oppenheim, and Kathy Scanlan contributed wise and valuable comments about earlier versions of this manuscript; we appreciate their insight and support. We also acknowledge and appreciate the careful administrative work of Jay Alves and Jennifer Wickham during the final rounds of manuscript revision. Thomas Cummings has been a guiding light, providing us with support and insight; we send him our special thanks. We also send a note of appreciation to our friend and colleague William McAuliffe, whose important contributions to the field of substance abuse treatment needs assessment and prevalence research helped to stimulate many important conceptual and methodological ideas that came to fruition during this project. Emily McNamara, who worked diligently to assure that the administrative details of this project were coordinated, deserves special distinction. She provided thoughtful input and guidance for everyone associated with this project. We owe Emily a special debt of gratitude. Finally, we want to thank the National Center for Responsible Gaming (NCRG); the NCRG has our gratitude for providing financial support, and waiting patiently for our findings. Last, but certainly not least, we must acknowledge our families and friends who made space in their lives so we could complete this work. The project was vast, and so was their support.

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Introduction

This research report describes a conceptual and empirical review of the existing literature which estimates the prevalence of disordered gambling in the United States and Canada. During the past decade, there has been an increasing clarion call among researchers (Ladouceur, 1996; Sartin, 1988) and policy makers (e.g., National Gambling Impact and Policy Commission Act of 1996) to develop precise estimates of gambling-related disorders among both adults and adolescents throughout the United States and Canada. Since prevalence estimates are a direct reflection of the research methods and strategies scientists develop and implement to measure a particular phenomenon, debate and controversy are regular consequences of prevalence estimation projects (e.g., Nadler, 1985). This methodological debate results in confusion among the legislators, health care providers and public health program planners who use these estimates to make policy, funding, and treatment decisions (e.g., Eadington, 1992). To minimize controversy and yield the most useful estimates of gambling-related problems, this project employed a meta-analytic strategy to develop estimates of gambling-related disorders across an array of differing estimation methodologies and populations. This approach provides the opportunity to assess and integrate the variety of assumptions and strategies used by the array of scientists who previously have estimated disordered gambling prevalence. Shaffer and Hall (1996) provided the first meta-analytic estimate of gambling disorders among an adolescent population. This research extends their earlier investigation and provides new insight into the many gambling-related factors that require examination or additional research.

Background: The Need for Estimates of Disordered Gambling

United States

We are now in the midst of the third wave of widespread legal gambling in the United States (Rose, 1986; 1995).[1] The third wave began in the 1930s, during the Great Depression, when Nevada re-legalized casinos and pari-mutuel gambling spread across the country. The current era of gambling expansion began in 1964, when New Hampshire initiated the first modern state lottery. Since the start of the New Hampshire lottery, the opportunity to gamble has exploded across America. Between 1974 and 1996, the total amount of money legally wagered nationwide increased from $17.3 billion to $586.5 billion (Christiansen, 1997; National Council on Problem Gambling, 1993). In 1996, the gaming industry earned $47.6 billion, a 5.6% increase from the previous year (Christiansen, 1997). Between 1975 and 1996, the national per capita sales of lottery products alone increased from $20 to approximately $150 per year (Clotfelter & Cook, 1989; McQueen, 1996). To date, 37 states in addition to Washington D.C. have legalized lotteries and 26 states have Native American or independent casinos (Whyte, 1997). All states with the exception of Utah and Hawaii have legalized some form of gambling.

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[1] According to Rose (1986), the first wave of gambling in the United States began during the colonial period and did not end until the decades immediately prior to the Civil War. The second wave of legal gambling started with the Civil War and ended in a series of scandals (e.g., Louisiana Lottery scandal) in the last decade of the nineteenth century.

Canada

An expansive wave of gambling accessibility has similarly washed over Canada during the past twenty years (Ladouceur, 1996). An estimated $20 to $27 billion a year is wagered on all forms of legal gambling in Canada (National Council of Welfare, 1996). The national total of $4.6 billion in gambling revenues represents 2.7% of the total provincial and territorial revenues (National Council of Welfare, 1996). Currently, lotteries, bingo, and pari-mutuel wagering are available in every Canadian province (International Gaming & Wagering Business, 1997). Casinos have been established in five provinces: Quebec, Ontario, Nova Scotia, Manitoba, and Saskatchewan. In addition, charity casinos have been established in British Columbia, Alberta, and Ontario.

Risks of Gambling

Gambling is neither a financially nor a psychologically risk-free experience. In addition to the possibility that gamblers will lose their money, gamblers also risk experiencing a variety of adverse psychological, social, and biological consequences from gambling. Given the increasing access to gambling during the latter half of the 20th century, public health researchers, clinicians, and policy makers have had both the opportunity and social obligation to study the impact of legalized gambling on adults as well as children and adolescents. As the popularity of legalized gambling grows, society is directing more attention toward the public health risks and the economic, legal, and social costs of expanded gambling (Eadington, 1994).

Although most people view gambling as an entertaining recreational activity, numerous studies reveal the serious consequences of gambling for a segment of the population (e.g., Lesieur & Rosenthal, 1991; Shaffer, Hall, Walsh, & Vander Bilt, 1995). Gamblers experiencing adverse reactions to gambling have become known as "compulsive," "problem," or "pathological" gamblers. The American Psychiatric Association (APA) includes pathological gambling as an impulse disorder in their Diagnostic and Statistical Manual (APA, 1994). The essential characteristic of impulse disorders is the person's inability to "…resist an impulse, drive, or temptation to perform an act that is harmful to the person or to others" (APA, 1994, p. 609). Often people with impulse disorders feel an increasing tension prior to acting, and then a sense of relief, calm, or pleasure following the impulsive act. Impulsive acts may or may not be followed by a sense of regret, guilt, or shame. The manual states that "the essential feature of pathological gambling is persistent and recurrent maladaptive gambling behavior... that disrupts personal, family, or vocational pursuits. The diagnosis is not made if the gambling behavior is better accounted for by a manic episode..." (APA, 1994, p. 615).

On the Conduct of a National Prevalence Study

To date, a range of studies have been conducted in the United States and Canada to determine the prevalence of disordered gambling among adults and adolescents. However, with the exception of Kallick, Suits, Dielman, and Hybels' (1979) national effort, which represents the first and only national prevalence study, each of these studies restricted their sampling strategy to a limited geographic area. A variety of estimates from a range of geographical areas has prevented the gambling research field from producing prevalence rates that reflect the scope and severity of disordered gambling within a national context. "There seems to be no real agreement among health professionals and government agencies as to the actual NUMBER of Americans afflicted with the subject at hand [i.e., disordered gambling]. Discrepancies in various reports are too broad to make a viable average.... For a subject receiving so much widespread publicity, the disparity in these numbers is alarming" (Sartin, 1988, p. 371). The American Psychiatric Association's Fourth Edition of its Diagnostic and Statistical Manual (APA, 1994) notes that the prevalence of pathological gambling may be between 1% and 3%, stating that the vagueness of the statistic is due to the limited availability of data.

Thus, the field of gambling research, the gambling industry, and national and state policy makers are in need of an accurate and reliable estimate of the extent of gambling problems throughout the United States and Canada. However, the time and expense required for a national prevalence study would be considerable, perhaps even prohibitive. For example, planning a national prevalence study would—and arguably should—entail a lengthy debate about the propriety of methodological issues. For example, to date, at least 25 different survey instruments (including modifications) have been used to measure gambling problems among adolescents and adults. The selection of any one or even several of these scales—or the creation of a new scale—for use in a national study would require extensive research and scientific debate.[2] For example, some researchers (e.g., Christiansen/Cummings Associates Inc., Princeton Marketing Associates, Inc., Spectrum Associates Market Research Inc., & Volberg, 1992) have suggested that the South Oaks Gambling Screen (Lesieur & Blume, 1987), the most widely used instrument for estimating the prevalence of disordered gambling, creates an overestimate of the disorder. In addition, investigators also would have to resolve issues relating to the reliability and validity of an instrument that would be applied across a diverse and representative national sample. If a new instrument was developed, it might take years to determine the accuracy and utility of its psychometric properties before it could be applied to a national sample. Further, the development of a valid sampling strategy designed to yield a sample representative of the entire country would be an extremely complicated methodological and administrative undertaking. This sample would have to represent every state or province and be based on a stratified random selection strategy. If the study purpose included a meaningful effort to understand treatment needs and other social costs, then the actual administration of a survey to a national sample would become prohibitively expensive.[3] Under these circumstances it would become essential for the research to bear the additional costs of contacting adolescents, hospitalized patients, homeless individuals, prison inmates, and other groups who best represent the treatment-seeking population who are at higher risk for gambling disorders, and who often are difficult to contact by telephone.

Finally, unless the sample size was considerable, a single national prevalence study would be unable to compare geographic rates, chronological trends, and the impact of shifting social policies or events. Absent sufficient resources to ameliorate these matters and the other problems described earlier, scientists have not been able to conduct an adequately designed national study of disordered gambling prevalence that would yield useful results.

Estimating Prevalence Using Meta-analysis

There is an efficient, expeditious, and less expensive method available to develop estimates of the extent of gambling problems in the United States and Canada. This method entails a quantitative synthesis, or meta-analysis, of previously conducted studies on the prevalence of gambling disorders. This

[2] Canadian researchers currently are engaged in this methodological debate with an aim to adopt a standardized problem gambling screen for use in Canada (*Measuring Problem Gambling in Canada: A Request for Proposals Issued by the Inter-Provincial Task Force on Problem Gambling*, June 6, 1997).

[3] Currently, for example, a single telephone interview requiring a 20- to 40-minute survey protocol costs about $75.00 to administer. Most single state samples require a minimum of approximately 7,000 initial interviews to obtain a sample of disordered gamblers that provides adequate power for the important comparisons of interest; therefore, a national survey that would permit meaningful data analysis would require millions of dollars in survey administration costs alone. Further, the most time-consuming aspect of most prevalence studies is developing a sampling design and selecting and preparing survey materials; therefore, developing and conducting a national prevalence study even with limited objectives would require expenses of millions of dollars.

method is much more cost-effective than a national study, since it makes use of all of the research already conducted in the field. In addition, research in other fields (e.g., Cappelleri et al., 1996) has shown that the results of large studies are similar to the results of meta-analyses of smaller studies. Shaffer and Hall (1996) conducted the first meta-analytic study of the prevalence of youth gambling problems. However, at the time this research was conducted, only 11 youth gambling studies were available for analysis. Currently, there are more than 150 studies on the prevalence of gambling problems among youth and adult populations. A comprehensive meta-analysis of adult gambling prevalence studies has never been conducted. The study previously conducted by Shaffer and Hall (1996) provides the conceptual and methodological framework for this new broad-based study. The original meta-analytic methods employed by Shaffer and Hall (1996) will be expanded and enhanced so that additional comparisons of moderator variables can be examined (e.g., evaluations of adult versus adolescent prevalence rates, high-quality methods versus less rigorous approaches, treatment populations versus general populations, regional variations in prevalence estimates).

Meta-Analytic Methodology

Meta-analysis, a term coined in 1976 by Glass (Goodman, 1991), is a research technique employed to review and synthesize a body of research. Scientists often conduct meta-analyses when there is a disparity of results from individual studies in a field. This strategy allows for a quantitative, empirical integration of previously derived estimates (Rosenthal & Rosnow, 1991). Scientists have applied meta-analytic techniques to better understand, for example, the efficacy of various treatments or interventions across a broad range of health concerns. Scientists have used meta-analytic strategies to study the efficacy of assessment and psychotherapy with adults and children (Bowers & Clum, 1988; Brown, 1987; Hasselblad & Hedges, 1995; Lipsey & Wilson, 1993; Smith & Glass, 1977; Stein & Lambert, 1995; Weisz, Weiss, Alicke, & Klotz, 1987; Wampold, Mondin, Moody, Stich, Benson, & Ahn, 1997; Weisz, Weiss, Han, Granger, & Morton, 1995); gender differences (Bettencourt & Miller, 1996; Eagly, Karau, & Makhijani, 1995); patterns of marital and friendship relationships (Erel & Burman, 1995; Newcomb & Bagwell, 1995); aggression (Bettencourt & Miller, 1996; Ito, Miller, & Pollock, 1996); depression and memory impairment (Burt, Zimbar, & Niederehe, 1995); perceptual sensitivity and vigilance (See, Howe, Warm, & Dember, 1995); and educational achievement and ability (Slavin, 1990).

More specifically, within the field of addictions, meta-analysts have examined areas of drug prevention (Ennett, Tobler, Ringwait, & Flewelling, 1994; Tobler, 1986); patterns of alcohol use and alcohol treatment (Fillmore, Hartka, Johnstone, Leino, Motoyoshi & Temple, 1991; Hartka, Johnstone, Leino, Motoyoshi, Temple, & Fillmore, 1991; Longnecker, Berlin, Orza, & Chalmers, 1988; Longnecker, Orza, Adams, Vioque, & Chalmers, 1990; Miller, Brown, Simpson, Handmaker, Bein, Luckie, Montgomery, Hester, & Tonigan, 1995), and drug abuse treatment (Stanton & Shadish, 1997). In general, a small number of meta-analyses have been conducted within the domain of prevalence estimation (Habermann-Little, 1991; Lipton & Stewart, 1997; Quigley & Vitale, 1997; Ritchie, Kildea & Robine, 1992; Stewart, Simon, Shechter & Lipton, 1995), and only Shaffer and Hall (1996) have examined specifically the prevalence of gambling disorders using meta-analytic methods. Consequently, this study of disordered gambling serves as one of the first meta-analytic models for synthesizing a pool of prevalence estimates.

In the field of gambling research, there is meaningful scope of conceptual, regional, and methodological differences among the existing studies that estimate the prevalence of gambling disorders. A meta-analytic approach allows us to integrate these disparate studies while respecting the different strategies and assumptions employed by scientists. In their classic meta-analytic work on psychotherapy outcome ef-

fects, Smith and Glass (1977) noted that, "Mixing different outcomes together is defensible. First, it is clear that all outcome measures are more or less related to 'well being' and so at a general level are comparable. Second, it is easy to imagine a Senator conducting hearings on the NIMH appropriations or a college president deciding whether to continue funding the counseling center asking, 'What kind of effect does therapy produce—on anything?' Third, each primary researcher made value judgments concerning the definition and direction of positive therapeutic effects for the particular clients he or she studied. It is reasonable to adopt these value judgments and aggregate them" (p. 753). Like Smith and Glass, we also can imagine a public official asking, "What is the prevalence of gambling problems among young people and adults—the full range of gambling problems—as measured by a variety of estimates?" To answer this question properly, we must consider the influence of value judgments made by primary researchers and their respective conceptualizations of disordered gambling. In addition, we must integrate different research methodologies and gambling patterns that are evident across regions of the United States and Canada. A meta-analytic approach to these issues makes it possible to synthesize or pool a range of gambling studies to derive a more stable estimate of gambling prevalence rates than could be obtained from any single approximation (Shaffer & Hall, 1996).

Manufacturing Prevalence Estimates

Estimating prevalence is a complex task. This task rests on a variety of conceptual issues. Casti (1989) noted that scientists view the world through three different frameworks: (1) realism, (2) instrumentalism, and (3) relativism.[4] The notion that there is a "true" prevalence rate to be identified reflects a "*realistic*" perspective on science and the scientific method. "Realists believe that there is an objective reality 'out there' independent of ourselves. This reality exists solely by virtue of how the world is, and it is in principle discoverable by application of the methods of science... this is the position to which most working scientists subscribe" (Casti, 1989, p. 24). Alternatively, *instrumentalists* cling "...to the belief that theories are neither true nor false, but have the status only of instruments or calculating devices for predicting the results of measurements. Basically, this amounts to the belief that the only things that are genuinely real are the results of observations" (p. 25). Finally, *relativism* is becoming increasingly popular: "...truth is no longer a relationship between a theory and an independent reality, but rather depends at least in part on something like the social perspective of the person holding the theory. Thus for a relativist as one passes from age to age, or from society to society, or from theory to theory, what's true changes. In this view it's not what is taken to be true that changes: au contraire, what changes is literally truth itself" (pp. 25-26).

Instead of adopting a realistic or instrumentalist view of prevalence, we have taken a relativistic perspective on the concept of prevalence. From this standpoint, scientists *manufacture* prevalence estimates. Scientists adopt strategic and tactical plans, based upon the principles of the scientific method, to generate a prevalence estimate. Instead of simply assuming that a "true" prevalence estimate awaits our capacity to accurately identify it, we believe that a dynamic interplay of factors influences and determines every prevalence estimate: which measurement instrument, with which population, with which sampling strategy, with which administrative procedure, at which historical point in time, un-

[4] Realists, instrumentalists, and relativists are similar to three baseball umpires. Like the realist, the first umpire says, "Some are balls, and some are strikes, and I call them as they are." Like the instrumentalists, the second umpire says, "Some are balls, and some are strikes, and I call them as I see them." The final umpire, like the relativist, says, "some are ball and some are strikes, but they ain't nothin' till I say so!"

der the direction of which scientists all influence the outcome of an effort to estimate prevalence. By adopting a relativistic posture, we can explicate the manufacturing process responsible for generating prevalence estimates, which in turn will allow us to improve the quality controls associated with these production activities.

In addition to being guided by a relativist philosophy, we also think it vital to understand the specific purpose for which a prevalence estimate is produced. For example, we could assume that prevalence estimates simply exist and scientific curiosity motivates the identification process—because it's "out there." While scientific interest is often sufficient to motivate an investigation, prevalence estimates have valuable applications. We can use prevalence estimates to allocate limited prevention or treatment resources, estimate social costs, inform diagnostic protocols, or advise the development and implementation of social policy. With few exceptions (e.g., Sin, 1996; Steinberg, Kosten & Rounsaville, 1992; Thompson, Gazel & Rickman, 1996; Vagge, 1996), scientists who have estimated the prevalence of gambling disorders do not inform their readers how, where, when, or by whom their newly developed prevalence estimate will be utilized.

Epidemiological Considerations

Prevalence versus Incidence

Scientists usually investigate prevalence to estimate the public health consequences of a specific disorder for the purpose of informing policy makers and treatment planners. Prevalence studies often are conducted within a field of inquiry that has yet to discern the public health burden of a particular problem. While *prevalence* estimates provide a snapshot of a disorder at one point or one period in time, *incidence* rates estimate new cases of the disorder over a specified period of time by determining the change that occurs in a population over time. Thus, incidence and prevalence estimates answer different questions and serve different purposes. For example, an incidence rate can answer the following question: if you follow a population for five years, what percentage of the population develops their first episode of a gambling disorder? A related question an incidence measure addresses is whether there is a higher rate of disordered gambling following the development of a new avenue of gambling (e.g., a new casino, a new lottery game, legalization of a previously illegal gambling activity) than there was before this circumstance.

Over the past two decades, researchers have conducted virtually no incidence studies in the field of disordered gambling.[5] Instead, the field of disordered gambling research has been fascinated and absorbed by the attempt to establish a precise and valid prevalence estimate. Prevalence studies have been conducted on national, state and province, local, and other targeted population levels. This effort has enabled the field to grow increasingly confident of the base rate of disordered gambling, albeit within a variable range of estimates. One limitation of simply continuing to replicate studies designed to estimate prevalence is that two major factors influence these estimates: (1) the scientific process of manufacturing prevalence rates; and (2) the socio-cultural factors (e.g., access to gambling, overall economy) associated with the acceptability of gambling. Moreover, a collection of prevalence studies is unable to provide the same information revealed by a single incidence study.

Collectively, researchers, policy makers, the gambling industry, and others appear to be increasingly interested in the factors responsible for shifting the prevalence rate of disordered gambling over time. This question requires observation over time and can only be answered

[5] Winters et al. (1995) collected prevalence data from the same cohort at two different points in time. However, their study should be considered a prevalence study rather than an incidence study because they did not focus on the onset and duration of disordered gambling which would have allowed an estimate of new cases (i.e., an incidence rate).

with precision by conducting incidence studies. The most appropriate study design to assess incidence rates is a cohort study. Cohort studies follow a group of people prospectively over time. In this type of research, investigators attempt to identify the rates of disordered gambling across the risk "exposure" categories. Researchers can define the risk exposure to gambling, or availability of gambling, in a myriad of conceptual and concrete ways. Pragmatically, the results of each cohort study will contribute understanding to the nature of the initiation, development and maintenance of disordered gambling. A series of incidence studies also can begin to clarify temporal relationships. For example, do disordered gamblers who frequent casinos develop more problems with alcohol than the general population because they spend time in an environment where alcohol is more accessible than usual? Or, alternatively, do disordered gamblers become disordered gamblers because they like to drink alcohol and, therefore, are attracted to venues where alcohol is affordable and readily accessible? While prevalence studies can only speculate about relationships such as these, incidence studies can begin to decipher the "chicken or egg" questions of causality.

The Importance of Range Estimates

Investigators usually report prevalence estimates of disordered gambling by providing a single number. These estimates represent a distinct statistic (e.g., 5.7%) designed to indicate the proportion of people who were at risk, or who have experienced the outcome of interest (e.g., disordered gambling) according to some criterion (e.g., a gambling screen). Single estimates are the most simple—and often the most attractive—method of providing an index of prevalence. However, a range estimate of prevalence (e.g., 5.3% [3.7-6.2]) is more informative than a single estimate. Range estimates provide a measure of *confidence* around the prevalence index. For example, a 95% confidence interval indicates that if a particular prevalence estimate X% was generated by randomly drawing a set of 100 population samples, this prevalence estimate X% would reside within the range established by the upper and lower bounds 95% of the time. Similarly, a 99% confidence range establishes boundaries within which the estimate would reside 99% of the time. To illustrate further, for a 99% confidence interval, 99% of all the various sample proportions of size "n" would lie between the upper and lower boundaries established by the interval. In the case of prevalence estimates, a confidence interval identifies the domain within which a distribution of sample proportions reside. Finally, when populations reside in different, non-overlapping intervals, investigators can claim that the populations are "different" with increased assurance.

Levels of confidence are very useful for determining the upper and lower limits of a phenomenon. Furthermore, range estimates provide more guidance than single estimates to policy makers and social planners who use these estimates for allocating limited resources. Range estimates permit planners to consider the upper and lower bounds of resource allocation; for example, budget analysts can develop best and worst case scenarios for treatment programs. In spite of the utility of range estimates, only 10.6% of all the studies included in this meta-analysis reported confidence intervals. This circumstance tacitly encourages the belief that there is a single accurate or "true" estimate of gambling prevalence independent of the methods and procedures employed to generate these estimates.

Time frame

Prevalence is a measure taken at one point in time that estimates the occurrence of a disorder. If a disorder tends to occur episodically, in waves of active and inactive episodes, a *point prevalence* rate will not necessarily be an accurate representation of the extent of the problem. Pathological gambling, like most addictions, is a disorder that fluctuates in episodic waves (e.g., Zinberg, 1984; Zinberg & Harding, 1982; Zinberg, Harding, & Winkeller, 1977). In the field of disordered gambling, most of the prevalence studies have addressed this issue by capturing a

period prevalence. Traditionally, disordered gambling researchers have developed period prevalence rates by asking individuals whether they have experienced a range of problems within the past year or during their lifetime. Identifying the time period is of great importance for understanding the framework of a disorder. Furthermore, the value of lifetime rates is questionable because of uncertainty about the clustering of lifetime symptoms within a particular time frame, or confusion about other psychiatric disorders that may have stimulated or sustained gambling behaviors across extended time periods (e.g., obsessive compulsive disorder). In addition, since we can assume that some disordered gamblers resolve their problems and recover, lifetime prevalence rates are not a particularly reliable index of the current scope and severity of disordered gambling (Dickerson, 1994). Finally, lifetime rates of every population sample are subject to shifts in the population due to death, memory distortion, and forgetting. We will address issues related to time frames in more detail later in the *Discussion* section.

Semantics of Disordered Gambling: Conceptual Chaos

Conceptual and methodological chaos is common among emerging scientific fields (Cohen, 1985; Shaffer, 1986a; Shaffer, 1997b). This discord encourages dialogue and debate among workers in the field. While researchers in the gambling field agree about the importance of understanding the nature, scope, and severity of disordered gambling, there is much variation in the terms that researchers use to designate various levels of disordered gambling. These terms commonly include "problem" gambling, "at-risk" gambling, "potential pathological" gambling, "probable pathological" gambling, and "pathological" gambling. Some authors have used terms for adolescents that are different from the terms generally used for adults (e.g., Volberg, 1993a; Winters & Stinchfield, 1993). The particular term attached to a specific level of disordered gambling severity is less important than terminology that allows researchers, clinicians, and others in the field to communicate precisely and understand one another. The value of any simple description of a complex and multidimension activity such as gambling "…is bought at the expense of a lack of precision in meaning" (Walker & Dickerson, 1996, p. 243). Precision is vital to the conduct of a meta-analysis, since research synthesis takes place across an assortment of study designs. Therefore, when conducting a meta-analysis, it becomes mandatory to find an effective classification system that can make sense of the diversity of labels used by scientists to measure comparable constructs. This classification system must permit comparisons among, for example, adolescent prevalence rates derived from studies that use different criteria and category labels. In the first meta-analysis of disordered gambling studies, Shaffer & Hall (1996) suggested a classification nomenclature composed of disordered gambling levels. To facilitate the necessary comparisons, reconcile the divergent methods, and reduce the chaos of contemporary gambling category terminology, we will employ the Shaffer and Hall generic multi-level classification scheme. We will discuss the details of this classification system later in the *Methods* section.

To facilitate the conduct of a meta-analysis, investigators must find common ideological ground on which to integrate the findings of diverse research. The multi-level system proposed by Shaffer and Hall provides the conceptual architecture to integrate research findings. To use this system, we also require a semantic architecture. Therefore, we have chosen to employ the concept of "disordered" gambling throughout this report.[6] We have selected the phrase *disordered gambling* for two primary reasons. First, the concept of disordered gambling transcends each of the existing constructs (e.g., excessive, problem, pathological, and

[6] Although we have chosen to use the term "disordered gambling" in most cases, we will use other terms where they are appropriate (e.g., the use of "pathological" in discussions of APA criteria).

compulsive gambling) by recognizing that each of these categories represents, at various levels of intensity, a lack of order in one of the major systems of human experience. For example, disordered gamblers can experience disruption of their social, psychological, or biological system. Disordered gambling in its most intense form can stimulate turmoil in all three of these realms. Second, the notion of a disorder represents a continuum of experience. Not all gamblers experience an excessive relationship with the games they play; not all excessive gamblers experience compulsive or pathological behaviors; not all pathological gamblers experience impairment in every part of their activities. The concept of disordered gambling encourages us to recognize the wide range of gradual shifting of human experiences that can occur among gamblers who make the transition from regulated gambling to intemperate gambling.

A Brief History of Disordered Gambling Prevalence Studies

In the mid-1970s, Kallick et al. (1979) undertook the daunting task of describing the nature and scope of gambling activities in the United States on behalf of the U.S. Commission on a National Policy Toward Gambling. One of their objectives was to determine the extent of "compulsive" gambling among their sample. While the national survey was being conducted, Robert Custer was offering the American Psychiatric Association Task Force a description of compulsive gambling for use in the Diagnostic and Statistical Manual (DSM) (Kallick et al., 1979, p. 73). Lacking an instrument with which to measure compulsive gambling, Kallick and her colleagues created a scale of 18 items based on concepts from the extant literature that seemed related to compulsive gambling. This first instrument became known as the *ISR (Institute for Social Research) test*. Only one other researcher subsequently used Kallick et al.'s gambling scale (i.e., Culleton & Lang, 1985). Nevertheless, the process of attempting to accurately measure the construct of disordered gambling officially had begun.

The results of Custer's and others' advice and guidance to the APA on the subject of pathological gambling first surfaced in the third edition of the *Diagnostic and Statistical Manual* (DSM-III; APA, 1980). The appearance or omission of an illness, disorder, or syndrome in the American Psychiatric Association's Diagnostic and Statistical Manual is a reflection of cultural norms, social perception, and current medical knowledge. For example, the symptom cluster "post-traumatic stress disorder" first appeared in the DSM-III in 1980, replacing diagnoses such as "shell shock" and "combat fatigue" (Breslau & Davis, 1987). Conversely, in 1973, "homosexuality" was removed from the second edition of the DSM (APA, 1973) reflecting the medical profession's shift toward viewing sexual orientation as something other than a disorder that needed to be treated (Bayer, 1981). In 1980, at the urging of Robert Custer, pathological gambling joined pyromania, kleptomania, and intermittent and isolated explosive disorders as an impulse disorder in the DSM-III (APA, 1980). Since 1980, many researchers and instrument developers have opted to use the DSM-III or subsequent DSM-based instruments (e.g., DSM-III-R, DSM-IV) to assess and measure the prevalence of pathological gambling.

Kallick et al. (1979) designed *The Institute for Social Research s*cale to be used in population-based samples by researchers. The DSM-III and subsequent diagnostic manuals have offered clinicians a guide to determining whether an individual who presents with gambling-related problems has a diagnosable disorder. In 1987, in an effort to develop a "consistent, quantifiable, structured instrument that can be administered easily by nonprofessional as well as professional interviewers" (Lesieur & Blume, 1987, p. 1184), Henry Lesieur and Sheila Blume developed *The South Oaks Gambling Screen* (SOGS). Lesieur and Blume used the DSM-III-R criteria to guide both the development and validation of the SOGS (Culleton, 1989).

The SOGS rapidly became and has continued to be the instrument of choice among researchers estimating disordered gambling prevalence. For example, of the studies included in this meta-

analysis, 47.6% used the SOGS as at least one of the study instruments. If subsequent derivatives of the SOGS (e.g., SOGS-RA, other modified SOGS for adolescent samples) are included, this percentage increases to 55.1%. One reason for the large proportion of SOGS-based prevalence studies is the work of Rachel Volberg, who consistently has used the SOGS in her gambling research. Numerous provinces and states have commissioned Volberg to estimate the prevalence of disordered gambling in their geographic region. The work of Volberg and Lesieur account for 17.2% and 11.9%, respectively, of all the prevalence studies identified in this meta-analysis.

Several observers of the disordered gambling prevalence field have written about the evolution of prevalence instruments and methodological issues in disordered gambling research (Culleton, 1989; Dickerson, 1994; Laundergan, Schaefer, Eckhoff & Pirie, 1990; Laventhol & Horwath, Guida, David Cwi & Associates, & Public Opinion Laboratory, 1990; Lesieur, 1994; Lesieur & Rosenthal, 1991; Volberg, 1996b; Walker & Dickerson, 1996). For example, Culleton raises the question of the appropriateness of applying a screening test (e.g., the SOGS) to a population-based sample for the purpose of establishing a prevalence rate (Culleton, 1989). He criticizes this method on the basis of the low predictive value of a test that screens for a low base rate disorder within the general population. That is, he believes the SOGS fails to account for the increase in false positives when used within a population with low gambling pathology. Culleton recommends estimating prevalence using the Cumulative Clinical Signs Method (CCSM), a shortened version of the Inventory of Gambling Behaviour (Zimmerman, Meeland & Krug, 1985). Culleton considers the CCSM to be the best instrument for addressing the misclassification of false positives and for estimating a precise prevalence estimate. Despite this recommendation, only two studies in this meta-analysis used the CCSM, both of which were conducted by Culleton (Culleton & Lang, 1985; Transition Planning Associates, 1985). In spite of many other issues surrounding the screening instrument debate sparked by Culleton, his concern with estimating the prevalence of low base rate behaviors represents a very important issue for investigators. Culleton introduced the important matter of positive predictive value to the gambling literature. Most simply, screening instruments appear most capable of identifying the problem of interest given a positive score (i.e., have high positive predictive value) when measuring a phenomenon that is common among the sample population; the accuracy of any screening instrument diminishes when investigators apply it to a sample where the base rate of the disorder is low. Even when an instrument has excellent criterion validity, "…the actual predictive value of the instrument could be much more limited, depending on the prevalence of the disorder of interest" (Goldstein & Simpson, 1995, p. 236).

Dickerson has commented on the limitations of both the CCSM and the SOGS. He believes the CCSM is a poorly constructed test with little face validity (Dickerson, 1994). He argues that the reliability of the SOGS is not well established, and that respondents with identical scores could have entirely different characteristics. Dickerson also suggests that the use of the SOGS may result in an overestimation of prevalence of pathological gambling (Dickerson, 1994). Similarly, Volberg has suggested that the SOGS produces inflated estimates of the lifetime prevalence of pathological gambling (Volberg & Boles, 1995). Lesieur (1994) revisited the criticisms of the SOGS in his critique of epidemiological surveys. He states that most epidemiological surveys *underestimate* the extent of disordered gambling as a result of methodological flaws such as not including the homeless or hospitalized populations and not "catching" gamblers at home in a telephone survey. While Lesieur is correct on methodological grounds, investigators have still failed to recognize that scientists can identify over- or under-estimates of a prevalence screening instrument only when a "gold" standard also exists to identify the attribute of interest. The proper question, then, is not (1) whether the SOGS provides an overestimate or an underestimate, or (2) whether the methodological weak-

nesses of research protocols offset the unique measurement characteristics of a screening instrument. Neither would it be correct to conclude that the SOGS yields a higher estimate of disordered gambling until scientists could assure that comparison instruments do not *underestimate* the prevalence of disordered gambling. Rather, the question is with what independent standard can we compare the SOGS or any other estimate of prevalence? Only by evaluating a screening instrument against an independent and valid standard can we decide about the precision of its measurements. In the area of disordered gambling prevalence, there is no epidemiological "gold" standard. We will discuss this matter in more detail later in the *Discussion* section.

The history of the disordered gambling research field reflects the developmental process of shifting scientific attempts to measure a singular phenomenon. Although various instruments are available to assess the prevalence of disordered gambling, each instrument is best understood by viewing it through an evaluative lens which can focus on the context of its origin, driving motivation, relationship to funding, and its inherent strengths and weaknesses.

Current Status of the Disordered Gambling Prevalence Field: Methodological Considerations

A meta-analysis allows a quantitative review of the current state of the disordered gambling field. However, empirical evidence always derives from methodological considerations. In the following section, we will describe the current status of five central methodological issues associated with the development of prevalence estimates. These issues include coverage, populations, special populations, instrumentation, and the overall methodological quality of prevalence research.

Coverage

To properly estimate the prevalence of any psychiatric disorder among a population (e.g., residents of the United States or Canada), researchers must first determine how to represent the population to be studied. To date, there are two major clusters of population studies. The first of these investigations has focused attention on the general adult or general youth populations. The adult studies typically have employed telephone surveys. The youth studies rest primarily on in-school and telephone surveys. However, adults and adolescents who have telephones or who attend school provide only one perspective on gambling problems. Therefore, to better understand the prevalence of gambling disorders, we must study representatives of the entire population. This group includes many constituencies often ignored in general population surveys, for example, the full range of minority groups, the homeless, and those individuals who reside within institutions (e.g., residential substance abuse treatment programs, psychiatric hospitals, prisons). It is common for both the homeless and residents of substance abuse treatment programs to experience a disproportionate number of psychiatric and other disorders (e.g., Greene, Ennett, & Ringwalt, 1997) compared with the general population. If this phenomenon is evident with respect to gambling disorders, then limiting the assessment to general population studies will provide a conservative estimate of the entire population's gambling-related problems and social costs.

Populations

Prevalence estimates have been derived from many segments of society. These segments can be classified into eight general groups: (1) adult general population; (2) youth general population; (3) in-school youth; (4) college student population; (5) in-treatment adolescents; (6) in-treatment adults; (7) incarcerated adults; and (8) "special populations" (e.g., active bingo players, enlisted military personnel). Although researchers (e.g., Jacobs, 1989; Lesieur et al., 1991) historically have noted that the rate of disordered gambling among adolescents exceeds the rate of disordered gambling among adults, no study has conducted the necessary investigations to determine the magnitude of this difference. Similarly, we also would expect patients

with substance abuse or other psychiatric disorders, as well as prison inmates, to reflect higher rates of disordered gambling than the general population. In this study, we will compare these various rates to determine whether there is a meaningful difference among the levels of gambling disorder found among adults, adolescents, patients, and inmates.

Special Populations

"Special populations" refers to an assorted category of prevalence studies that include samples having at least one notable or unique characteristic that distinguishes the group from the general population. These distinguishing attributes influence the likelihood of the sample to have a rate of disordered gambling that is higher than the general population. Twenty three (17.2%) of the prevalence studies identified in this meta-analysis represent special populations. These studies include samples of military personnel, video lottery terminal players, Native Canadians and Native Americans, children of disordered gamblers, and a range of other study samples. In addition to these populations that have been studied, there are other special populations whose rates of disordered gambling either have not been studied or have been studied in a preliminary fashion (e.g., Castellani et al., 1996). Some of these special groups may evidence higher rates of disordered gambling than the general population. These population segments include senior citizens or the elderly, gay men and lesbians, and the homeless. To illustrate, a segment of senior citizens often have more time and disposable income on hand; consequently, they are often targeted for gambling excursions. Gay men and lesbians have been shown to have higher rates of substance abuse than the general population (Cabaj, 1992; Diamond & Wilsnack, 1978; Lohrenz, Connelly, Coyne & Sparks, 1978), due in part to the importance of gay bars and clubs within the gay community and culture, and perhaps even to the dysthymic consequences of experiencing homophobia and discrimination (e.g., Glaus, 1989). The homeless, while seemingly having less disposable income, also may have a special attraction to gambling because of the promise of a turn of good luck and seemingly few other opportunities to change their economic standing. The one study of disordered gambling among the homeless (Castellani et al., 1996) indicates that homeless individuals with gambling problems have significantly fewer coping skills than homeless individuals without gambling problems. We can hypothesize that there may be elevated rates of disordered gambling among the homeless, gay men and lesbians, and the elderly. Future research will be instrumental in testing these hypotheses.

During the early years of studying disordered gambling prevalence, scientists tended to be most interested in determining the scope and severity of disordered gambling among the general population, both adults and adolescents. As more estimates became available describing the general population, researchers turned to in-treatment groups and special populations to more closely investigate correlates of disordered gambling and factors characterizing specific subgroups of the population. In-treatment populations and special populations (e.g., regular VLT gamblers, Gamblers Anonymous members) tend to have higher rates of disordered gambling than the general population. The shifting of this pattern of research interests over time has resulted in a perception that rates of disordered gambling are increasing. That is, reported rates from more recent studies are often higher than earlier reported rates. Complicating matters, general population studies usually have larger sample sizes compared with smaller studies of special populations. It is therefore critical, when observing patterns over time, to take into account the specific populations being studied.

Instrumentation

A total of 25 different instruments were used in the collected pool of studies included in this meta-analysis. Of these studies, 55.1% used the SOGS or derivatives of the SOGS for their estimates, 11.1% used DSM criteria, 5.2% used the Diagnostic Interview Schedule (DIS), 1.7% used

the multi-factor method,[7] and 1.5% used the Massachusetts Gambling Screen (MAGS). Other instruments were used in 25.4% of the remaining studies included in this analysis. Some researchers have suggested that when using the South Oaks Gambling Screen (SOGS), "…estimates of the prevalence of problem and pathological gambling generated… are higher than the estimates generated by different instruments…" (Christiansen/Cummings Associates Inc. et al., 1992, p. 116). Consequently, Christiansen/Cummings Associates Inc. et al. (1992)—recognizing the relative nature of prevalence estimates—suggest that one cannot compare prevalence estimates of disordered gambling across the use of different instruments. In addition to producing descriptive data on the use of disordered gambling instruments to date, the use of meta-analytic methods permits an exploration of two related questions: (1) *can* different instruments' estimates be compared, and (2) if yes, what are the differences in the estimates between instruments?

Some research on instrument comparison has been conducted.[8] Within a study, researchers may elect to use two or more instruments for the purpose of comparing the instrument-based estimates. For example, when comparing the SOGS-RA, DSM-IV-J, and the Gamblers Anonymous (G.A.) 20 questions, Derevensky and Gupta (1997) found that the DSM-IV-J yielded the most conservative estimates of prevalence, even though the inter-correlations among all three instruments were moderately high (range .61 to .68). While reviewing the approaches used to estimate disordered gambling, Dickerson commented "there is no doubt that any prevalence work in this area stands or falls according to the accuracy of the available measurement instruments for detecting cases of pathological gamblers in the general population" (Dickerson, 1994, p. 3). An approach that considers instruments to hold various degrees of accuracy implies that there is a "true" prevalence that can be measured. Our approach is, as we stated earlier, that the choice of instrument is one of the important factors in the process of manufacturing prevalence estimates. The gambling research field does not yet have an accepted "gold standard," nor does it currently have a biological marker that might diagnose pathological gambling with high "accuracy." Until the field develops standardized tools, the ability of an instrument to successfully determine whether an individual is a pathological gambler remains dependent upon the method of validation, interviewing technique, sampling design, and other methodological factors.

Methodological Quality

Epidemiologists think of "quality" as that which "gives us an estimate of the likelihood that the results are a valid estimate of the truth" (Moher, Jadad, Nichol, Penman, Tugwell & Walsh, 1995, p. 62). The cluster of factors that contribute to the methodological soundness of a study may influence that study's prevalence estimate. A meta-analytic research strategy allows us to evaluate the quality of the research methods employed by each principal investigator and to compare the influence of these methodological attributes across the range of studies. This comparison allows us to determine whether more methodologically rigorous research designs yield significantly different estimates of disordered gambling (e.g., Miller et al., 1995). Intuitively, perhaps, investigators might think that more rigorous methods would produce higher prevalence rates than less demanding research protocols. For example, rigorous research designs could influence the sensitivity[9]

[7] The multi-factor method also is based on the SOGS, and represents a different method of calculating disordered gambling.

[8] See Table 14, which lists each study included in the meta-analysis that reported rates on more than one instrument.

[9] Sensitivity refers to the probability that a test result is positive among individuals with the characteristic of interest.

and specificity[10] of screening instruments for gambling disorders to yield either higher or lower prevalence estimates than designs with limited methodological rigor. In the case of lowered test sensitivity and increased specificity, for example, prevalence screening research would generate conservative estimates. A careful consideration of methodological quality may assist us in identifying the most appropriate research designs for future prevalence studies.

Measurement, Prevalence Estimation, and Social Setting

Readers should bear in mind that gambling problems exist on a continuum, ranging from very minor problems at one end to very severe problems at the other end. To facilitate the delivery of appropriate treatment, the estimation of prevalence, and the understanding of disordered gambling, clinicians and researchers have divided this continuum into distinct categories (e.g., non-problem, problem, pathological). However, these categories are simplifications of the existing continuum of gambling problems, and the determination of the division between one category and another is ultimately arbitrary. Thus, the threshold of, for example, level 3 gambling can shift from one study to another depending on the authors' respective conceptualizations of level 3 gambling and their purposes for estimating prevalence.

Researchers require a better understanding of the data needs in the field of disordered gambling research in general and youth gambling research in particular. As the previous paragraph suggests, differences among instruments in criteria and category thresholds may result in the generation of different prevalence rates when these instruments are used among the same sample. In other words, some instruments consistently provide more conservative estimates and other instruments consistently provide more liberal estimates. For example, in her study of Washington State adolescents, Volberg states that "Our approach, while conservative, is intended to focus as clearly as possible on those adolescents who show ***incontrovertible*** signs of problematic involvement in gambling" (Volberg, 1993a, p.17, emphasis added). Compared to more sensitive standards, Volberg's strategy will yield a lower estimate of level 3 gambling prevalence. Indeed, this conservative adolescent instrument yielded a level 3 estimate of 0.9% among this adolescent sample, while the "adult" scoring system yielded a level 3 estimate of 1.5% among this sample. As this example illustrates, no prevalence estimate exists independent of the criteria used to determine the disorder. Investigators' decisions about the nature of their instruments' criteria (e.g., where to establish the "cutoff points" for the different group categories) determine the prevalence estimates that their instruments will provide.

The process of redefining disorders is common. Both scholars and the public have recognized the need for shifting standards related to both biological and psychological disorders (e.g., Centers for Disease Control and Prevention, 1992; Flavin & Morse, 1991; Kleinman, 1987; Knox, 1997; Schuckit, Nathan, Helzer, Woody, & Crowley, 1991; Wakefield, 1992). For example, the Centers for Disease Control expanded the surveillance case definition for AIDS to include pulmonary tuberculosis, recurrent pneumonia, and invasive cervical cancer as potential indications of low CD4+ T-lymphocyte counts or percentages (Centers for Disease Control and Prevention, 1992). The case of diabetes is similar. Instead of defining diabetes as a condition marked by 140 milligrams of glucose per deciliter of blood, a shifting standard marked the disorder as a condition evidenced by a blood sugar threshold of 126 milligrams of glucose per deciliter of blood (Knox, 1997). The shifting definitions of both AIDS and diabetes served to increase the numbers of people clinicians diagnose and treat, compared with the numbers who would have been cared for under the old criteria.

[10] Specificity refers to the probability that a test result is negative among individuals without the characteristic of interest.

The decision to employ a more or less sensitive measure should take into account the purposes for which the prevalence estimate was developed. For example, although a less sensitive measure would reduce the number of adolescents who might be stigmatized by a "pathological gambler" label, it also would reduce the opportunity for early identification of gambling problems and primary prevention and treatment efforts. Conversely, a more sensitive measure of gambling problems would increase the magnitude of the observed problems of adolescent gamblers but also would give advance warning of developing problems and create the opportunity for focused education, prevention and treatment programs.

Finally, every attempt to estimate the prevalence of a gambling disorder depends upon the interaction between (1) the measurement instruments and methods employed to construct a prevalence index and (2) the social context that influences the meaning and experience associated with average day-to-day patterns of human behavior (Zinberg & Shaffer, 1985). Therefore, estimates of gambling problems must consider the shifting social milieu that is affecting those who gamble, their associated experiences, and the impact of this process on prevalence estimates. We will revisit this theme later in the *Discussion* section of this report.

The Central Hypotheses

Although more than 150 disordered gambling prevalence studies have been conducted to date, there are a variety of central hypotheses that have not yet been explored empirically. This meta-analysis of prevalence estimates will address the following major hypotheses.

1. Prevalence estimates of different population segments (e.g., youth and adult, males and females) will yield meaningfully different estimates of disordered gambling.

2. The increased access and exposure to gambling opportunities of the past 23 years will be reflected in an increase in prevalence of gambling and the problems and disorders associated with this activity. In addition, over the past 23 years, the rates of gambling-associated problems will have increased or decreased at different rates depending upon the populations (e.g., in-treatment patients, prison inmates, youth) from which the prevalence estimates were derived.

3. The instruments used to generate prevalence estimates will influence the rate of observed gambling problems.

4. Different geographical regions will have different rates of disordered gambling.

5. Investigators will differ in the prevalence estimates they generate as a consequence of their characteristic research methods. In this hypothesis, we can view researchers as a proxy for study protocols, instrumentation, and an assortment of other study attributes.

6. Experience playing different types of gambling activities (e.g., sports betting or lottery playing) will influence disordered gambling prevalence rates differentially.

Methods

Identifying Primary Studies

We conducted a literature search to identify the maximum number of published and unpublished studies on the prevalence of disordered gambling. We began by examining every issue of the *Journal of Gambling Studies* (formerly the *Journal of Gambling Behavior*) up to and including the Spring 1997 issue. This was an important step in optimizing the number of studies available for analysis, since the *Journal of Gambling Studies* is not yet indexed in Medline, and was not indexed in PsychInfo until 1985. In addition, to identify studies that received limited

distribution, we searched the library of the Massachusetts Council on Compulsive Gambling for unpublished articles.

In May, 1996, we sent a letter to 10 prominent researchers in the field of disordered gambling. In this letter, we included a list of the studies we already had compiled and asked for assistance in identifying and locating studies that were not on our list. In October, 1996, we repeated the initial mailing and expanded the list of recipients to 60 individuals. On this occasion, we included 40 researchers, clinicians, and program administrators working in fields related to gambling. In addition, we sent this letter to 17 state Councils on Compulsive Gambling and 3 representatives of the gaming industry. We received 18 responses to these letters. In addition, we conducted searches of standard research databases, including Medline, PsychInfo, and the Harvard OnLine Library Information System (HOLLIS). The Medline database indexes 3,600 journals. In Medline, keyword searches consistently yielded more entries than text word searches, so we searched for the keyword "gambling." In Medline, the keyword "gambling" is categorized under "risk-taking" and "impulse control disorders." Combination searches of "gambling" and "prevalence" identified a total of 8 studies among the five Medline databases; therefore, we broadened our search to every "gambling" item identified by this strategy. Table 1 summarizes the yield of prevalence studies from this comprehensive search strategy.

Eligibility Criteria

To be eligible for inclusion in this study, a prevalence study had to meet the following seven criteria:

1. the study had to be a report written in English;
2. the study had to be conducted in either the United States or Canada;
3. the study had to specify what instrument or set of criteria was used to identify disordered gambling;
4. the study had to report the prevalence of disordered gambling among the sample it studied;
5. the study had to report the size of the sample it studied;
6. the study had to be conducted between January 1, 1974 and June 15, 1997;

Table 1: Literature Search Results

Database	Year of Database	Total # of "Gambling" items	Total # identified studies (overlapping)	Total # distinct studies	Total # eligible studies (ineligible removed)
HOLLIS	1975-1997	873	1	1	1
Journal of Gambling Studies (JGS)	Spring/Summer 1985 - Spring 1997		26	9	6
Medline					
♦ Medline	1966-1975	168	0		[0]
♦ Medline	1976-1980	41	0		[0]
♦ Medline	1981-1986	55	1		[1]
♦ Medline	1987-1992	112	9		[9]
♦ Medline	1993-June 1997	111	18		[15]
♦ Citation appears only in Medline	1975-1997		3	3	2
PsychInfo					
♦ Cited in PsychInfo only			6		[6]
♦ Cited in both PsychInfo & JGS			18		[10]
♦ Cited in both PsychInfo & Medline			25		[23]
♦ PsychInfo Total	1984-1997	851	49	49	39
Invisible College[11]			64	64	52
On File Prior to Study[12]			26	26	20
TOTAL				**152**	**120**[13]

7. the study had to be available to the authors for review by June 15, 1997.

Data Abstraction and Data Entry Procedures

The first step of the data abstraction and entry procedure was to identify the variables for which we wanted data. After reviewing a sample of representative disordered gambling prevalence studies and relevant meta-analyses in other fields, we identified 313 variables for which data would be collected from each study. Multiple-choice coding options were assigned to each variable for which a multiple-choice format was appropriate. We then arranged the set of core variables (i.e., those we thought should be reported in every study) on a six-page data collection coding

[11] Studies obtained through the "invisible college" (Rosenthal, 1994); studies in this category were brought to our attention by colleagues or were sent to Harvard Medical School Division on Addictions without being requested.

[12] Studies that we "had on file" were in our library before the present study.

[13] Bracketed numbers are not included in the total.

form. Additional variables that we expected only a small percentage of the studies to report were arranged on "attachment forms." When a study presented data for these additional variables, we included an appropriate add-on data collection form and attached it to the main form. We developed attachment forms for stratified prevalence estimates (gender, age, etc.), confidence intervals, and illicit gambling.

We then assigned four members of our research team to the job of "coding," or identifying the relevant information in the studies. This group of coders abstracted the information from each study by completing a six-page data collection form. The coders attended a comprehensive coder training. Each of the coders had expertise in the substantive areas covered by the coding system. We pilot tested the coding protocol and then revised it based on this experience. To avoid any coding biases potentially associated with our research team members, we randomly assigned each of the 152 studies to two of the four coders. Data abstraction and entry then proceeded according to the following eight steps:

1. Two randomly assigned coders abstracted information from each study.

2. For each study, the two coding forms were compared and any discrepancies were identified.

3. We grouped the data abstracted from each study into one of the following three categories: (1) discrepancies on major data components; (2) discrepancies on individual variables; and (3) no discrepancies between the two coders. Major data components included the number of prevalence estimates provided in a study and the types of attachment forms required completion.

4. For studies with discrepancies on major components, we held a "Component Discrepancy Resolution Session." During this session, each pair of coders met to discuss and resolve discrepancies related to major components. When a resolution required one coder to complete forms that the other coder already had completed, the coder would complete these forms independently, without referring to the forms already completed by the other coder. In cases where coders could not agree on a resolution, the study was sent to the arbiter (a senior member of the research team who was not involved in coding) to be resolved. Once the two coding forms for a study had equivalent components, the individual variables were compared.

5. Coding forms with discrepancies on individual variables were returned to coders with the discrepant items marked. The coders reread the corresponding studies and recoded these items without knowing how the other coder had responded previously.

6. Recoded studies were compared again. Discrepancies that remained were marked and sent to the arbiter for final resolution.

7. Once all discrepancies had been resolved, studies were entered into an SPSS database. Every prevalence estimate was double-entered by two different staff members to ensure accuracy.

8. We assessed our data entry reliability by randomly selecting 10% of the cases in our database and double-checking each data entry point. Of the 6,573 variables entered in these 21 randomly selected studies, 13 data points, or .002% of the variables entered for these studies, were identified as data entry errors. This percentage is well within the acceptable range of less than 1% errors for data entry (e.g., McAuliffe et al., 1995).

We assessed inter-rater reliability among the four coders and the discrepancy rate of the total number of coded judgments by taking a random selection of 15.3% of each of the six coder-pair combinations from the total number of cases in the data set. We defined a discrepancy as a dis-

agreement between the two coders that required resolution by the arbiter, as described in step 6 above. The discrepancy rates for the six coder-pair combinations ranged from 1.17% to 5.38% with a mean of 3.36%. The discrepancy rates for each of the four coders evaluated across their study samples were 2.34%, 2.45%, 3.91%, and 4.59%. Finally, the total discrepancy rate for all coders was 3.33%, yielding a study-wide rate for coder reliability of 96.67%.[14]

Quality Component Analysis: Methodological Quality Scores

Methodological quality scores provide an index of a study's design and procedure attributes. Meta-analysts often use quality scores to adjust for the wide range of methodological approaches chosen to estimate similar constructs. In the field of disordered gambling prevalence research, methodological rigor varies enormously among studies. To evaluate the methodological quality of studies that provide estimates of disordered gambling, we created a methodological quality score. We will briefly discuss our method of calculating the methodological quality score in this section and later in more detail in the *Results* section. Now, we will describe some of the central methodological characteristics of the extant set of gambling prevalence studies. For example, among the studies included in this meta-analysis, only 61.9% reported a response rate. Of these, the response rate ranged from 11.39% to 100%. The mean response rate for those that reported one was 71.89% (s.d. = 22.1). Although 71.89% may seem to fall within an acceptable range for response rates, this finding is misleading due to several considerations. For example, consecutive admissions to treatment within a specified time period were coded as having a response rate of 100% so long as each admission agreed to participate in the research. Furthermore, only 44.9% of the studies reporting a response rate used a denominator which represented the entire pool of respondents eligible to participate in the study.[15] A number of studies (11.1%) used a denominator that did not include all eligible respondents, and 44% of the studies did not specify whether the denominator used to calculate the response rate represented all of the eligible respondents. In addition, descriptions of age and gender of a study sample are essential because these are two factors that have been shown to influence rates of disordered gambling. Yet 9% of the studies did not report which age group (e.g., adolescents, adults) their study examined, and a more alarming 26.3% did not report the gender breakdown of their sample.

These and other methodological factors provide a rationale for considering the assignment of a weight to each included study corresponding to its methodological quality. This procedure assures that more methodologically sound studies exert more influence on synthesized estimates than studies having more methodological weaknesses. This weighting system is based on the assumption that studies with better methodology provide more precise estimates. However, this assumption is not inexorably accurate. For ex-

[14] To determine the percentage of absolute agreement among raters, the simplest and most easily interpreted measure of inter-rater concordance is the percentage of ratings about which coders agree (Bangert-Drowns, Wells-Parker, & Chevillard, 1997). However, Bangert-Drowns et al. also note that we would expect some of these agreements by chance. To avoid over estimating inter-rater reliability, the kappa statistic (Cohen, 1960) provides a measure of the ratio of agreements beyond those expected by chance to the total number of observations minus agreements expected by chance. However, ultimately, inter-rater reliability is not an issue in this study, since all but the data entry errors were resolved by arbitration. Therefore, we have not provided a kappa adjustment. We include inter-rater reliability estimates to demonstrate that the arbitration process had minimal impact on coding, and that coders were readily able to abstract data objectively.

[15] When possible, if a study reported a response rate using a denominator other than all eligible respondents, we calculated a new response rate with the given data.

ample, Blair et al. (1995) state that the use of quality scores "…is controversial and approaches to it vary widely. Consensus was not reached on use of quality scores…. it has been argued that quality scoring should be abandoned in favor of quality-component analysis…. Quality scores, if used at all, should be specific to study characteristics such as study design or methods of exposure assessment, rather than providing a single overall measure of quality" (Blair et al., 1995, p. 195). When quality scores are used to weight studies, this procedure "...imposes subjective criteria into what purports to be an objective procedure" (p.136). Alternatively, Hasselblad et al. (1995), Blair et al. (1995), and Olkin (1995) provide guidelines for developing and applying quality indices in meta-analytic studies and minimizing potential risks to objectivity. We have followed their suggestions and avoided subjective rating scales to measure quality by constructing a quality component index that evaluates whether studies include various attributes; this method does not use subjective rating scales for determining quality. We developed the methodological index for this study as follows: First, a focus group of researchers convened to identify the methodological elements associated with high methodological quality for prevalence estimation research. This procedure identified the following nine methodological factors as essential components to any assessment of the internal validity of prevalence research:

1. sample selection process (i.e., randomly selected sites and/or respondents);
2. response rate (including the appropriateness of the method used to calculate the response rate);
3. survey anonymity (not applicable for treatment or prison samples);
4. whether the study underwent a peer review process (e.g., for publication in a refereed journal);
5. whether the authors assessed the reliability of their data collection and entry procedures;
6. whether the authors varied the time of day survey data was collected (for household surveys);
7. the number of respondents in the study sample;
8. whether the authors took a multidimensional approach to measuring disordered gambling (e.g., multiple dependent measures); and finally,
9. whether the study was intended primarily as a prevalence study.

Rather than asking coders to apply their subjective judgment to assess the methodological quality of a study, we asked coders to abstract objective data on these nine factors. These factors were then combined into a single aggregate index. Since prevalence studies vary by setting and population, we calculated this methodological quality score differently for each study type. For example, factor 3 above (i.e., anonymity) was not used in the calculation of the quality score for treatment studies or prison studies, because conducting an anonymous survey would be difficult given the nature of these settings. In addition, factor 6 above (i.e., varying the time of day for collecting data) applied only to household telephone surveys. Since we used different methodological elements in the calculation of the composite index for different study types, we also standardized each composite index by calculating it as a percentage of the maximum total possible. The standardized composite quality variable derived from this procedure is continuous and distributed normally. We will examine the impact of quality scores on prevalence estimates of disordered gambling. In addition, we will employ multiple statistical procedures for analyzing the moderator variables that influence prevalence rates.

In spite of our best efforts, we remain aware that there are many remaining threats to the integrity of quality scores. For example, Moher et al. (1995) warn that, "It is important to distinguish between assessing the quality of a trial and the quality of its report. We define the quality of a trial, our primary interest, as 'the confidence

Table 2: Level System for Meta-analysis

Level	*Description of Level*
3	Represents the most severe level of disordered gambling
2	Represents gamblers with sub-clinical levels of gambling problems
1	Represents the proportion of the population that does not experience gambling problems

that the trial design, conduct, and analysis has minimized or avoided biases in its treatment comparisons.' This definition focuses on methodological quality. The quality of a trial report can be defined as 'providing information about the design, conduct, and analysis of the trial.' A trial designed with several biases that is well reported can receive a high-quality score. Conversely, a well-designed and well-conducted trial that is poorly reported would receive a low-quality score" (p. 63). Although ideally the object of quality evaluation would be the trial (i.e., the study itself) meta-analysts can evaluate only what is included in the report. Therefore, a report that fails to reflect rigorous methodology will yield a relatively low quality score in this meta-analysis, even if investigators actually were meticulous about their design and protocols. This problem is somewhat existential: If scientists employ precise methods and fail to report them accurately, will anyone know of their rigor?

Nomenclature & Classification: Levels of Disordered Gambling Severity

Applying the Level System to Meta-analysis

As Shaffer & Hall (1996) noted, disordered gambling prevalence studies have used a wide array of criteria and labels to define and name the levels of disordered gambling severity. However, while the classification methods and labels are not identical, the majority of these designs are conceptually parallel. For example, what might be called "pathological" gambling in one study might be called "compulsive" gambling or "probable pathological" gambling in another study or even "problem" gambling (e.g., in the Multifactor Method and the SOGS-RA). Similarly, a group called "problem" gamblers in one study might be conceptually equivalent to the group labeled "at-risk," "in-transition," or "potential pathological" gamblers in another study. Thus, for the purposes of comparing conceptually equivalent groups derived from different studies, we have translated these categories into three generic levels of disordered gambling.

The first of these three levels, **level 1**, represents the proportion of the population that does not experience gambling problems. This group includes both "non-problem" gamblers and non-gamblers. The second level, **level 2**, represents gamblers with sub-clinical levels of gambling problems (e.g., "problem," "at-risk," "in-transition," "potential pathological"). The third level, **level 3**, represents the most severe category of disordered gambling (e.g., "pathological" gambling). Table 2 summarizes this conceptual level system. In many studies, level 3 gamblers are those who meet established diagnostic criteria for pathological gambling (e.g., the DSM-IV criteria). In other studies, the established diagnostic criteria have been modified, but the group remains conceptually equivalent.

As stated previously, there was wide variation in how the original authors classified respondents into these groups. In each case, we used the original authors' definitions of the levels described above. For example, some studies among adults defined level 2 as a score of 3 or 4 on the SOGS, while other adult studies defined this level as a score of 1 to 4 on the SOGS. We coded this data as it was reported, since we wanted to respect the research methods used by

each original author and represent these methods in our synthesis of the extant research. However, we found that studies that did not provide an estimate of level 2 gambling had substantially higher rates of level 1 gambling than studies that did provide level 2 estimates. In other words, if a study did not classify respondents into a level 2 group, those respondents who would have been classified in this group in another classification system were included in the study's level 1 group. Thus, to standardize the definition of level 1 for the purposes of this study, we analyzed only estimates of level 1 gambling that were derived from studies that also reported estimates of level 2 gambling.

Level 2: In-transition Implies Bi-directionality

Level 2 gambling includes categories such as "in-transition," "at-risk," and the SOGS "problem" gambling. Although several of the diagnostic systems reviewed in this paper, such as the DSM, Pathological Gambling Signs Index, and the Gamblers Anonymous 20 Questions do not have a level 2 category, most of the classification schemes currently in use do employ this category.

The matter of whether level 2 gamblers are "in transition" or "at risk" represents a very important conceptual concern and practical problem that has not yet been addressed adequately by empirical research. Most classification systems reviewed in this paper organize the signs and symptoms of gambling pathology into sub-clinical (i.e., symptoms do not meet diagnostic code) and clinical categories. However, considering that gambling pathology likely resides on a continuous rather than dichotomous dimension, and its intensity for any individual may change over time, sub-clinical signs and symptoms may be pre-clinical (i.e., have not yet reached clinical state) or post-clinical (i.e., are receding from a clinical state). With the exception of the notion of in-transition gamblers in the MAGS (Shaffer et al., 1994), none of the extant classification schemes has conceptually recognized the potential presence of level 2 gamblers who are moving *away* from pathology. Most addiction models in general and gambling classification strategies in particular imply that sub-clinical gamblers are simply moving in one direction, toward a more pathological state. However, since past-year estimates of adolescent gambling pathology consistently exceed past-year estimates of adult gambling pathology, it also is possible that some young people are actively moving away from a state of pathological gambling (for relevant discussions of stage change and addictive behavior, interested readers should see Prochaska, DiClemente and Norcross, 1992, and Shaffer, 1992, 1997a).

Estimation Methods

Weighting

Weighting is a specific strategy that takes into account the inevitable reality of heterogeneity among study samples. That is, there are differences among studies with respect to sample size, sample population characteristics, and other factors that can influence the accuracy of a prevalence estimate. To illustrate how sampling can influence estimation accuracy, consider a practical application of the central limit theorem. A prevalence study of 1,000 adults—sampled from a population of 10,000 people—will produce a more precise and representative estimate of disordered gambling prevalence than a study of 100 adults drawn from the same population of 10,000. Stated differently, a smaller sample will tend to be more biased than a larger sample. When sampling bias is predictable, it is justifiable to assign appropriate weights (i.e., values) to study attributes to compensate for the inherent bias (Cooper & Hedges, 1994).

We weighted the cases in our database to control for the following two factors: (1) multiple prevalence estimates derived from the use of multiple instruments within a single study population (e.g., using the SOGS and the DSM-IV as two estimates of prevalence for a single adult sample); and (2) single studies published in multiple formats (e.g., the same study published as a

book chapter and a journal article). For the first factor above, we created a weighting variable called *Weight1*. For this weighting variable, each prevalence estimate received a value equal to 1/(the number of instruments used to derive prevalence estimates in the study). For example, if a study used three different instruments and provided three different prevalence rates for a single study sample, each of these estimates would receive a weight of .33. For the second factor above, we created a second weighting variable called *Weight2*. To determine a case's weight on this variable, we identified and compared identical studies published in multiple formats. For studies that were published on multiple occasions, we assigned a weight of 1 to the publication that reported the most data; other versions of the same study received weights of 0. Finally, the two weighting variables were multiplied; the product, a new weighting variable called *Weight3*, was used in all analyses unless otherwise specified.

Prevalence Estimates: A Multi-Method Approach

One of the primary objectives of this research was to establish more precise estimates of the prevalence of disordered gambling among the general population of adults and youth in the United States and Canada than currently are available. Although estimating the central tendency of a distribution of estimates (e.g., providing a meta-prevalence estimate for a population) appears straightforward, there are a variety of complex issues associated with this process. Since the various estimates more distant from the mean of the set of estimates can be weighted more or less, depending upon the statistical strategy, we have opted for a multi-method strategy (Campbell & Fiske, 1959). This strategy employs a variety of statistical techniques for estimating the central tendency of the distribution of prevalence estimates. One of these techniques is the use of M-estimators, or robust maximum-likelihood estimators (e.g., Barnett & Lewis, 1994; Norusis, 1993; Winer, 1971). M-estimators of central tendency differ in the weights they apply to the cases, or in this instance the obtained prevalence estimates. Extreme values receive less weight than values closer to the center of the distribution. When the data is from a symmetric distribution with long tails, or when the data set includes extreme values, M-estimators provide better estimates of the location than do the traditional mean or median. The four estimators included in this analysis are Huber's M-estimator,[16] Andrew's wave estimator,[17] Hampel's redescending M-estimator,[18] and Tukey's biweight estimator.[19] In addition to the use of M-estimators, we have included the unweighted mean, and other weighted indicators (i.e., 5% trimmed mean,[20]

[16] An M-estimator of location. Cases with standardized values less than *c* receive a weight of 1 (*c* is a mathematically determined standardized score value that serves as a "cutoff" point and has a different value for each of the four M-estimators described here). Cases with absolute values larger than *c* have weights that decrease as their distance from zero increases.

[17] A type of redescending M-estimator that does not have abrupt changes in the weights assigned to cases. Instead, a smooth sine curve is used to determine case weights. Standardized values in absolute value greater than *c* are assigned a weight of 0.

[18] A three-part redescending M-estimator that is characterized by three constants (*a, b, c*). Standardized observed values with an absolute value greater than *c* are assigned a weight of zero. Values between 0 and *a* are assigned a weight of 1, while values between *a* and *b* and between *b* and *c* are assigned weights that depend on their distance from zero.

[19] Tukey's biweight estimator assigns weights of zero for observations with standardized values greater than 4.685 and weights inversely proportional to the distance from the center for all other observations.

[20] The arithmetic mean calculated when the largest 5% and the smallest 5% of the cases have been eliminated. Eliminating extreme cases from the computation of the mean results in a better estimate of central tendency, especially when data are not distributed normally.

Winsorized estimates,[21] and medians which represent values that are 50% trimmed), and estimates weighted by quality score for comparison. Appendix 1 provides the variety of data points associated with various statistical strategies for combining measures of central tendency. Finally, although the collinearity of prevalence estimates with other factors discourages the development of a meta-point estimate, it is possible to compute such an estimate. With this caution in mind, for those interested, we have included the mean of these strategies as a "meta" point estimate.

In addition to the measures of central tendency described above, we calculated the 95% confidence interval around each central estimate, based on the distribution of prevalence estimates.

Taken together, these multi-method strategies yielded calculations of an assortment of values for gambling levels 1, 2, and 3, in both lifetime and past-year time frames. These calculation procedure for these values is summarized according to the following six steps:

1. the unweighted median;
2. the mean and the 95% confidence interval around the mean;
3. four different M-estimators (or maximum-likelihood estimators);
4. the mean with the 5% most extreme cases removed;
5. steps 1-2 above repeated with a Winsorized distribution;
6. steps 1-4 above repeated with each case weighted by its methodological quality score value.

A Note on Time Frames

The majority of studies included in this meta-analysis (62.7%) indicated what time frame their prevalence rates represented (e.g., lifetime, past-year); however, over one third of the studies (37.3%) failed to indicate the time frame for their prevalence rates. Prevalence rates from these studies were re-coded to represent a lifetime time frame. In addition, studies that indicated that their prevalence rates represented a "current" time frame but did not provide more specific information on the details of this time frame were re-coded to represent a past-year time frame. Finally, three studies provided prevalence rates in a six-month time frame; these rates were re-coded as past-year rates to allow their inclusion in the categories established in this study. As a result of these modifications, the prevalence rates reported in this study may reflect conservative estimates.[22]

Results

Study Demographics

The search strategy described earlier identified 152 primary studies that were available to test against our inclusion criteria. Of the 152 primary studies identified, 32 failed to satisfy the inclusion criteria specified previously in the *Methods* section, and were deemed ineligible for analysis. The remaining 120 studies satisfied the inclusion criteria and were accepted into this study. Fifty-seven different primary authors conducted these 120 studies and provided prevalence estimates of disordered gambling from 134 distinct study population samples. Of these 134 samples, 73.9% were derived from studies conducted in

[21] Winsorization is a technique in which a specified number of extreme values (in this study, two) are removed from each end of the distribution; the next most extreme value on either end is then replicated a number of times equal to the number of extreme cases that have been removed (Winer, 1971).

[22] Six-month rates are more conservative than past-year rates, just as past-year rates are typically more conservative than lifetime rates. There simply is less statistical opportunity for people to develop a disorder within a six-month time frame compared with a past-year time frame.

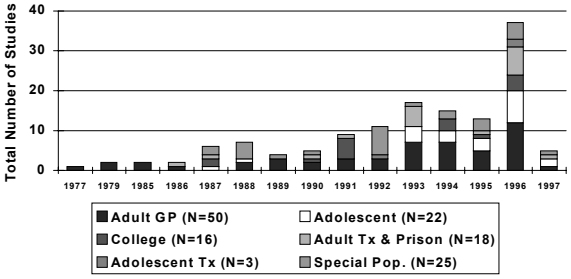


Figure 2: History of Prevalence Estimates

the United States (N= 99) and 26.1% were derived from studies conducted in Canada (N= 35). A comparison of the prevalence estimates available from the United States and Canada revealed no significant differences between these countries for any of the population segments. Consequently, the remainder of these analyses describe pooled data.

The 134 study samples represent the following eight major segments of the population: (1) adult general population (Adult, GP) (N = 50); (2) youth general population (Youth, GP) (i.e., telephone surveys; N = 9); (3) in-school youth (N = 13); (4) college students (N = 16); (5) adolescents in treatment programs (N = 3); (6) adults in treatment programs (N = 16); (7) incarcerated adults (N = 2); and (8) "special populations" (e.g., Native Americans on reservations, lottery players in Connecticut; N = 25). Figure 1 illustrates the percentage of studies associated with each population type.

Figure 2 provides an illustration of the history of prevalence estimation studies. Beginning with Kallick and her colleagues, who conducted the national study in 1975 (and published the report in 1979), attempts to estimate the prevalence of disordered gambling have rested primarily on studies of adults from the general population. During 1986, the first non-general-population study was published (i.e., Lesieur, Blume, & Zoppa, 1986). During the 1990s, like gambling opportunities, estimates of disordered gambling became widely available. Indeed, half of all disordered gambling prevalence studies conducted in the United States and Canada to date have been released since 1992.

The variety of prevalence studies available have been conducted by an equally diverse group of principal investigators. Figure 3 illustrates these investigators and their relative contributions to the gambling prevalence literature. As this figure indicates, Volberg and Lesieur are the two largest individual contributors to the disordered gambling prevalence literature, with 17% and 12% of the studies, respectively. Furthermore,

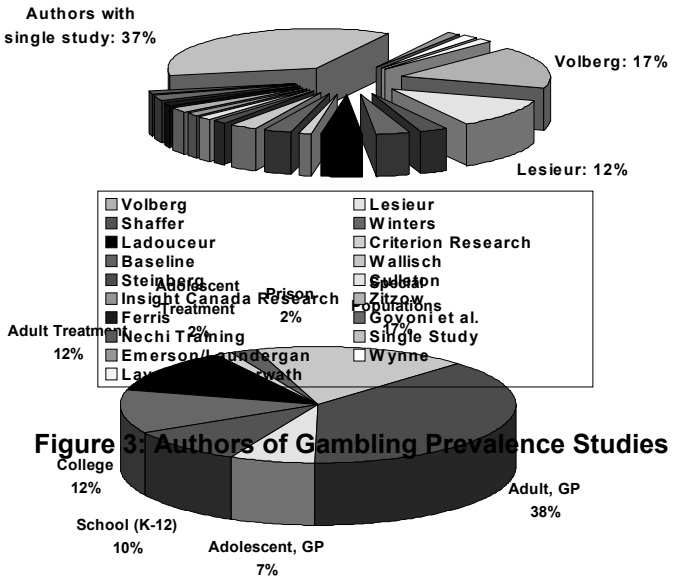


Figure 3: Authors of Gambling Prevalence Studies

Figure 1: Percentage of Study Population Types

Volberg has conducted 36% of the adult general population prevalence study samples and served as consultant to an additional 4 adult general population study samples. Consequently, Volberg has influenced a total of 44% of the adult general population prevalence study samples. Lesieur has conducted 28% of the treatment (psychiatric treatment or prison) study samples and 38% of the college student population study

Table 3: Meta-analysis Population Segment Samples

Population Segments	Number of Study Samples	Total Number of Respondents	Proportion of Total Respondents
Adult general population	50	79,037	65%
Adolescents	22	27,741	23%
College Students	16	8,918	7%
Adults in treatment	18	6,590	5%
Totals	106	122,286	100%

samples. Five separate research teams (i.e., Ladouceur, Shaffer, Volberg, Wallisch, and Winters) each contribute 9% of the adolescent prevalence study samples. In addition, there are 17 other primary authors or research teams that have contributed two or more prevalence studies to the field. Authors who have conducted only one disordered gambling prevalence study account for 38% of the studies in the field. As Figure 3 shows, many different scientists have estimated the prevalence of disordered gambling.

Preliminary examination and analysis of the population groups allowed us to modify the eight groups discussed above for further analyses. For example, youth studies employed two different primary data collection methods (i.e., school-based versus home-based). These investigations provided the opportunity to compare prevalence rates obtained from these methodologies. Comparisons of prevalence estimates derived from general population youth studies with those derived from in-school youth studies revealed no significant differences between these two groups (lifetime level 3: $\chi^2 = 1.422$, df = 1, $p > .20$; lifetime level 2: $\chi^2 = .135$, df = 1, $p > .50$; past-year level 3: $\chi^2 = .031$, df = 1, $p > .80$; past-year level 2: $\chi^2 = 1.741$, df = 1, $p > .10$); therefore, we combined these groups for analysis into a general youth group. Similarly, adults in treatment programs and adults in prison were combined after analyses revealed no significant differences between these two groups (lifetime level 3: $\chi^2 = .000$, df = 1, $p > .95$; lifetime level 2: $\chi^2 = .046$, df = 1, $p > .80$). Thus, for the remainder of the report, the "treatment" group will refer to adults in treatment for substance abuse or psychiatric disorders as well as adults in prison. For the purposes of this report, we conceptualize psychiatric and substance abuse treatment as well as incarceration as social responses to deviant behavior.

Using the "special populations" category as a "study type" introduced considerable and misleading variation into the data analysis. This group of studies had no unifying characteristic and was more heterogeneous than any of the other population groups studied; therefore, to avoid analytic bias and misleading data from which to draw integrative conclusions, we did not enter this class of studies into the analyses. Finally, the "youth in treatment" group was not used in the following analyses because we were not confident that the small number of studies in this category (N = 3) represented this population adequately. Thus, the analyses that follow classified the population groups as follows: (1) **adult general population** (N = 50); (2) **adolescents** (N = 22); (3) **college students** (N = 16); and (4) **adults in treatment** (N = 18). These four categories include 94 studies that provide prevalence estimates among 106 distinct study samples. These 106 study samples represent an aggregate of 122,286 respondents. The adult general population studies represent a total of 79,037 respondents, the youth studies represent 27,741 respondents, the college studies repre-

sent 8,918 students, and the adult treatment studies represent 6,590 respondents. Table 3 summarizes the study samples and respondents included in this meta-analysis. The mean number of respondents per study sample across these four population segments was 1,154 (standard deviation = 1,248); the median number was 880; the smallest sample size was 85 respondents and the largest was 7,214.[23]

The File Drawer Problem: Publication Status, Significant Findings, & Prevalence Rates

Rosenthal and Rosnow (1991) remind us that researchers have long suspected that published studies represent a biased sample of the research that investigators conduct. The "file drawer problem" occurs when published studies represent type I errors (finding significant results when there are in fact none), "…while the file drawers back at the lab are filled with the 95 percent of the studies that show non-significant (e.g., $p > .05$) results" (Rosenthal & Rosnow, 1991, p. 509). While prevalence studies do not engage in "significance testing" in the primary analyses, it is important to consider whether published studies that examine the prevalence of gambling disorders differ from the body of unpublished research. In the field of gambling studies, most prevalence studies remain unpublished. Of the 106 cases included in this meta-analysis, only 40.1% were peer-reviewed. Over half of the studies (51.4%) were reports disseminated by the author or through the funding organization (e.g., Insight Canada Research, 1994; Volberg, 1996a, 1996b; Wallisch, 1996); these reports must be considered unpublished studies, since they are not widely available to the public (i.e., through libraries and other public channels). These organization reports represent a significant portion of the disordered gambling prevalence literature. A t-test analysis revealed that the methodological quality scores of peer-reviewed studies were not significantly different from those of non-peer-reviewed studies ($t = .178$, $df = 104$, $p = .859$).[24] In addition, the prevalence rates of peer-reviewed and non-peer reviewed studies were not significantly different (lifetime level 3: $t = -.674$, $df = 80$, $p = .502$; lifetime level 2: $t = -.073$, $df = 63$, $p = .942$; past-year level 3: $t = .488$, $df = 41$, $p = .628$; past-year level 2: $t = .240$, $df = 37$, $p = .812$).[25] As a result of these tests, we combined the prevalence estimates provided by these two groups of studies for all of the remaining analyses in this report.

Methodological Quality Among Prevalence Studies

The set of disordered gambling prevalence studies identified for inclusion in this investigation provides a reflection of the methodological quality of research in this field. The descriptive data that follows illustrates the prevalence of each of the nine methodological quality criteria that protect the internal validity of scientific research:

- *Random Selection*: **Site selection.** Half of the studies included in this meta-analysis (50.7%) used a random selection process to sample data collection sites. The second most prevalent strategy was an opportunistic sample of sites (36.1%); one study (0.9%) selected all of the eligible sites; and 3 stud-

[23] These descriptive statistics reveal data that is highly skewed. Readers will note that most of the analyses to follow employ non-parametric statistics which do not assume that the data are distributed normally. In addition, non-parametric statistics are less sensitive than parametric instruments. Typically, decreased statistical sensitivity encourages investigators to be conservative in their inferences and conclusions.

[24] For this analysis, the variable indicating whether a study was peer reviewed or not was removed from the calculation of the methodological quality score, and quality scores were standardized within study type.

[25] For this analysis, prevalence rates were standardized within study type.

ies (2.8%) used another sampling strategy. Ten studies (9.4%) failed to report any sampling strategy for their site selection process. **Respondent selection.** Slightly more than half of the studies included in this meta-analysis (54%) randomly selected study respondents. Ten percent (10.4%) selected all of the eligible respondents; 6.6% selected respondents opportunistically; 9 studies (8%) used another respondent selection strategy, and 22 (21%) studies failed to report any strategy to select respondents.

- *Response Rate:* The studies included in this analysis reported response rates that ranged from 25% to 100% with a mean of 72.1% (s.d. 19.8%). Thirty six (34%) of the studies failed to report a response rate. Of the studies that reported response rates, only 44.6% reported properly calculated rates (i.e., rates calculated using the entire pool of eligible respondents as the denominator); 13.1% reported improperly calculated response rates (i.e., rates calculated using less than the entire pool of eligible respondents as the denominator), and 42.1% did not specify the method used to calculate the response rate.

- *Peer Review:* Forty percent (40.1%) of the studies included in this meta-analysis were subjected to and satisfied a formal peer review process. That is, of the study samples included in this meta-analysis, those that were peer-reviewed also were published. In meta-analyses of controlled trials or other studies that produce measures of effect, publication bias can result because studies with statistically significant findings are more likely to be published (i.e., peer-reviewed) than studies that did not report statistically significant findings (Cooper & Hedges, 1994). In the field of gambling prevalence research, factors other than significant findings also are responsible for determining whether a study is peer-reviewed (i.e., published) or not. For example, state and provincial governments that contract scientists to conduct prevalence studies expect a written report; these groups, however, do not expect a published article in a peer-reviewed academic journal. The setting within which a researcher works (e.g., academic, private) influences whether publications are encouraged, for example, because of promotion and advancement criteria. Therefore, the institutional setting of prevalence workers may influence the format and publication status of completed prevalence studies. For example, of the 20 studies included in this meta-analysis that were conducted by Volberg, who works in a private setting, 75% were not peer-reviewed. Nevertheless, readers should recall from the discussion above that peer reviewed studies did not report prevalence rates of disordered gambling that were meaningfully different from studies that were not peer reviewed.

- *Data Reliability:* **Data collection.** Twelve studies (11.1%) reported having assessed the reliability of their collected data. **Data entry.** Seven studies (6.6%) reported having assessed the reliability of their data entry procedure (e.g., by randomly checking data-entry accuracy).

- *Sample size:* The number of respondents in the studies included in this meta-analysis ranged from 85 to 7,214, with a mean of 1,154 (s.d. 1,248).

- *Multi-instrument methodology:* The majority of the studies (82.8%) used a single instrument to assess the prevalence of disordered gambling. Thirteen studies (11.8%) used two instruments, and six studies (5.4%) used three instruments.

- *Intention:* The majority of studies included in this meta-analysis (80.2%) were conducted with the primary intention of estimating prevalence rates of disordered gambling.

- *Anonymity:* Among all studies included in this meta-analysis with the exception of those that sampled treatment populations, 41.5% reported having administered the surveys to respondents with an assurance of

anonymity. Three percent (3.4%) did not conduct an anonymous survey, and 55.1% did not report whether the survey was anonymous or not.

- *Varied times:* Among the studies that used a telephone survey methodology, 17.9% varied the time of day at which the respondents were called, and 1.9% reported no variation of time. Eighty percent (80.2%) did not report whether the times were varied or not.

Analyzing the Methodological Quality Score

A one-way ANOVA revealed that there were significant methodological quality score differences among the four study population types ($F = 7.001$, $df = 3, 102$, $p<.001$).[26] Post-hoc Scheffé tests revealed the following differences among groups: adult studies (M[27] = 57.7) had significantly higher quality scores than treatment populations studies ($M = 49.2$, $p<.05$); adolescent studies ($M = 61.2$) had significantly higher quality scores than college studies ($M = 50.8$, $p<.05$); adolescent studies ($M = 61.2$) had significantly higher quality scores than treatment population studies ($M = 49.2$, $p<.05$).

Additional analyses indicated that it was appropriate to aggregate studies of all levels of methodological quality for all subsequent analyses of prevalence rates. To determine if quality scores influenced prevalence rates, we first standardized[28] quality scores and prevalence rates within study type and conducted bivariate correlations between these variables using data from all four study types. This analysis revealed no significant relationships between quality score and prevalence rates (lifetime level 3 & quality scores: $r = -.023$, $p = .835$; lifetime level 2 & quality scores: $r = -.092$, $p = .466$; past-year level 3 and quality scores: $r = -.031$, $p = .843$; past-year level 2 and quality scores: $r = -.012$, $p = .941$). Next, we conducted similar correlations within each study type individually, using unstandardized scores; these analyses also revealed no significant relationships between quality score and prevalence rates (range of r for 12 analyses = -.336 to .600; range of p for 12 analyses = .170 to .906; average p for 12 analyses = .595). We conducted an extreme groups analysis to confirm these findings by comparing the prevalence rates of the studies representing the top 20% of the distribution of quality scores with the studies representing the bottom 20% of the quality scores; this analysis revealed no sig-

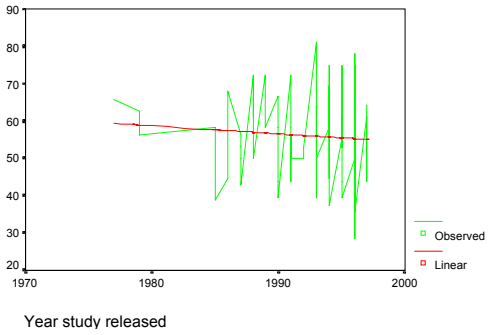


Figure 4: Trend of Quality Scores Over Time

[26] Readers should note that collinear data sets inflate correlation coefficients. In addition, collinearity inflates F tests. Consequently, the p value reported here might be an overestimate.

[27] In this report, "M" represents the mean value.

[28] We standardized prevalence rates and quality scores within study type by converting these distributions to z-score distributions. A z-score distribution represents a distribution of values that has a mean of zero and a standard deviation of one. By transforming the prevalence rates within regions to z-scores, each prevalence rate was standardized with reference to all other prevalence rates within the same study type. Similarly, each quality score was standardized with reference to all other quality scores within the same study type. This transformation has the effect of removing the influence of study type on prevalence rates and quality scores; thus, this transformation allows us to enter prevalence rates and quality scores from all study types into analyses together.

nificant differences between these groups (lifetime level 3: t = -.117, df = 31, p = .908; lifetime level 2: t = .231, df = 20, p = .819; past-year level 3: t = .188, df = 13, p = .854; past-year level 2: t = .041, df = 9, p = .968).

Finally, linear curve estimation regression analyses did not identify any trend in the quality scores of prevalence studies during the past twenty years (i.e., from the first study in 1977 to 1997). Figure 4 illustrates the relatively flat pattern of quality scores over time across all study types. Figure 5 illustrates this pattern by depicting the trend of quality scores over time for all studies and for adult general population studies.

Organizing the Results by the Central Hypotheses

The six central hypotheses presented earlier provide a ready organizational strategy for presenting the major results focusing on prevalence estimates. These hypotheses suggested that:

1. prevalence estimates of different population segments (e.g., youth, adult) will yield meaningfully different estimates of the prevalence of disordered gambling;

2. increased access to gambling opportunities of the past 15 years and exposure to the shifting social setting that exposes more people to gambling opportunities will be reflected in an increase in gambling problems; over the past 23 years, the rates of gambling-related problems will have increased at different rates depending upon the populations from which the prevalence estimates were derived;

3. instruments used to generate prevalence estimates will influence the rate of observed gambling problems;

4. different geographical regions will have different rates of disordered gambling

5. researchers will differ in the prevalence estimates they generate as a consequence of their characteristic research methods; and

6. experience playing different types of gambling activities (e.g., sports betting or lottery playing) will influence prevalence rates differentially.

In addition, these results will include information about the various strategies applied to weight the data, including the methodological quality scores. Before presenting the results that bear on each of these central hypotheses, we will discuss important additional features of the overall data set.

Initial Observations on Collinearity of Primary Variables

The estimates of the prevalence of disordered gambling derived from the 106 study samples reveal a significant and unexpected empirical attribute: the population type, sample size, and prevalence rates are intercorrelated, or collinear. Cohen & Cohen (1975) define collinearity (also called multicollinearity) as "the existence of substantial correlation among a set of IVs [independent variables]" (p.115). For example, in this data set, studies of the general adult population have the largest samples, with youth, college, and treatment following in descending order. As the fol-

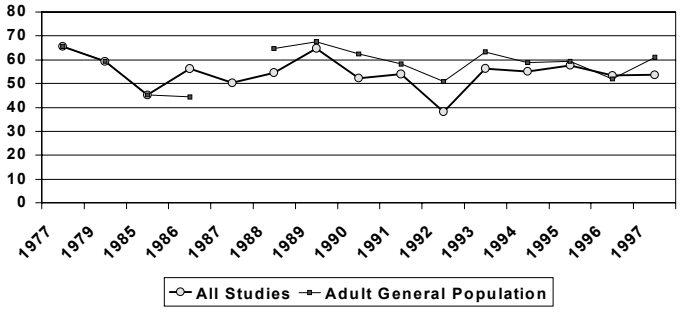


Figure 5: History of Methodological Quality Scores

Table 4: Bivariate Correlations Among Primary Collinear Variables

	Sample Size	Lifetime Level 3	Lifetime Level 2	Past-Year Level 3	Past-Year Level 2	Quality Score
Study Type	r = -.394, p<.001	r = .744, p<.001	r = .598, p<.001	r = .593, p<.001	r = .482, p<.01	r = -.325, p<.01
Sample Size	---	r = -.328, p<.01	r = -.263, p<.05	--[31]	--[31]	r = .196, p<.05

lowing results will reveal, this order also reflects an increasing estimate of disordered gambling prevalence. In addition, methodological quality score has a significant relationship with study type. Table 4 summarizes these relationships by depicting the bivariate correlations among these variables.[29] For the purposes of this illustration, study type will be represented as a single variable with the following values: 1 = adult; 2 = adolescent; 3 = college; 4 = treatment.[30]

Collinearity of Individual Variables

Further examination of study type and individual variables representing specific study authors (i.e., principal investigators), regions of the United States and Canada, and survey instruments revealed substantial collinearity among these variables as well. For example, studies that used the SOGS generally defined level 2 gambling as either (1) a score of 3 to 4 on the SOGS (a relatively conservative definition) or (2) a score of 1 to 4 on the SOGS (a more liberal definition). Analyses revealed that adult studies were significantly associated with the use of the SOGS's more conservative definition of level 2 gambling (i.e., a score of 3 or 4), while adolescent studies had a negative association with this variable ($r = .280$, $p < .01$; $r = -.329$, $p < .01$, respectively). In other words, adult studies were more likely to use a conservative definition of level 2 gambling, resulting in lower estimates than a liberal definition would yield, while adolescent studies were more likely to use other, more liberal definitions. Later in the *Results* section, we will address whether the differences between adult and adolescent prevalence rates can be attributed primarily to this relationship between study types and instruments.

We observed numerous other correlations among specific authors, regions, instruments, and study types within the current data set. For illustrative purposes, the following list presents selected examples of some relationships responsible for the multi-collinearity of the current data set:

- the New England region was significantly associated with adolescent studies ($r = .207$, $p < .05$) and the use of the MAGS ($r = .409$, $p ,< .01$).
- the work of Lesieur (e.g., Lesieur & Klein, 1987) was significantly associated with the Mid-Atlantic region ($r = .523$, $p < .01$).
- the work of Shaffer (e.g., Shaffer & Hall, 1994) was significantly associated with the

[29] Readers also should note that collinearity tends to inflate both correlation coefficients and therefore estimates of explained variance (i.e., r^2). An r^2 term (in this case, the square of the correlation) represents the percentage of the variation in the dependent variable "explained" by the independent variable(s).

[30] Although this variable is a categorical variable and technically should not be used in correlation analysis, the relationship depicted here was verified with the use of four "dummy variables" (or indicator variables) representing the four study types. The analysis with a single variable representing study type is presented here for the sake of simplicity.

[31] Too few cases are available in the college group and the treatment group to conduct these analyses.

New England region ($r = .433$, $p < .01$) and adolescent studies ($r = .193$, $p < .05$).

- the work of Volberg (e.g., Volberg, 1996b) was significantly associated with adult studies ($r = .414$, $p < .01$), the use of the SOGS ($r = .278$, $p < .01$), and the use of 3 to 4 items on the SOGS as the definition of level 2 gambling ($r = .355$, $p < .01$).

- the work of Winters (e.g., Winters, Stinchfield, & Fulkerson, 1993a, 1993b) was associated significantly with the North Central U.S. region ($r = .400$, $p < .01$) and the use of the SOGS-RA ($r = .374$, $p < .01$).

The collinear characteristics of these results interfere with attempts to precisely identify the unique effect of any particular author, region, instrument, or moment in time on prevalence estimates of disordered gambling. To illustrate: a significant difference between the prevalence rates of two regions may not be a direct result of geographic location. Instead, these apparent differences may be confounded by other factors. For example, these distinctions may be attributable to differences between the instruments associated with studies in those regions, or to differences among the methods of particular authors working in those regions. With collinear variables such as these, it is not possible to distinguish the causal influence of any one variable from the set of multiply correlated variables. Thus, although we have attempted to identify differences among instruments, regions, and authors, and to identify patterns over time, we must interpret these findings with caution. We must view with caution and skepticism aggregated comparisons of instruments, regions, and authors. Throughout the results and discussion that follow, we will revisit the issue of collinearity and illustrate its influence on our understanding of disordered gambling prevalence rates.

Testing the Central Hypotheses

Although a meta-analytic strategy assumes that there is a modicum of "truth" associated with each of the studies and methodologies included in the data set, there have been concerns about how investigators integrate their collected studies (e.g., Goodman, 1991; Olkin, 1995; Mosteller & Colditz, 1996; Shadish, 1996).[32] Collinearity can compromise the apparent truths associated with a complex data set. Therefore, the distinctive collinearity of the present data set acts as a lens through which the results must be viewed and evaluated. The following results address each of this study's central hypotheses. The reader should bear in mind, however, that while factors such as instrument, researcher, and region appear as separate sections, as we have described earlier, there are important underlying collinear relationships that reside among them.

[32] One methodological guideline from the Potsdam Consultation on meta-analysis (Cook, Sackett & Spitzer, 1995) is that scientists specify whether the random effects model or the fixed effects model is used to statistically combine the study results. The random effects model allows for heterogeneity among study results that may remain after stratification, while a fixed effects model assumes homogeneity of results across studies. Both models have been widely used in meta-analyses that combine risk ratios, odds ratios, or other measures of effect. In this report, we are conducting statistical analyses under a mixed model of random and fixed effects assumption. The theoretical and practical implications of this assumption are very important. For example, we can generalize the prevalence rates identified in this study, and the associated confidence intervals, to the population at large. However, the moderator variables described in these results and the respective influence of these variables on the identified prevalence rates can be generalized only to the sample of studies that were included in this meta-analysis. Future research will determine which model, if either, is most appropriate for use with meta-analyses of prevalence estimates.

Table 5: Mean Prevalence Rates (95% Confidence Intervals) for Four Study Populations*

	Adult	Adolescent	College	Treatment
Level 3 Lifetime	1.60 (1.35-1.85)	3.88 (2.33-5.43)	4.67 (3.44-5.90)	14.23 (10.70-17.75)
Level 2 Lifetime	3.85 (2.94-4.76)	9.45 (7.62-11.27)	9.28 (4.43-14.12)	15.01 (8.94-21.07)
Level 1 Lifetime	94.67 (93.71-95.62)	89.56 (85.88-93.25)	86.66 (80.90-92.42)	71.54 (62.90-80.18)
Level 3 Past year	1.14 (.90-1.38)	5.77 (3.17-8.37)	--	--
Level 2 Past Year	2.80 (1.95-3.65)	14.82 (8.99-20.66)	--	--
Level 1 Past Year	96.04 (95.04-97.04)	82.31 (75.59-89.03)	--	--

**Estimates are rounded to two decimal places*.

Hypothesis 1: Rates of Disordered Gambling Prevalence Vary by Population Segment

There are a variety of methods for integrating prevalence estimates for any population. As we described previously, methodologists suggest using multiple methods to assure stability of estimates (e.g., Campbell & Fiske, 1959; Olkin, 1995). Therefore, we compared the prevalence estimates reported in each study by a variety of statistical algorithms as described previously in the *Methods* section. The results of these different techniques for each of the population segments are summarized in Appendix 1. The final estimate for each population segment in Appendix 1 is the arithmetic mean of these 16 alternative estimates. For illustrative purposes, Figures 6 and 7 reveal that there is little difference among these estimation techniques for adult general population lifetime level 2 and 3 data, respectively, suggesting that the variety of methods for identifying central tendency reflect considerable stability. This pattern of stability is consistent across the various population segments. In addition, the range of adult lifetime level 3 prevalence estimates across all of the weighting strategies is 1.5% to 1.6%; similarly, the range of adult lifetime level 2 prevalence estimates is 3.0% to 3.9%. These narrow ranges encourage confidence in prevalence estimates represented by unweighted data. Since unweighted data represents evidence that is independent from statistical modifications and assumptions that can influence these methods, we will continue to use the unweighted data represented in Table 5 for discussion. Table 5 summarizes these methods by providing the unweighted mean prevalence

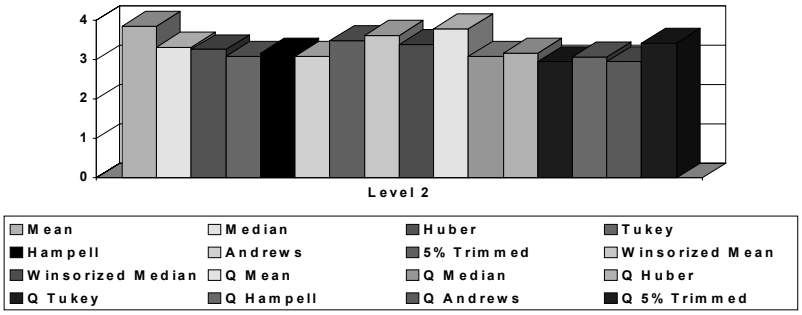


Figure 6: Lifetime Prevalence M-Estimates for Adult GP Level 2 Gambling

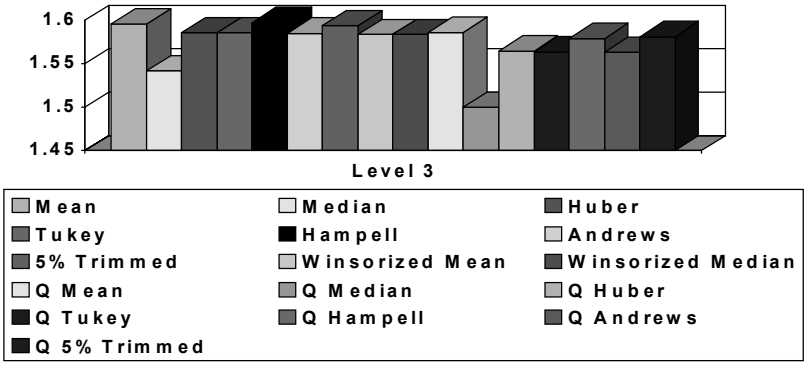


Figure 7: Lifetime Prevalence M-Estimates for Adult GP Level 3 Gambling

rates and the confidence intervals associated with each of these means for the four population segments discussed above. Box and whisker plots in Figures 8 and 9 illustrate the relatively stable distinctions of disordered gambling intensity across levels 2 and 3. That is, level 3 estimates of gambling disorders that satisfy diagnostic criteria are almost uniformly lower than level 2 estimates of sub-clinical gambling problems. These unweighted study estimates represent the general adult population segment for lifetime and past-year gambling disorders.

An interesting finding emerges from this data for adolescents: past-year prevalence rates exceed lifetime rates. This outcome would be impossible within a single sample; however, readers should note that the group of studies that provided past-year estimates and the group of studies that provided lifetime estimates are mutually exclusive. We will examine this issue in more detail later in the section on comparing lifetime and past-year prevalence rates.

Figure 8: Lifetime Prevalence of Level 2 & 3 Among the Adult General Population

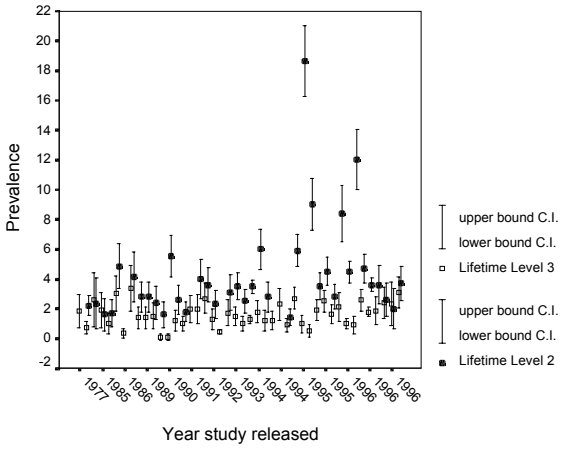
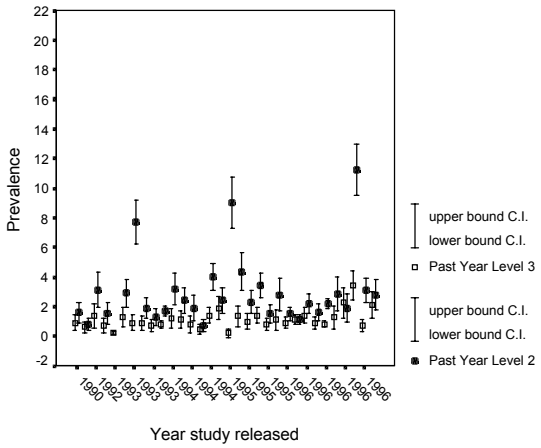


Figure 9: Past-Year Prevalence of Level 2 & 3 Among the Adult General Population



Comparing The Rates Of Disordered Gambling Among Different Population Segments

The four primary population segments (i.e., study types) described previously were com-

Table 6: Significant Lifetime Prevalence Differences Among Population Groups[a]

	General Population Adults	Adolescents	College Students
General Population Adults			
Adolescents	Level 3 * Level 2 *		
College Students	Level 3 * Level 2 ns	Level 3 ns Level 2 ns	
Adults in Treatment or Prison	Level 3 * Level 2 *	Level 3 * Level 2 ns	Level 3 * Level 2 ns

[a] Where "*" indicates a significant statistical difference at $p < .05$ and "ns" indicates no significant difference

pared to reveal differences among the groups' prevalence rates. For general population adults, adolescents, college students, and adults in treatment, Kruskal-Wallis tests (Siegel, 1956) revealed that there were significant group differences for lifetime level 3 and level 2 prevalence rates among these four groups (χ^2 = 58.413, df = 3, $p < .001$ and $\chi^2 = 31.430$, df = 3, $p < .001$, respectively). Figure 10 illustrates the relative levels of lifetime prevalence rates for the four groups.

Dunnett C tests, assuming unequal variance for post-hoc analyses, revealed the following differences between the groups: for lifetime level 3 estimates, the rate of disorder among the adult general population (M = 1.60) was significantly lower ($p < .05$) than adolescents (M = 3.88), college students (M = 4.67), and adults in treatment or prison (M = 14.23). The adolescent group's rate of level 3 lifetime gambling was significantly lower ($p < .05$) than adults in treatment or prison. College students also evidenced a meaningfully lower ($p. < .05$) level 3 lifetime gambling rate than adults in treatment or prison. For level 2 lifetime gambling rates, adults (M = 3.85) evidenced significantly lower ($p < .05$) prevalence than adolescents (M = 9.45) and adults in treatment or prison (M = 15.01). These findings are summarized in Table 6.

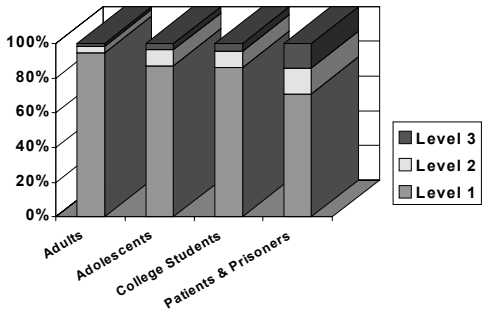


Figure 10: Lifetime Prevalence Rates Among Population Segments

For past-year rates, there was insufficient data for the college and treatment groups to make comparisons among the four groups. Therefore we compared past-year prevalence rates among the remaining two groups, adults and adolescents, using Kruskal-Wallis tests.[33] For past-

[33] While using SPSS 7.5, we identified a problem with the non-parametric algorithm. After consultation with SPSS technicians, this difficulty was deemed to be a software "bug." This problem made analyses of weighted data unreliable unless the weights were integers. To correct for this difficulty, we employed the Kruskal-Wallis statistic instead of the more typical Mann-Whitney test because the former provides a chi-square statistic and the latter does not. After multiplying the weight by a factor designed to produce integer weighting, we divided the chi-square statistic by the same factor, therefore bypassing the "bug" and yielding a reliable statistic for interpretation. We notified SPSS and researchers should be assured that the corporation will repair the algorithm.

Table 7: Relative Risk of Disordered Gambling by Population Types

(General Population Adults as Reference Group)

	Adolescents	College	Treatment
Lifetime Level 3	2.43	2.92	8.89
Lifetime Level 2	2.45	2.41	3.90
Past-Year Level 3	5.06		
Past-Year Level 2	5.29		

year level 3 rates, adult rates were significantly lower than adolescent prevalence rates ($\chi^2(1) = 16.703$, $p < .001$). Similarly, for past-year level 2 rates, adult estimates were significantly lower than adolescent estimates ($\chi^2(1) = 18.344$, $p < .001$).

A relative risk represents the risk of one group (e.g., adolescents) having a condition (e.g., level 3 gambling disorder) compared to another group's (e.g., adults in general population) risk of having the same condition. The results of this meta-analysis reveal that there is a meaningful difference in the relative lifetime risk of experiencing a level 3 gambling disorder for youth compared to adults. Specifically, the relative risk of experiencing a level 3 gambling disorder for youth from the general population is 2.43 times higher than for their adult counterparts. Similarly, for college students and adults in treatment or prison the lifetime level 3 relative risk is 2.92 and 8.89, respectively. The relative risk of experiencing a lifetime level 2 gambling disorder for adolescents is 2.45; the relative risk for college students is 2.41, and 3.90 for adults in treatment or prison.

For past-year level 3 problems, the relative risk for general population youth is 5.06 compared with the general adult population. Finally, for past-year level 2 problems, the relative risk for general population youth compared with their adult general population counterparts is 5.29. There is insufficient past-year data to calculate similar relative risk values for college or in treatment adult populations. Table 7 summarizes these relative risk ratios using the adult general population as the reference group.

Estimating Population Prevalence Differences While Controlling for Instrument

Since there is considerable collinearity between instruments and population types, the conclusion that prevalence rates vary significantly among different population groups may be artifactual. Therefore, we have identified the most commonly-used instrument – the SOGS – and limited the following analysis to studies that use this instrument. Table 8 summarizes the prevalence rates for disordered gambling for the primary populations types when the measurement instrument is held constant.

Table 8: Comparing Prevalence Estimates & (95% Confidence Intervals) Associated With SOGS[34] Studies[35]

	Adult	Adolescent	College	Treatment
Level 3 Lifetime	1.71 (1.46 - 1.96) (n = 30)	4.25 (1.91 - 6.59) (n = 6)	5.05 (3.55 - 6.56) (n = 14)	14.55 (10.60 - 18.50) (n = 16)
Level 2 Lifetime	3.41 (2.81 - 4.0) (n = 27)	8.58 (5.69 - 11.47) (n = 5)	7.0 (4.49 - 9.50) (n = 9)	8.83 (3.34 - 14.31) (n = 6)
Level 3 Past Year	1.12 (.945 - 1.30) (n = 26)			
Level 2 Past Year	2.16 (1.81 - 2.50) (n = 25)			

Kruskal-Wallis tests reveal similar patterns to those presented earlier: for SOGS lifetime rates of level 3 gambling, there were significant differences among the four study types ($\chi^2 =$ 48.929, df = 3, $p < .001$). However, Dunnett's C post-hoc tests revealed a somewhat different pattern of results from those reported above: for SOGS lifetime rates of level 3 gambling, the prevalence among adult studies (M = 1.71) was significantly lower ($p < .05$) than the prevalence among college studies (M = 5.05) and treatment studies (M = 14.55) but was not significantly different from adolescent studies (M = 4.25). However, we must exercise caution in interpreting the finding that adult prevalence rates were not significantly lower than adolescent prevalence rates in this analysis. Power analyses revealed that the power to detect this difference was 10%. This low level of power, caused mainly by the small number of studies available for analysis, indicates that any existing difference between these two groups most likely would not be revealed by this analysis.

Dunnett's C tests also revealed the following differences in lifetime level 3 rates: the adolescent rate was significantly lower ($p < .05$) than the treatment rate and the college rate was significantly lower ($p < .05$) than the treatment rate. For SOGS lifetime rates of level 2 gambling, a Kruskal-Wallis test revealed significant differences among the four groups ($\chi^2 = 23.118$, df = 3, $p < .001$). Dunnett's C post-hoc analyses revealed the following differences between the groups: adult general population rates (M = 3.41) were significantly lower ($p < .05$) than adolescent rates (M = 8.58) and college rates (M = 7.00). There was not sufficient data to make comparisons of past-year rates among the groups. These comparisons are described in Table 9.

Gender-specific Prevalence Estimates

[34] This table represents studies that used the original SOGS, the SOGS modified to reflect a past-year time frame, and the SOGS modified minimally for use with adolescent populations. This table does not include studies that used the SOGS-RA, Multi-factor Method, or other more substantial modifications of the SOGS.

[35] The level 2 prevalence rates in this table represent studies that defined level 2 gambling as a SOGS score of 3 or 4. These rates are conservative compared to those derived from the use of scores from 1 to 4 on the SOGS as the definition of level 2 gambling. We used the more conservative definition for this analysis because the use of this definition provided more data for analysis than the use of the more liberal definition would have.

Table 9: Significant SOGS Lifetime Prevalence Differences Between Population Groups[a]

	General Population Adults	Adolescents	College Students
General Population Adults			
Adolescents	Level 3 *ns* Level 2 *		
College Students	Level 3 * Level 2 *	Level 3 *ns* Level 2 *ns*	
Adults in Treatment or Prison	Level 3 * Level 2 *ns*	Level 3 * Level 2 *ns*	Level 3 * Level 2 *ns*

[a] *Where "*" indicates a significant statistical difference at $p < .05$ and "ns" indicates no significant difference*

This study confirms the empirical evidence often reported in the disordered gambling research literature that males exhibit higher rates of disordered gambling than females. This does not preclude the possibility that individual studies occasionally will find higher rates of disordered gambling among females (e.g., New Mexico Department of Health, 1996). The language used in the scientific literature to discuss gender differences in rates of disordered gambling is remarkably varied. Some reports refer to gender as a risk factor or a correlate of disordered gambling, while other studies illustrate gender differences by presenting a table of the percentage of disordered gamblers (or combined level 2 and level 3 gamblers) who are male (e.g., Volberg, 1992a, 1996a, 1996b; Ladouceur, 1991; Sommers, 1988). Since prevalence studies essentially are epidemiological explorations of the patterns and characteristics of a disorder or illness of interest, presenting rates of gender-specific disordered gambling prevalence are useful for two primary reasons. First, stratifying data by gender allows a more precise examination of the nature of the phenomenon of interest, unclouded by differences between males and females. For example, in studies reporting higher rates of disordered gambling among men than women, an unstratified rate underestimates the prevalence for men and overestimates the prevalence for women. Secondly, gender-stratified rates are useful to calculate relative risk ratios. A relative risk ratio compares the magnitude of difference in the risk for disordered gambling that exists between two groups (e.g., male and female). That is, risk ratios allow the observation that male adolescents are, for example, *four times more likely* to be pathological gamblers than female adolescents, instead of simply stating that "males are *more likely* than females to be pathological gamblers." Risk ratios quantify the difference that gender—or any other factor on which stratified data is available—can make on the phenomenon of interest. For example, Bland et al. (1993) express the results of their epidemiological study of Edmonton adults by observing a 3-to-1 ratio of male to female disordered gambling (more specifically, a relative risk of 3.1).

Of the 134 estimates identified in this meta-analysis, 56% (n = 75) provided gender-specific estimates of disordered gambling. Though this sample of 75 estimates is not precisely representative of the larger sample of 134, it is representative of all the prevalence estimates provided between 1975 and 1997 that include gender-specific data.

The 75 estimates of gender-specific disordered gambling use two different time frames. Fifty-five (73.3%) represent lifetime estimates and 26 (34.7%) are past-year estimates. Some studies provided both lifetime and past-year estimates, which is why these percentages add to more than 100%. Table 10 displays the gender-specific and population-specific estimates of disordered gambling across time frames and levels of gambling.

Attributable Proportion

Table 11 presents relative risks for the risk factor of gender across the four population segments (adult general population, adolescents, college students, and adults in treatment or prison). While these relative risks reflect the *comparative* likelihood of having level 3 or level 2 gambling problems, a different measure reveals the level of influence that the identified risk has on the population. This measure is an **attributable proportion**, which also is called **attributable risk**. An attributable risk provides a measure of the public health impact of an exposure, assuming that the association is one of cause and effect (Hennekens & Buring, 1987). For example, in a study on the association between smoking and cancer of the mouth and pharynx, the attributable proportion was 72%. That is, 72% of the cases of mouth or pharynx cancer in this study are attrib-

Table 11: Gender-specific Relative Risks of Disordered Gambling

Population Segment	Relative Risk (females as reference group)
General Population Adult	
♦ Lifetime Level 3	2.15
♦ Lifetime Level 2	2.10
♦ Past-year Level 3	1.78
♦ Past-year Level 2	1.80
Adolescents	
♦ Lifetime Level 3	3.03
♦ Lifetime Level 2	2.75
♦ Past-year Level 3	3.39
♦ Past-year Level 2	1.67
College Students	
♦ Lifetime Level 3	3.84
♦ Lifetime Level 2	1.96
Adults In-treatment or Prison	
♦ Lifetime Level 3	1.85
♦ Lifetime Level 2	2.07

Table 10: Estimates of Disordered Gambling by Population Group Stratified by Gender*

Group	Level 3 Lifetime		Level 2 Lifetime		Level 3 Past Year		Level 2 Past Year	
	f	m	f	m	f	m	f	m
General Population Adult	1.24 n = 11	2.67 n = 11	3.34 n = 11	7.03 n = 11	.96 n= 9	1.71 n = 9	3.12 n = 8	5.6 n = 8
Adolescents	2.0 n = 6	6.05 n = 6	5.13 n = 5	14.13 n = 5	2.50 n = 5	8.4 n = 5	13.66 n = 5	22.83 n = 5
College students	2.24 n = 12	8.62 n = 12	10.86 n = 11	21.22 n = 11				
Treatment	7.15 n = 5	13.22 n = 5	4.48 n = 4	9.25 n = 4				

**where f = female and m = male*

utable to smoking as the causal factor (Ahlbom & Norell, 1990). The numerical value of the attributable risk can be used to calculate the proportion of cases among the exposed segment of the population that can be attributed to the exposure itself. The data available in this meta-analysis provides few variables or risk factors that we can consider "exposures" for level 2 or level 3 gambling. However, gender is one of these variables, or "exposures" which is associated with disordered gambling. Given that there is a paucity of "exposure" data available in most prevalence studies of disordered gambling, and there is considerable gender data, gender is the "exposure" we will use to demonstrate the application of attributable risk.

Table 12: Attributable Risks for Gender

Population Segment	Attributable Risk * (among males as "exposed" group")	Population Attributable Risk ** (attributable to "maleness")
General Adult Population		
♦ Lifetime Level 3	.53	.358
♦ Lifetime Level 2	.50	.350
♦ Past-year Level 3	.38	.046
♦ Past-year Level 2	.42	.269
Adolescents		
♦ Lifetime Level 3	.67	.504
♦ Lifetime Level 2	.64	.467
♦ Past-year Level 3	.70	.530
♦ Past-year Level 2	.40	.240
College Students		
♦ Lifetime Level 3	.74	.559
♦ Lifetime Level 2	.49	.312
Treatment		
♦ Lifetime Level 3	.46	.355
♦ Lifetime Level 2	.52	.420

*The attributable risk percent is computed as: AR_e= RR-1/RR

**The population attributable risk (or proportion) is estimated by the following formula: AR = p_e(RR-I)/p_e(RR-I)+1, where p_e = % of exposed people in the population

Table 12 organizes the various attributable proportions of gender by population segment, time frame, and level of disordered gambling. For example, the proportion of male lifetime level 3 gamblers for whom lifetime level 3 gambling is attributable to being male is 53%. In public health, attributable proportions usually convey a sense of the extent to which a particular illness or disorder can be prevented by blocking the effect of a specific exposure (or eliminating it altogether) (Rothman, 1986). In the current example, since it is not possible to block the effect of being male, we are interested in understanding what about the state of "maleness" or "being male" is contributing to or "causing" disordered gambling. That is, since we do not have empirical evidence that the physiologic or genetic constitution of males compared with females is an etiologic cause of disordered gambling, being male stands as a proxy for the causes of disordered gambling that are yet to be identified. For example, males likely differ from females in how they experience and relate to money, feeling states (e.g., impulses), and regulatory mechanisms (e.g., coping with impulses).

In addition to calculating the attributable risk among an exposed (i.e., male) group, we also can calculate the attributable risk among the entire population. This measure has many different names in the epidemiological literature (e.g., total attributable risk, etiologic fraction). For the purposes of clarity, we will refer to the measure of attributable risk among the entire population as the **population attributable risk**. The population attributable risk is the excess rate of disease in the total study population that is attributable to the exposure (Henneken & Buring, 1987). To determine the impact of any one risk factor on public health, it is necessary to know both the relative risk and the percentage of the population who have that risk factor (Kahn & Sempos, 1989). In the subset of study samples that reported stratified data, the proportion of males ranged from 44.5% (adult general population level 3 lifetime) to 67.9% (adult

treatment level 2 lifetime). Using the appropriate proportion for each population segment by time frame and gambling level, we calculated the proportion attributable to the proxy of "being male." For example, 50.4% of the rate of level 3 lifetime gambling among adolescents in the general population is associated with being male and the risk factors that being male entails. Knowing the attributable risk due to gender does not mean that other factors also cannot be strong causes of disordered gambling. Not only can other factors exist, but the attributable risks of each factor can add to more than 100%. For example, x% of cancer is caused by smoking, y% by diet, z% by alcohol, and zz% by other factors. Added together, these percentages can legitimately exceed 100% because of the interactive nature of causality (Rothman, 1986). The population attributable risk caused by one factor may be shared by other influences. Therefore, since "maleness" represents other influences, these other factors also can "cause" a meaningful proportion of disordered gambling. As the previous example illustrates, these additional factors can cause the same or even higher proportions of the disorder than "maleness."

Other Stratified Data

Stratified data was presented in 62.3% of the eligible prevalence studies. In addition to gender, these studies provided stratified data on a number of other factors. A proportion of studies provided stratified data on age (36.3%), race or ethnicity (25.7%), socio-economic status (SES) (25.2%), education level (30.6%), primary language (2.2%), family member(s) with gambling problems (18%), level of involvement in specific gambling activities (13.4%), and marital status (29.1%). In addition, 34.9% of the studies reported data stratified by a factor other than the ten reported here. In this results section, we will report only the gender-stratified data and will not investigate the other stratified factors. Some of these other factors are not conducive to a synthesis because studies classified data in such a way that integration might yield misleading conclusions. For example, socio-economic status can be approached in many different ways. Some investigators used annual household income as the marker for SES, but even among these investigators the sub-categories differed to such an extent that data pooling was impossible. Other factors did not yield reliable data. For example, the existence of a family member with gambling problems usually was reported by someone other than that family member. We believe this secondary data must be confirmed; yet, there were no studies that verified these collateral reports by screening the appropriate family members directly. Therefore, we chose not to examine this factor based on the subjective and potentially unreliable nature of the data. A future report will examine this sub-set of the data in more thorough detail.

Hypothesis 2: The Prevalence of Disordered Gambling is Shifting Over Time

We examined the prevalence rates for all four study types together in one grouping to identify any significant changes in these rates over time. For this analysis, prevalence rates were standardized within each study type, to control for the fact that studies of populations with higher prevalence rates (e.g., adolescents, treatment groups) were more likely to have been conducted in recent years. This analysis revealed a significant positive correlation between the year a study was conducted and the rate of past-year level 3 gambling ($r = .448$, $p < .01$). This relationship also existed between the year a study was released and the rate of past-year level 3 gambling ($r = .382$, $p < .05$).

Although these correlations are significant, readers should note that the r^2 terms[36] are relatively small, indicating that the year a study was conducted accounts for only a small percentage of the total variance associated with shifting prevalence rates over time (i.e., 20%). Similarly, the year a study was released accounts for

[36] An r^2 term (in this case, the square of the correlation) represents the percentage of the variation in the dependent variable "explained" by the independent variable(s).

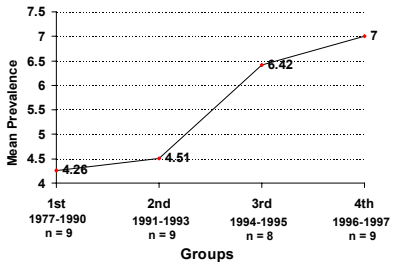


Figure 11: Adult Lifetime Level 2 & 3 Combined Prevalence

15% of the variance. Small r^2 values suggest that other unidentified but meaningful factors also influence the increasing rates of disordered gambling prevalence.

Next, we examined prevalence rates within each study type using the method described above to identify any significant patterns over time. Analyses of adolescent, college, and treatment studies revealed no significant patterns over time. Among adult studies, the past-year level 3 rate showed a statistically significant pattern: this analysis revealed a significant positive correlation between the year a study was conducted and respondents' past-year level 3 gambling prevalence rate ($r = .558$, $p < .01$). This relationship also was revealed between the year a study was released and past-year level 3 gambling ($r = .415$, $p < .05$). In addition, this analysis revealed a significant positive correlation between the year a study was conducted and respondents' combined level 2 and level 3 gambling prevalence rate ($r = .338$, $p < .05$). Similarly, this relationship was revealed between the year a study was released and combined level 2 and level 3 gambling ($r = .353$, $p < .05$).

We validated this finding by using a second analytic strategy. Here we compared the prevalence rates from studies released before the median year (i.e., 1993.5) for all adult studies with the prevalence rates from studies released after the median year. Table 13 presents these mean prevalence rates. Kruskal-Wallis tests revealed that, for studies among the adult general population, recent (i.e., post-median) studies had significantly higher prevalence rates than earlier (i.e., pre-median;) studies for lifetime level 2 (χ^2 (1) = 5.792, $p < .05$), lifetime level 2 and level 3 combined (χ^2 (1) = 7.5235, $p < .01$), and past-year level 3 (χ^2 (1) = 4.033, $p < .05$).

Next, we created approximately equally-sized groups (e.g., quartiles) of the range of adult studies according to the year the studies were released. A Kruskal-Wallis test did reveal significant differences among the four quartiles for combined lifetime level 3 and level 2 prevalence rates (χ^2 (3) = 8.102, $p < .05$). Figure 11 illustrates the mean prevalence rates for these four groups. Kruskal-Wallis tests failed to identify significant differences among these four groups for lifetime level 3, lifetime level 2, past-year level 3, and past-year level 2.

Table 13: Mean Adult Prevalence Rates for Pre-Median-Year and Post-Median-Year Groups

	Early Studies (1977-1993)	Recent Studies (1994-1997)
Lifetime Level 2	2.93	4.88*
Lifetime Combined	4.38	6.72*
Past-Year Level 3	.84	1.29*

*rates significantly higher than early studies' rates, $p < .05$

Finally, we identified significant patterns in prevalence rates over time among adult studies by conducting curve estimation regression analyses (i.e., trend analyses). These analyses revealed significant linear patterns over time for lifetime combined level 3 and level 2 (r^2 = .22508, F (1,17) = 4.88948, $p < .05$) and past-year level 3 (r^2 = .28231, F (1,17) = 6.62141, $p < .05$). In addition, for level 3 lifetime, the trend analysis revealed a significant linear pattern over time (r^2 = .36407, F (1,17) = 9.63720, p <

.01). Figure 12 illustrates one of the linear relationships and is representative of the two other significant findings. Similar to the results reported before, each of these curve estimation regressions accounts for a relatively small percentage of the total variation associated with these prevalence rates. Readers will recall that small r^2 values indicate that other meaningful factors must be identified to account for the unexplained variance. The identification of these influences will provide additional insight into the nature of increasing rates of disordered gambling prevalence. We will return to this issue in more detail later in the section that discusses regression analyses.

Hypothesis 3: Differences Among Prevalence Rates Derived from Different Screening Instruments

Given the collinearity of the data set described above, the most sound method of identifying differences among instruments is to compare prevalence rates derived from instruments that have been used among the same study sample. For example, some authors have used two or more instruments within a single study. The use of two or more instruments with the same study sample provides quasi-experimental conditions in which all factors except the instrument (e.g., the respondents, the method of survey administration, the survey administrator) remain constant. This strategy permits the difference in rates from different instruments to be examined with some confidence. This meta-analysis identified thirteen studies of adults, adolescents, or college students in which two or more instruments were used. Table 14 below shows the comparisons of instruments derived from these studies. In this table, each horizontal row represents a study's comparison of two instruments; each row indicates the author and year of the study, the study type, the time frame, the two instruments used among the study's sample, and the two level 3 rates derived from these instruments. The final cell in each row indicates the *ratio* of the first instrument's rate to the second instrument's rate. For example, if instrument A provided a rate of 3.0% and instrument B provided a rate of 1.5% among the same sample, the ratio would read "instrument A = 2.0 instrument B," indicating that instrument A provided a rate that was two times the rate provided by instrument B.

Table 14 illustrates four major comparisons among screening instruments (i.e., comparisons that have been replicated in three or more studies): (1) SOGS with versions of the DSM criteria; (2) SOGS with the Multifactor Method; (3) SOGS-RA narrow criteria with SOGS-RA broad criteria[37]; and (4) MAGS with DSM-IV.

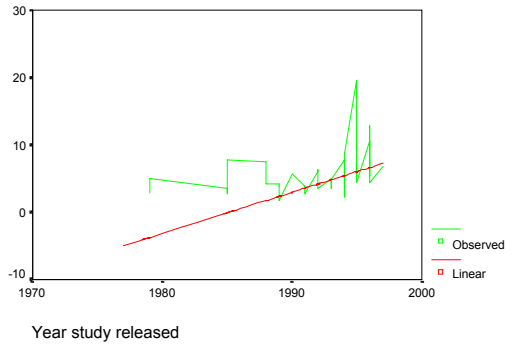


Figure 12: Combined Lifetime Level 3 & 2 Trends

[37] As readers may recall, the SOGS-RA is a modified version of the original SOGS instrument designed for use with adolescents; it uses 12 scored items and a past-year time frame (Winters, Stinchfield, & Fulkerson, 1993a). The SOGS-RA can be scored in two different ways: the "narrow criteria" and the "broad criteria" (Winters, Stinchfield, & Kim, 1995). These two scoring methods are scored as follows: The Narrow Criteria: **"no problem"** = 0-1; **"at risk"** = 2-3; **"problem"** = 4+ ; The Broad Criteria: **"no problem"** = no history of gambling, or gambling less than daily and score of 0; **"at risk"** = weekly gambling and score of 1, or less than weekly gambling and score of 2+; **"problem"** = weekly gambling and score of 2+, or daily gambling and any score.

Table 14: Comparing Screening Instruments Across Studies With Multiple Measures (Level 3 Rates)

Study	Sample	Time frame	Instr. 1	Instr. 1 Rate	Instr. 2	Instr. 2 Rate	Ratio
Oster & Knapp (1994)	College	lifetime	SOGS	11.2	DSM-III-R	5.1	SOGS = 2.20 DSM-III-R
Oster & Knapp (1994)	College	lifetime	SOGS	8.0	DSM-III-R	5.7	SOGS = 1.40 DSM-III-R
Ferris & Stirpe (1995)	Adults	lifetime	SOGS	.971	DSM-IV	.485	SOGS = 2.00 DSM-IV
Oster & Knapp (1994)	College	lifetime	SOGS	11.2	DSM-IV	4.2	SOGS = 2.67 DSM-IV
Volberg (1996b)	Adults	past-year	SOGS	1.4	DSM-IV	.875	SOGS = 1.60 DSM-IV
Volberg (1996a)	Adolescents	lifetime	SOGS	3.4	Multifactor Method	2.8	SOGS = 1.21 M.M.
Volberg (1993b)	Adolescents	lifetime	SOGS	1.5	Multifactor Method	.9	SOGS = 1.67 M.M.
Wallisch (1993a)	Adolescents	lifetime	SOGS	3.7	Multifactor Method	5.0	SOGS = .74 M.M.
Govoni et al. (1996)	Adolescents	past-year	SOGS-RA "narrow"	10.3	SOGS-RA "broad" criteria	21.1	broad = 2.05 narrow
Winters et al. (1995)	Adolescents	past-year	SOGS-RA "narrow" criteria	2.9	SOGS-RA "broad" criteria	8.2	broad = 2.83 narrow
Winters et al. (1995)	Adolescents	past-year	SOGS-RA "narrow" criteria	3.5	SOGS-RA "broad" criteria	9.5	broad = 2.71 narrow
Shaffer et al. (1994)	Adolescents	past-year [38]	MAGS	8.5	DSM-IV	6.4	MAGS = 1.33 DSM-IV
Vagge (1996)	Adolescents	past-year	MAGS	4.3	DSM-IV	4.2	MAGS = 1.02 DSM-IV
Shaffer & Hall (1994)	Adolescents	past-year	MAGS	7.0	DSM-IV	8.0	MAGS = .875 DSM-IV
Ladouceur & Mireault (1988)	Adolescents	lifetime	PGSI[39]	3.6	DSM-III	1.7	PGSI = 2.118 DSM-III
Govoni et al. (1996)	Adolescents	past-year	SOGS	8.1	SOGS-RA "narrow" criteria	10.3	narrow = 1.27 SOGS
Govoni et al. (1996)	Adolescents	past-year	SOGS	8.1	SOGS-RA "broad" criteria	21.1	broad = 2.60 SOGS
Steinberg (1997)	Adolescents	past-year	MAGS	3.2	SOGS-RA "broad" criteria	8.7	broad = 2.72 MAGS

The four major comparisons among screening instruments can be summarized as follows:

- Five studies provided the opportunity to compare the SOGS with some version of the DSM criteria; in these studies, the SOGS provided higher rates than the DSM criteria by factors ranging from 1.4 to 2.67, with a mean factor of approximately 2. A Wilcoxon signed ranks test revealed that the SOGS produced significantly higher estimates than DSM-based instruments ($Z = -2.023$, $p < .05$) in the five comparisons eligible for analysis. This set of five comparisons included both college student and adult population samples as well as lifetime and past-year time frame prevalence estimates.

- Three studies provided the opportunity to compare the SOGS with the Multifactor Method; in two of these studies the SOGS was higher, and in one of these studies the Multifactor Method was higher. The mean ratio of SOGS to Multifactor Method was approximately 1.2.

[38] The rates from Shaffer et al. (1994) are calculated among respondents who have gambled in their lifetime.

[39] Pathological Gambling Signs Index.

- The SOGS-RA broad criteria has been compared with the SOGS-RA narrow criteria in three studies; in these studies, the broad criteria provided higher rates than the narrow criteria by a mean factor of approximately 2.5.

- The MAGS has been compared with the DSM-IV criteria in three studies; in two of these studies the MAGS rate exceeded the DSM-IV rate, and in one of these studies the DSM-IV rate exceeded the MAGS rate. The mean ratio of MAGS to DSM-IV was approximately 1.

In addition, there are four other comparisons that have been made; however, these comparisons reside within a single study: (1) the ratio of the Pathological Gambling Signs Index (a precursor to the SOGS) to the DSM-III was approximately 2; (2) the ratio of the SOGS-RA narrow criteria to the SOGS was approximately 1.3; (3) the ratio of the SOGS-RA broad criteria to the SOGS was approximately 2.6; (4) the ratio of the SOGS-RA broad criteria to the MAGS was approximately 2.7.

We strongly encourage readers to view these ratios as *approximate*, preliminary findings: these ratios should be considered as "ballpark" comparisons rather than precise estimates. To date, there is insufficient data to draw confident conclusions from these comparisons. Furthermore, the mean ratios provided above represent the aggregation of three or more studies; in some cases, these mean ratios represent the aggregation of different study types and/or time frames. This methodology, although not ideal, is the only current procedure for aggregating this data. In the future, the addition of more studies that provide the opportunity to compare multiple screening instruments will allow meta-analysts to address each study type and time frame individually. At this time, however, these ratios should be viewed as an early approximation of the potential rate differences between instruments.

Hypothesis 4: Differences Among Prevalence Rates Derived from Different Regions

To test the hypothesis that different regions of the United States and Canada would have meaningfully different prevalence rates, we standardized prevalence rates within study type by converting these rates to z-scores. Transforming rates to z-scores has the effect of removing the influence of study type on prevalence rates. This procedure permitted us to manage the collinear aspects of prevalence rates and study type so that we could enter prevalence rates from all study types into a Kruskal-Wallis analysis. This analysis examined whether there were any regional differences in lifetime level 3, lifetime level 2, past-year level 3, or past-year level 2. This procedure revealed no significant prevalence rate differences among the regions of the United States and Canada on these four variables.

Hypothesis 5: Differences Among Prevalence Rates Derived from Different Researchers

To test the hypothesis that different primary researchers would yield meaningfully different prevalence rates, we followed the procedure described above for Hypothesis 4 to develop z-scores. As we found with regional comparisons, Kruskal-Wallis analyses revealed no significant differences among individual researchers on standardized rates of lifetime level 3, lifetime level 2, past-year level 3, or past-year level 2.

Hypothesis 6: Experience with Different Types of Gambling Activities Yield Different Rates of Gambling Disorder

Many of the studies included in this meta-analysis reported the prevalence rates of participation in various gambling activities. Table 15 illustrates the mean prevalence of participation in a variety of different gambling activities for each of the three population segments within a lifetime and past-year time frame. The treatment population segment was represented by

Table 15: Prevalence of Gambling Activity by Population Segment

	Adults (%)	*Adolescents (%)*	*College (%)*
Lifetime Prevalence of Gambling	81.19	77.55	85.04
Casino Games - Lifetime	32.32	7.74	40.59
Casino Games - Past Year	14.95	12.56	60.83
Lottery - Lifetime	61.25	34.89	50.29
Lottery - Past Year	49.05	30.16	60.18
Sports Gambling - Lifetime	26.83	38.17	28.45
Sports Gambling - Past Year	14.76	30.69	30.5
Pari-mutuel - Lifetime	25.11	10.88	27.17
Pari-mutuel - Past Year	7.13	11.24	8.9
Financial Markets - Lifetime	13.11	--	16.65
Financial Markets - Past Year	5.81	--	4.2
Non-Casino Card Games - Lifetime	28.16	53.46	47.37
Non-Casino Card Games - Past Year	15.89	39.61	36.1
Games of Skill - Lifetime	18.57	40.43	39.93
Games of Skill - Past Year	10.25	31.61	23.93

only three studies; therefore, it is not included in the following table.

As was the case with the aggregated prevalence rates presented earlier, readers should note that in some cases past-year rates are higher than lifetime rates (e.g., casino games for adolescents and for college students). This phenomenon occurs when the group of studies that provide past-year rates and the group of studies that provide lifetime rates represent orthogonal data sets. That is, among this group of studies, there are no investigations that provide both lifetime and past-year rates. When there is a relatively small number of studies in each group, other factors (e.g., regional variations) are likely to bias the results. This phenomenon is illustrated in the college study estimates, in which regional variation may be a significant factor (e.g., of the four study samples providing past-year rates, three are from Minnesota; the other is from Atlantic City). In addition, there is a disproportionate number of studies conducted among students in colleges proximal to casinos; thus, these college rates may be misleadingly high. This finding reflects the robust collinear characteristics of this data set and indicates that these rates should be interpreted with caution.

The Relationship between Specific Gambling Activities and Prevalence Rates

Correlations between study samples' rates of participation in seven different gambling activities and the rates of disordered gambling among these study samples were examined to identify any significant relationships among these variables. We conducted these analyses separately within each study type. Among adult studies, the analyses revealed the following relationships: there was a significant negative correlation between the lifetime rate of sports betting and the lifetime rate of level 3 gambling ($r = -.482$, $p < .05$); lifetime rates of level 2 gambling had significant positive correlations with both lifetime and past-year rates of gambling in financial markets ($r = .737$, $p < .01$ and $r = .693$, p

< .05, respectively); there was a significant negative correlation between rates of past-year level 3 gambling and lifetime rates of pari-mutuel gambling (r = -.542, p < .05); finally, there was a significant positive correlation between rates of past-year level 2 gambling and lifetime rates of participation in the lottery (r = .476, p < .05).

Although there were insufficient data points for most gambling activities to conduct these analyses among the set of adolescent studies, a significant positive relationship was revealed between rates of lifetime level 3 gambling and past-year rates of gambling on games of skill (r = .920, p < .05). Similarly, insufficient data precluded most of these analyses for the set of college studies. However, the following relationships were observed: rates of lifetime level 2 gambling had significant positive correlations with both lifetime rates of casino gambling (r = .755. p < .05) and lifetime rates of gambling on non-casino-based card games (r = .804, p < .05). Insufficient data entirely precluded these analyses among the set of in-treatment population studies.

To evaluate whether the prevalence of participation in each of seven common gambling activities (casino games, lottery, sports betting, pari-mutuel, financial markets, cards, and games of skill) was significantly different among particular segments of the population, we again performed Kruskal-Wallis tests. Of the fourteen tests (seven activities within both lifetime and past-year time frames), ten (all but lifetime sports betting and past-year pari-mutuel wagering) revealed significant differences among the four population types (all tests significant at p < .001). We then conducted post-hoc Dunnett C tests to examine the specific differences among the four population types. Although the influence of collinearity cannot be dismissed, results show that the adult general population has gambled at casinos, played the lottery, and participated in pari-mutuel wagering significantly more than adolescents (all results at p < .05). On the other hand, adolescents and college students have gambled on non-casino card games, sports betting (in the past year), and games of skill significantly more than adults in the general population (all of these results were significant at p < .05).

Regression Analyses: Factors that Influence Prevalence Estimates of Disordered Gambling

There is a significant body of knowledge suggesting that, within the context of meta-analysis, weighted least squares multiple regression analyses are recognized as the convention for determining the moderator variables that influence the effects of interest (e.g., Cohen & Cohen, 1975; Cook et al., 1992; Cooper & Hedges, 1994; Rosenthal, 1984). Weighted regression techniques permit studies with more precise estimates to have more influence in determining the eventual explanatory model. The precision of prevalence estimates is a function of experimental methodology and sample size—studies based on larger samples provide more precise estimates of prevalence (Cook et al., 1992). Since it is desirable to avoid any subjective bias in the conduct of research, empirical measures of variability have a significant advantage over subjective ratings of quality (e.g., Hasselblad et al., 1995; Blair et al., 1995; Olkin, 1995). However, in the present study, this matter is complicated because the various indices traditionally associated with study quality (i.e., sample size, quality score) are related collinearly with study type and prevalence as described previously. As a result of this finding, weighted least squares regression analyses among the four study types do not provide meaningful data for interpretation. Thus, we conducted unweighted regression analyses using the four study types. For regression analyses within each study type, we used weighted least squares methods, since analysis within study type eliminates the problems related to collinearity with study type.

The initial regression solution, using the four primary study population types, revealed that the population type from which an estimate of gambling disorder is derived significantly influences prevalence estimates for lifetime level 3,

lifetime level 2, past-year level 3, and past-year level 2 ($F = 91.324$, $df = 3, 78$, $p < .001$; $F = 13.850$, $df = 3, 62$, $p < .001$; $F = 33.313$, $df = 3, 39$, $p < .001$; $F = 49.145$, $df = 3, 36$, $p < .001$, respectively). These regression analyses indicated that for lifetime level 3, lifetime level 2, past-year level 3, and past-year level 2, population type accounted for 77.7%, 40.1%, 71.9%, and 73.2% of the variance, respectively. Since the current data set does not permit us to distinguish the unique variance accounted for by population type, the amounts of variance explained by population type given above are shared with other causal influences. Figure 13 illustrates the extent to which population type influences the variance associated with prevalence estimates.

In the area of prevalence estimates of disordered gambling, there is no "gold standard" against which to determine a measure of precision. If we knew in advance what the prevalence of disordered gambling was among a specific population segment, then we could determine how disparate various estimates are from that known standard. In the absence of such a standard, we must determine a measure by which to value our set of prevalence estimates. Therefore, we elected to conduct our weighted least squares regression to explain prevalence estimates using a methodological quality score as the weighting variable. This strategy weights estimates of prevalence as a function of the methodological characteristics of the study from which these estimates are derived. Readers will recall from the earlier discussion on the calculation of quality scores that we developed the methodological index for this study by integrating data about nine methodological factors: (1) sample selection process (i.e., randomly selected), (2) response rate (including the appropriateness of the method used to calculate the response rate), (3) survey anonymity, (4) whether the study underwent a peer review process (e.g., for publication in a refereed journal), (5) whether the authors assessed the reliability of their data collection and entry procedures, (6) whether the authors varied the time of day survey data was collected, (7) the number of respondents in the study sample, (8) whether the authors took a multidimensional approach to measuring disordered gambling (e.g., multiple dependent measures), and (9) whether the study was intended primarily as a prevalence study.

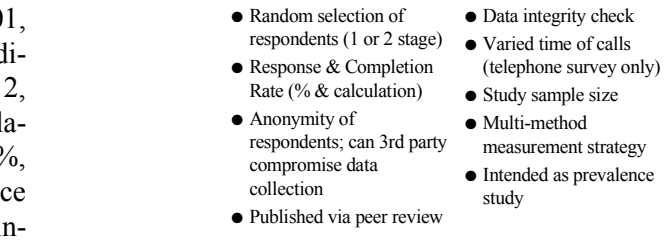


Figure 14: Elements of the Methodological Quality Index

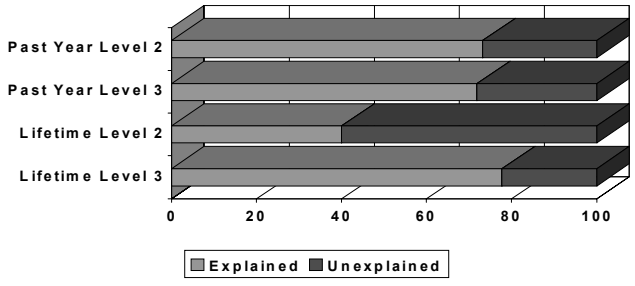


Figure 13: Explained Unique & Shared Variance Among Prevalence Rates Due to Population Type

Figure 14 summarizes these elements of methodological quality.

These weighted least squares regression analyses within study type also were complicated by collinearity; as we discussed previously, region, author, and instrument were highly collinear. As a result of this phenomenon, regression analyses with all of these variables entered simultaneously did not provide meaningful results for interpretation. Thus, the nature of this data set precluded the identification of the *unique* variance accounted for by an independent variable. Instead, we entered each variable individually into a regression analysis for each dependent variable and identified the *relative* amount of variance explained; these figures represent the unique variance explained by an independent variable *plus* the explained variance it shares with other variables. The relative degree to which region, author, instrument, and year influence prevalence estimates is depicted in Figure 15 for adults and Figure 16 for youth. As these figures illustrate, the year of the research accounts for a relatively small percentage of the variance in prevalence rates compared to the other factors with the exception of past-year level 3 among adults.

The regression analyses yield the following relative results: Subject or population attributes (e.g., age, gender, psychiatric status) have the most powerful influence on prevalence estimates. Also important, but in descending order of influence are measurement instruments, location, principal investigator of the study, and the historical moment of the research.

Estimating the Number of Disordered Gamblers in the United States and Can-

Table 16: Estimated Number of Past-Year Disordered Gamblers in the United States & Canada (in millions)

	United States			Canada		
	Adolescents	**Adults**	**Both**	**Adolescents**	**Adult**	**Both**
Level 3	Range: 1.2 - 3.2 central estimate: 2.2	Range: 1.7 - 2.6 central estimate: 2.2	Range: 2.9 - 5.8 central estimate: 4.4	Range: 0.1 - 0.3 central estimate: 0.2	Range: 0.2 -0.3 central estimate: 0.3	Range: 0.3 - 0.6 central estimate: 0.5
Level 2	Range: 3.4 - 7.9 central estimate: 5.7	Range: 3.7 - 7.0 central estimate: 5.3	Range: 7.1 - 14.9 central estimate: 11.0	Range: 0.4 - 0.8 central estimate: 0.6	Range: 0.4 -0.8 central estimate: 0.6	Range: 0.8 - 1.6 central estimate: 1.2
Combined	Range: 4.6 - 11.1 central estimate: 7.9	Range: 5.4 - 9.6 central estimate: 7.5	Range: 10.1 - 20.7 central estimate: 15.4	Range: 0.5 -1.2 central estimate: 0.8	Range: 0.6 -1.1 central estimate: 0.9	Range: 1.1 - 2.3 central estimate: 1.7
Total: range of estimates = 11.2 - 23.0; central estimate = 17.1						

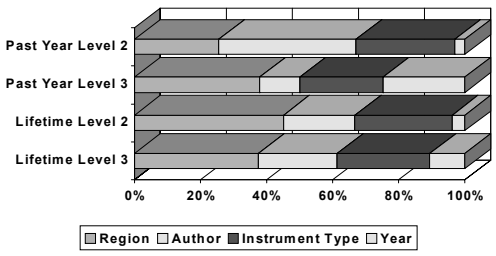


Figure 15: Sources of unique and shared variance among the explained sources of adult prevalence estimates

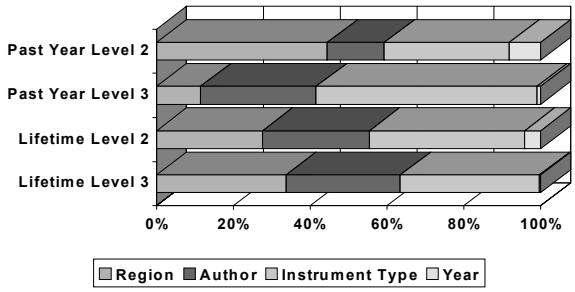


Figure 16: Sources of unique and shared variance among the explained sources of youth prevalence estimates

ada

To help people better understand the prevalence rates identified by this study, investigators often translate prevalence rates into estimates of the number of individuals who struggling with the illness or disorder in question. Policy makers and public health treatment planners also use these numbers to make decisions about, for example, beds needed in a treatment unit, or staff necessary to tend to a compulsive gambling hotline. Table 16 summarizes estimates of the number of past-year disordered gamblers based on the U.S. 1997 census and the Canadian 1996 census.[40] The range estimates in Table 16 reflect 95% confidence intervals; the central estimate represents an estimate of the middle of the confidence interval range. In this table, the adolescent groups represent those people from the general population 10-19 year-olds, and adults represent people who are 20 years of age and older. There was not sufficient data to estimate the number of past-year disordered gamblers among the treatment/prison or college populations. Since we have not included these "treatment" and college populations in the Table 16 estimates, readers should consider the estimates to represent conservative approximations of the number of people with gambling associated disorders.

[40] These statistics were retrieved from World Wide Web sites as follows: http://www.census.gov/population/estimates/nation/intfile2-1.txt (for U.S. figures); http://www.statcan.ca/english/Pgdb/People/Population/demo10a.htm (for Canadian figures).

Discussion

"Any solution to a problem changes the problem."

- R. W. Johnson (1979)[41]

The results of this meta-analysis reveal that a number of different factors can exert influence on prevalence estimates of disordered gambling. The results also reveal that study quality had little impact on observed prevalence rates. Taken together, these observations lead to the conclusion that disordered gambling is a relatively robust phenomenon that can withstand influence from a variety of sources. In spite of these conclusions, the collinearity of the present data set requires us to consider all of the findings quite carefully and conservatively. These multiple correlations among a variety of study attributes do relate quite systematically to prevalence estimates.

As a result of these observations, we have organized the following discussion into 6 major sections that will (1) consider the primary factors that influence prevalence estimates, (2) examine the original hypotheses that guided this study, (3) consider methodological issues associated with prevalence estimation, (4) examine how the interaction of social setting and personality can help to explain some of the current findings, (5) explore the implications of these findings for future research, and (6) recommend some standards for conducting future prevalence estimation research. Before we begin to discuss the findings directly, a brief digression is in order. Given the array of different analytical tools employed in this study, it is helpful to revisit a

[41] *Washingtonian* (1979, November).

basic issue associated with the conduct of meta-analytic research. Is it appropriate to integrate different estimates of disordered gambling prevalence, gathered from different populations, using various methods?

Can Different Prevalence Estimates Be Integrated?

Before examining the results presented earlier, it is important to revisit a fundamental issue underlying meta-analytic research in general and this synthesis in particular: can different prevalence estimates, derived from different studies, using different methods, be integrated in a meaningful way? (Goodman, 1991; Hasselblad et al., 1995). Not in spite of, but precisely *because of* the diverse research strategies and methods used to generate estimates of disordered gambling, prevalence estimates can, and should, be integrated. This is not a conclusion reached after casual consideration. For example, we understand well that "...methodological quality can be related to study outcomes and thus confound the interpretations one can draw from a body of research. However, the relation between quality and outcome is not consistent among different research domains, and accounting for variation in study quality is a thorny problem" (Bangert-Drowns et al., 1997, p. 424).

The integration of prevalence estimates rests on the very assumptions of meta-analytic research described by Smith and Glass (1977) in their seminal work on psychotherapy outcomes. Smith and Glass encouraged meta-analysts to integrate research findings specifically because the integration of evidence respected the variety of assumptions associated with many different investigators. Smith and Glass recognized that there was no single "true" psychotherapy outcome evidenced by a single research undertaking. There are many different ways to examine important health-related questions that range from treatment outcome to prevalence estimation. Since prevalence estimates are a direct reflection of the variety of the research methods and strategies that scientists develop and implement to measure this phenomenon, debate and controversy are common bedfellows of prevalence estimation projects (e.g., Nadler, 1985). These methodological disputes are particularly common among young scientific fields (Cohen, 1985).

The primary task of a meta-analytic study of prevalence estimates is to synthesize existing findings across a range of research assumptions, methodologies, instruments, and results into a more precise and reliable estimate of the phenomenon under investigation. This synthesis is justifiable only if the various estimates are measuring essentially the same phenomenon. For example, we can measure body temperature using a variety of methods and instruments. Different instruments (e.g., thermometer or heat-sensitive tape) and different routes of administration (e.g., oral, rectal, underarm, aural) do not deter observers from recognizing that results obtained by these various methods reflect an index of body temperature. Although these different methods vary in precision, we accept each method as an indication of a relatively stable underlying construct (i.e., body temperature). Similarly, we can be confident that the various instruments used in the disordered gambling field measure essentially the same underlying construct. Furthermore, since there is no "gold standard" for the identification of disordered gambling, we cannot determine the absolute accuracy with which any of these instruments identifies the underlying construct of pathological gambling. As a result, aggregation of rates derived from different instruments provides us with a more stable estimate than would be available from any single measurement instrument. We will discuss issues related to gold standards and validity in more detail later.

Factors Associated with Disordered Gambling Estimates: Sources of Influence

We began this report by suggesting that a scientific manufacturing process is responsible for the production of prevalence estimates. This relativist

view (Casti, 1989) encourages us to consider the possible factors that can influence the process of prevalence estimation. The results reveal that attributes of the individual, best interpreted as risk factors (e.g., age, gender, psychiatric status), are the most potent influences on prevalence estimates. Individual characteristics, represented by the four major population study types (i.e., adult, adolescent, college, and treatment), account for more variance associated with prevalence estimates than any other single factor.

There are other important moderator variables influencing prevalence estimates. In addition to individual respondent "traits," characteristics of the research process also influence estimates of disordered gambling prevalence. These influences are more highly variable and account for less variance than do population characteristics. Research process influences include the following factors: who conducts the investigation, how the investigator chooses to measure disordered gambling (i.e., instrument), where the investigation is conducted (i.e., region) and when in history the data is collected. Taken together, these factors combine to affect the rates of gambling disorder. Figure 17 provides an illustration of the primary factors that influence the estimation of disordered gambling prevalence rates.

- Subject or Population Attributes
  - Age, Gender, Psychiatric Status
- Measurement Instruments
- Geography or Location
- Principal Investigators
- Historical Moment of Study (e.g., History of Access to Gambling)
  - Only among adults (level 2 or 3)

Figure 17: Factors That Influence Prevalence Rates

Surprisingly, the quality of research methods has exerted little influence on prevalence estimates of gambling disorder. In this study, by using a reliable coding procedure for identifying the presence or absence of study features associated with matters of internal and external validity (e.g., Bangert-Drowns et al., 1997), we have determined that estimates of gambling disorder were neither higher nor lower as a function of research quality. Just as surprising as the absence of study quality influence on estimates, but perhaps more ominous, is the finding that research quality has not improved during the past two decades of prevalence research. Observers of the history of science might have assumed that scientists would have improved their methods of estimating disordered gambling prevalence as they moved along a learning curve. However, Bakan's (1967) critical observations about the development of science may apply here: scientific research rarely makes new discoveries, it usually confirms what we already know. In the field of gambling studies, in spite of a growing body of empirical data, there is only a modicum of theory. Theory is where important scientific advances occur. The available data unfortunately is often disconnected from organized theory. Although it is possible to speculate that during the past two decades the studies of prevalence were of sufficiently high quality that there was little room for improvement, this does not appear to be the case. As we will describe at the end of this discussion, we are of the opinion that it is time for investigators to adopt some basic standards for the conduct and reporting of disordered gambling prevalence estimates. Methodological advances from the field of psychiatric epidemiology (e.g., Tsuang, Tohen, & Zahner, 1995) must be integrated into the emerging research on disordered gambling. Unfortunately, until then, many conclusions about the extent and nature of disordered gambling prevalence must be held as tentative.

The Central Hypotheses: Drawing Conclusions

Hypothesis 1: Rates of Disordered Gambling Prevalence Vary by Population Segment

Producing a set of disordered gambling prevalence estimates is at the heart of this meta-analytic study. This project represents the first attempt to integrate quantitatively the array of prevalence estimates reported in the published and unpublished gambling literature to date. The lifetime and past-year estimates for each of the four population groups examined in this study demonstrate that an individual's risk of disordered gambling is primarily dependent upon their age, clinical situation, and gender. Moreover, the results reveal that rates of disordered gambling do vary by population segment. The results of this meta-analysis show that adolescents consistently have higher rates of level 3 and level 2 time frames gambling for both lifetime and past year than their adult general population counterparts, with only one exception. When examining only the subset of studies that used the SOGS instruments to measure disordered gambling, young people in the general population did not evidence significantly higher level 3 lifetime prevalence rates compared with adults. However, this finding should be interpreted with caution. This comparison had little statistical power to identify a statistically significant difference; a larger number of studies using the SOGS among adolescents may reveal and confirm the more stable observation that adolescents have higher rates of level 3 gambling than their adult counterparts.

Notwithstanding this exception, youthful age appears to be an important risk factor for developing gambling-related problems. One explanation for this finding is that, compared to adults, youth have had more exposure to gambling during an age when vulnerability is high and risk-taking behavior is a norm; consequently, these young people have higher rates of disordered gambling than their more mature and less vulnerable counterparts. In addition to pre-college adolescents, there are other population segments that have higher risk of experiencing gambling disorders. College students and adults in treatment or prison consistently had significantly higher rates of lifetime level 3 gambling than adults surveyed from the general population. The treatment/prison population evidenced the highest rates of disordered gambling among all the population groups studied. Using all the survey instruments, the results revealed that the in-treatment population had meaningfully higher rates of lifetime level 2 gambling than the adult general population.[42]

Membership in youthful, college, treatment, or prison population segments must be considered an important risk factor for the development of gambling-related disorders. As we will discuss later in the section on the interaction of social setting and personality, we can understand the risks associated with each of these population segments as a function of the interaction between personality and social context. Those most at risk for disordered gambling are (1) indifferent or insensitive to the social pressures or sanctions against immoderate behavior (e.g., the social separation often experienced by people with major mental illness, or the new independence commonly experienced by college students), (2) extremely sensitive to the perceived social pressures to participate in activities that they consider to be normative (e.g., as a result of the peer pressure often experienced by adolescents), or (3) in physical or emotional discomfort that is ameliorated by the gambling experience (e.g., people who are depressed and find that gambling relieves their discomfort). Disconnection from the pressure of a social setting to behave in a particular way can derive from an immature stage of psychosocial development, psychiatric illness, personality disorder, or a combination of these circumstances.

[42] If the results were limited to only SOGS studies, then college students and not the treatment group had significantly higher rates of lifetime level 2 gambling than the adult general population. This observation relates to the limited sample of studies available and the associated decrease in statistical power.

Lilly Tomlin humorously illustrated this relationship between personality and social setting during her one-woman play, *The Search For Signs of Intelligent Life in the Universe*: "...reality is the leading cause of stress amongst those in touch with it. I can take it in small doses, but as a lifestyle I found it too confining. It was just too needful; it expected me to be there for it *all* of the time, and with all I have to do—I had to let something go. Now, since I put reality on a back burner, my days are jam-packed and fun-filled" (Wagner, 1986, p. 18).

Males often evidence higher rates of behavioral disorders than females (e.g., fighting, crime, drunkenness). Across population segments, males similarly have higher rates of level 3 and level 2 lifetime and past-year gambling than females. These rates generally become less discrepant with advancing age. Males tend to be more insensitive to the pro-social forces exerted by the reality of their social setting than are their female counterparts; when not insensitive, men customarily withdraw from social settings that they experience as behaviorally constraining. Often the result of this pattern of social separation is disproportionate behavioral excess.[43] To illustrate, male college students are nearly four times as likely to be lifetime level 3 gamblers as females, and male adolescents are three times as likely to be lifetime level 3 gamblers as their female counterparts. Male adults are twice as likely as adult females to meet lifetime criteria for pathological gambling; those in the general population are just over twice as likely, while male adults in treatment settings or prison are almost twice as likely to be lifetime level 3 gamblers as their female counterparts.

This relationship also holds with lifetime and past-year measures of sub-clinical levels of gambling disorders. Being young, male, in college, having psychiatric co-morbidity, or a history of antisocial behavior are factors that represent meaningful risks for developing gambling-related problems. Maturing seems to provide a protective device against behavioral excesses, unless dysthymia, diminishing health, or some pre-existing problem facilitates the development of an addictive behavior pattern. Winick (1962) speculated that people who experience narcotic dependence can "mature out" of their addiction. Additional research will clarify whether Winick's notion applies to disordered gambling as well as narcotics abuse, or whether "maturing out" is better understood as an element of natural recovery (e.g., Shaffer & Jones, 1989). Testing these unexplored hypotheses is the domain of new studies which we will discuss later in more detail.

Identifying Risk Factors for Disordered Gambling

"Someone once asked me why women don't gamble as much as men do, and I gave the common-sensical reply that we don't have as much money. That was a true but incomplete answer. In fact, women's total instinct for gambling is satisfied by marriage." - Gloria Steinem (1983)

Individual, social, and cultural factors (e.g., gender, emotional temperament, access, availability, folkways and mores of a society) determine the risk of becoming a disordered gambler. Gender represents a considerable risk factor for disordered gambling. The results of this study reveal that men are much more likely than women to become disordered gamblers for every population segment. This gender difference is most apparent among college students, where men are nearly four times more likely than women to become gamblers with level 3 disorders during their lifetime. Youth also represents a considerable risk factor for disordered gambling. Within the general population, young people are almost 3 times more likely than their adult counterparts to evidence a level 3 gambling disorder during their lifetime and 4.47 times more likely during the past year to experience a level 3 disorder. Similarly, adults in treatment are almost 9 times more likely than adults in the general population to experience a

[43] For an interesting example of this behavior pattern with alcohol, interested readers should see Zinberg & Fraser (1979).

level 3 gambling disorder during their lifetime. Taken together, these findings suggest that youth and psychiatric status represent important risk factors for gambling disorders. As we described previously, youth with psychiatric comorbidity have compound risk factors that interact to significantly elevate the rate of disordered gambling prevalence over their non-impaired cohorts.

Stratified data provides important information that can improve the utility, generalizability and meaningfulness of prevalence estimates. For example, in addition to an aggregate or single estimate (which provides an overestimate for females and an underestimate for males), separate estimates for males and females and a relative risk ratio provide information that more accurately depicts the phenomenon for each gender. We recommend that, in the future, investigators present stratified data for factors that may serve as potential correlates of disordered gambling. That is, we recommend that gender-specific, age-specific or other risk-factor-specific rates be reported. In addition, the format for presenting these stratified rates is an important consideration. Rather than reporting, for example, that males make up 80% of the group of pathological gamblers, we recommend that investigators report gender-specific prevalence rates. For example, *"4.3% of the males in the sample were pathological gamblers compared to 1.2% of the females in the sample."* The former approach is an indication of the proportion of the entire sample that is male, and confounds an understanding of the relationship between gender and disordered gambling; the latter approach is a better index of a specific risk factor (e.g., gender) for disordered gambling. Data reported in this manner will stimulate an improved understanding of the factors that contribute meaningfully to the phenomenon of disordered gambling.

Hypothesis 2: The Prevalence of Disordered Gambling is Shifting over Time

Temporal effects of rates of psychiatric disorders, including pathological gambling, can manifest in several variations (Horwath & Weissman, 1995). *Age effects* refer to age-specific phases in life when individuals are at higher risk of developing pathological gambling. *Period effects* are specific eras in time associated with a higher prevalence of pathological gambling (e.g., a period effect might be seen in a country or a state that has just legalized gambling for the first time). Finally, a *cohort effect* indicates a specific group of individuals born within the same time period (e.g., in the same year or decade) who have different rates of pathological gambling as a cohort. Of these three variations of temporal effects, the meta-analysis data only allowed for an exploration of the age effect and the period effect. The lack of studies that examine incidence data as well as the lack of prospective research designs limit a critical review of cohort effects. These are important areas of investigation, and new incidence research initiatives are necessary to provide better insight into the nature of cohort effects and disordered gambling.

We already have described the age effect evident in rates of pathological gambling during our exploration of *Hypothesis 1*: the data revealed that adolescents have meaningfully higher rates of pathological gambling than adults. As for the period effect, there is correlational evidence supporting the notion that rates of pathological gambling have increased during the two decades between 1977 and 1997. This evidence reveals that past-year level 3 gambling, lifetime level 2 gambling, and combined lifetime level 2+3 gambling is increasing over time. When we control for the influence of differing study types, the evidence becomes stronger that the rates of past-year pathological gambling among adults in the general population are increasing over time. In addition, rates among adults in the general population are increasing for combined lifetime level 2+3 gambling. The data also reveal a potential period effect among

adult lifetime level 3 gambling rates and lifetime level 2 gambling rates. As we suggested previously, this pattern of increasingly higher rates of gambling disorder among the general adult population seems to be the result of the interaction between personality and social setting. Adults in the general population are much more sensitive to the social sanctions against illicit behaviors than are their adolescent, psychiatric, or criminal counterparts. As gambling has become more socially accepted and accessible during the past two decades, this population segment has started to gamble in increasing numbers. Adolescents, college students, psychiatric patients, and criminals historically have not avoided gambling just because it was illicit; these groups have been relatively insensitive to social sanctions. Newly exposed to the gambling experience, adults in the general population are having difficulty adjusting and, unlike the other population segments who already evidence gambling problems, are beginning to report increasingly higher rates of gambling disorder.

We can anticipate that, like the very slow adjustment people have made to the information about tobacco-related dangers, or the repeal of prohibition of beverage alcohol, the informal and formal social controls necessary to provide protection against gambling problems will emerge slowly, perhaps only after decades and generations of social learning. Formal social controls include law and other regulatory mechanisms; informal social controls rest more on the folkways and mores of a given social setting. We will explore the idea of a shifting social setting and its impact on gambling in more detail later in the section of the *Discussion* focusing on the interaction of personality and social setting.

Hypothesis 3: Differences among Prevalence Rates Derived from Different Screening Instruments

This meta-analysis included studies that used a total of 25 different instruments to assess rates of disordered gambling. It benefits researchers to know how these instruments compare to each other. To compare rates derived from different instruments, we investigated studies that used two or more different instruments among the same sample. The ratio of the two estimates within a single study ranged from 1.02 (quite similar) to 2.83 (quite different). Though we view this observation as tentative, these analyses revealed that the SOGS produces significantly higher estimates of pathological gambling than versions of the DSM criteria. Studies that used both the SOGS-RA broad and the SOGS-RA narrow criteria demonstrate that the broad criteria produce consistently higher rates than the narrow criteria. As a result of the small number of studies available for analysis, data comparing other screening instruments remains inconclusive.

Hypothesis 4: Differences among Prevalence Rates Derived from Different Regions

Characteristics of the data set restricted the identification of regional differences. First, although we were able to standardize scores to remove the effect of study type, collinearity among region, author, and instrument remained and may have influenced this analysis. In other words, an existing regional difference may have been concealed by differences among authors or instruments. In addition, statistical power for this analysis was limited. For example, this design had only 25% power to detect a moderate effect size for lifetime level 3 rates with an average of six estimates per region at a significance level of .05. To achieve adequate power (i.e., 80%) for this comparison, this analysis would require 26 estimates per region to detect a moderate effect size at a significance level of .05. Given this limitation and protecting against the contaminating influence of study type by using standardized scores, various analyses revealed no meaningful differences among regions in the United States and Canada. Since there was insufficient statistical power to reveal moderate regional differences, this finding does not preclude the possibility that with additional data, regional differences will emerge. For now,

however, we could not provide support for this hypothesis.

Hypothesis 5: Differences among Prevalence Rates Derived from Different Researchers

As with the tests of Hypothesis 4, there was limited statistical power for comparisons among different investigators. Given this limitation and by using standardized scores to protect against any contaminating influences from different study types (as we did with regional differences), our analyses again revealed no meaningful differences among different researcher's estimates of disordered gambling prevalence. As with regional variation, there was insufficient statistical power to reveal small differences among researchers. Therefore, as was the case with the regional analysis, this finding does not preclude the possibility that with additional data, meaningful differences among investigators will become apparent. Although the casual observer might detect higher rates produced by individual researchers, the collinear nature of the current evidence demands caution when attempting to interpret these observations. That is, researchers tend to conduct studies, be based geographically in certain regions, and use the same screening instrument across their studies. These inter-relationships cannot be teased apart within the current collection of prevalence studies. Therefore, we conclude that the data in this meta-analysis did not reveal any meaningful differences among various researchers' estimates of disordered gambling.

Hypothesis 6: Experience with Different Types of Gambling Activities Yield Different Rates of Gambling Disorder

Although we do not believe that any specific object of addiction (e.g., heroin, cocaine, keno, lottery, or shopping) represents the necessary and sufficient causes to produce addictive behavior,[44] there is reason to examine the epidemiological relationship between gambling disorders and the specific games people play. Therefore, this study examined the extent of participation in seven different common gambling activities among the adult general population, adolescents, adults in treatment and prison populations, and college students. We found that, as expected, adolescents participate significantly more than adults in gambling activities that are most socially accessible and do not require authorization. That is, adolescents are gambling more than adults on games of skill, non-casino card games, and sports betting. Adolescents can participate in these three activities within a group of school friends, with their families, or with their friends' families. Similarly, college students are betting more than adults in the general population on non-casino card games and games of skill; these represent activities which are popular within a college setting. Unsurprisingly, adults in the general population are gambling more than adolescents on casino games, the lottery, and pari-mutuel wagering. Though there are exceptions, the vendor of these adult activities generally requires authorization from a licensing bureau or certification board. Although there is evidence that adolescents are engaging in these three activities despite their illegal status, the vast majority of individuals who participate in these "legal" forms of gambling are adults.

We also examined in this report the pattern of relationships among specific gambling activities and disordered gambling. Among adults, higher levels of gambling in financial markets and on the lottery were associated with level 2 disorders. On the other hand, *lower* levels of betting on sports and pari-mutuel gambling was associated with more serious level 3 gambling. For adolescents, higher levels of betting on games of skill were associated with higher rates of level 3 gambling. Finally, among college students,

[44] We encourage interested readers to review Shaffer (1996, 1997b) for a more complete discussion of this matter.

higher levels of gambling at casinos and on non-casino-based card games were associated with higher rates of level 2 gambling. These preliminary relationships must be evaluated with great caution, particularly the finding that lower levels of betting on sports and pari-mutuels are associated with higher rates of diagnosable gambling disorders. This finding does not imply that participating in these two activities provides a "protective" factor; it may mean instead that individuals who choose not to gamble on sports and pari-mutuels are gambling with greater intensity on other activities.

Deciphering relationships among specific gaming activities and disordered gambling requires sophisticated research that focuses on the nature of the relationships that exist between an individual and the object of their addiction; that is, their gambling activity of choice. The field of gambling research would do well to emulate lines of inquiry within the substance abuse research field, which has discovered many important and illuminating differences between various substances and their substance-specific physiological, psychological, and socioeconomic influences on their users. For example, Khantzian (1975, 1985, 1989, 1997) has found that alcohol has special "releasing" properties that tend to dis-inhibit users. Cocaine has anti-depressant stimulating properties. Khantzian has suggested that certain personality types are more attracted to each of these drug classes to produce a self-medicating effect. Similarly, Jacobs (1989) suggests that certain gambling activities can produce dissociative effects that may be differentially attractive to individuals with certain personality attributes. Much remains to be learned about the relationship between people and the games they choose to play.

Table 17: Comparing Lifetime and Past-year Prevalence Rates of Adult Psychiatric Disorders in the United States: Where Does Disordered Gambling Fit?

	L.T.	P.Y.
Gambling Disorder Level 3	1.6	1.1
Anti-Social Personality	2.6	1.2
Obsessive Compulsive	2.6	1.7
Drug Abuse/Dependence	6.2	2.5
Major Depressive Episode	6.4	3.7
Generalized Anxiety	8.5	3.8
Alcohol Abuse/Dependence	13.8	6.3

How Does the Prevalence of Disordered Gambling Compare With Other Problems?: Making Sense of the Numbers

We can compare the prevalence of disordered gambling among adults in the United States to the prevalence of a variety of other, better-known psychiatric disorders. Although a range of epidemiologic studies have produced a range of prevalence estimates for each psychiatric disorder, Table 17 uses illustrative rates derived from the Epidemiologic Catchment Area study (Robins & Regier, 1991). Table 17 shows how estimates of level 3 gambling derived from this study compare with other disorders across both lifetime and past-year time frames among adults in the United States. Readers should note that, with the exception of the lifetime prevalence rate of alcohol abuse and dependence, all the prevalence rates are lower than 10%.

Prevalence estimates of psychiatric disorders among adolescents also vary as a function of methodological considerations such as instrument, region, and year. For illustrative purposes, Table 18 shows our meta-analysis estimate of past-year level 3 gambling among adolescents along with 6-month estimates of well-known psychiatric disorders from two studies. These two studies are a New York study of adolescents 11 to 20 years old (Velez, Johnson, & Cohen, 1989) and an Ontario study of young people 4 to 16 years old (Offord et al., 1987). As Table 18 reveals, the rates of conduct and attention deficit disorders are similar to level 3 gambling disorders.

Methodological Considerations & Prevalence Estimation

"I have yet to see any problem, however complicated, which, when you looked at it in the right way, did not become still more complicated." - Poul Anderson (1969)[45]

Prevalence Study Quality

According to the methodological quality index developed for this study, the results reported earlier revealed that the overall quality of disordered gambling prevalence research has not improved significantly during the past 20 years. In addition, studies with higher quality scores did not generate prevalence rates that were meaningfully different from those with lower quality indices. Among study types, adolescent and adult general population studies did evidence the highest overall quality scores. This finding simply may be due to the fact that these projects more often used larger sample sizes and random subject selection than the special population studies which often relied on smaller samples of convenience.

This study also revealed that only 40.1% of the available prevalence studies were subjected to peer review. Taken together, the failure to improve methods and the paucity of published prevalence studies encourages us to ask what factors may have hindered the evolution of methodological quality. For example, the peer review process is one important means of improving methodological rigor among scientists. Since the majority of prevalence studies in the gambling field were absent this resource, it is not surprising that, taken as a group, gambling prevalence studies have not reflected improved methods over time. Furthermore, the largest single publication outlet for the published prevalence studies was the *Journal of Gambling Studies*. While this is an excellent scholarly journal, it is not intended primarily as an epidemiological journal. During the period that these prevalence studies were published, to the best of our knowledge, there were no epidemiologists on the editorial review board. Therefore, given the relatively closed circle of investigators and reviewers who were conducting and inspecting

Table 18: Comparing Past-year Prevalence Rates of Psychiatric Disorders Among Adolescents: Where Does Disordered Gambling Fit?

	Meta	NY	ONT
Gambling Disorder (Level 3)	5.8		
Conduct Disorder (All Types)		5.4	5.5
Attention Deficit Disorder		4.3	6.2
Anxiety Disorder		2.7	N.A.
Major Depressive Episode		1.7	N.A.

[45] *New Scientist* (1969, September 25).

gambling prevalence research, there was little stimulation from independent psychiatric epidemiologists who specialized in the development and implementation of prevalence research. It is imperative that the field of gambling studies attract new and seasoned investigators from other more mature fields of inquiry to advance gambling research.

Somewhat surprising was the finding that study quality did not significantly influence prevalence rates. Since the methodological quality index was distributed normally, we might have expected that studies from the highest and lowest quartiles of the distribution would have yielded meaningfully different prevalence rates. However, this was not the case. Since methodological quality apparently failed to influence prevalence rates, we have concluded that disordered gambling is a robust and reliable phenomenon. Disordered gambling appears to be relatively impervious to some of the weaknesses inherent in many of the research designs reviewed in this study. Nonetheless, readers should consider the alternative explanation that the methodological quality index we have developed may not accurately reflect the degree of methodological quality associated with a study. This failure to accurately reflect methodological quality could have occurred for two reasons.

The first possibility is that our index of methodological quality may have failed to identify all of the appropriate variables that best represent methodological quality. Although we made efforts to include factors clearly related to the development of internal validity and methodological quality, other researchers might select a somewhat different set of factors; the possibility remains that we omitted some important factors and included some other factors less important to study quality. The second possibility is that some of the researchers who did conduct high-quality studies did not reflect these high-quality methods in their reports, and consequently received relatively low methodological quality scores. In addition, it is possible that researchers who conducted studies with low overall quality actually were diligent about reporting the details of their methodology. Under these circumstances, they would have received full credit for any individual components associated with study quality that appeared in their reports. In the cases where a study's methodological quality score failed to reflect the true nature of a study's quality, any existing relationship between quality score and prevalence rate may not have been revealed. More research is necessary to investigate the relationship between prevalence and study quality.

The finding that methodological quality did not influence prevalence rates should not be taken as support for sloppy research methods or for those who would avoid the expense associated with high-quality research protocols and designs. Scientists have a social responsibility: they are obliged ethically to develop and implement studies that are rigorous, objective, and precise. When a prevalence project includes most of the elements of a quality research design, but compromises on some of the important components, the entire study is questionable. Questionable studies do not permit meaningful interpretation of results, and as a consequence cannot be generalized with precision. Since poor-quality studies demand resources and may produce misleading results, we encourage legislators and administrators to devote the resources necessary to conduct high-quality studies. Researchers interested in reading more about the essential components of high-quality prevalence research should consult Appendix 3.

Comparing Lifetime and Past-Year Prevalence Rates

Inspection of the aggregated lifetime and past-year prevalence rates for adolescent studies summarized in Table 5 reveals an unexpected phenomenon for both level 3 and level 2 rates: the mean past-year rate is higher than the mean lifetime rate. There are a number of possible explanations for this curious phenomenon. We will consider two of the principal explanations here. The first explanation is as follows: for most adolescents, past-year gambling experiences will be comparable to lifetime gambling experiences; in other words, any gambling experiences adolescents have had in their lifetime

are likely to be featured in their past-year experiences. Adolescents are fairly close in time to the chronological moment when they started experimenting with gambling. Therefore, they are unlikely both to have developed and also recovered from gambling problems. This notion that adolescents' lifetime and past-year rates are similar is supported by the fact that there is considerable overlap between the confidence intervals that represent the lifetime and past-year prevalence of disordered gambling.

A second explanation is that very few adolescent studies provided both lifetime and past-year rates; those that did provide both types of rates used different instruments for lifetime and past-year rates. Thus, the studies that provided lifetime rates and the studies that provided past-year rates represent two fairly distinct and exclusive subsets of data. These two subsets of studies have other distinct characteristics. For example, lifetime studies were more likely to represent Quebec and the South Central region of the United States, while past-year studies were more likely to represent Ontario, New England, and the North Central Region. In addition, lifetime studies were more likely to use the SOGS, versions of the DSM, and the multifactor method, while past-year studies were more likely to use the MAGS and the SOGS-RA. Finally, lifetime studies were conducted earlier (mean = 1993) than past-year studies (mean = 1995). Taken together, these factors may have combined to yield higher past-year estimates than lifetime rates. An interesting example illustrates this possibility. In Volberg's (1993a) study of adolescents in Washington state, three separate prevalence rates are provided: a lifetime rate derived from the Multifactor Method, a lifetime rate derived from the SOGS, and a past-year rate derived from the SOGS-RA broad criteria. A comparison of these three rates reveals that, for level 3 gambling, the past-year estimate is higher than either of the lifetime estimates (SOGS-RA broad criteria past-year rate = 3.0%; Multifactor Method lifetime rate = 0.9%; SOGS lifetime rate = 1.5%). The same pattern exists for level 2 gambling (SOGS-RA broad criteria past-year rate = 20.0%; Multifactor Method lifetime rate = 9.0%; SOGS lifetime rate = 6.5%). This example suggests that instrumentation accounts for most of the difference between lifetime and past-year rates. However, since we have identified an increasing rate of disordered gambling among the general adult population, we should not dismiss the possibility that adolescents also are experiencing an increasing prevalence of gambling disorders that currently is not detectable using the existing meta-analytic data set. Future research is necessary to clarify this matter further.

Time Frame Caveats and Concerns

The results revealed that, compared to adults from the general population, youth from the general population were nearly three times as likely to have experienced level 3 (i.e., pathological) gambling in their lifetime and approximately 2.6 times as likely to have experienced level 2 (i.e., "problem") gambling in their lifetime. These findings raise interesting issues. In theory, these findings could indicate that the prevalence of disordered gambling is increasing in the general population. That is, in theory, lifetime rates cannot decrease over time; thus, when the adolescent respondents represented in this report reach adulthood, they should evidence higher lifetime rates of disordered gambling than the current adult respondents represented in this report. This finding would provide evidence that there is a cohort effect that is influencing the prevalence rates of level 3 gambling. In other words, assuming lifetime rates are valid, these results indicate that the adults represented in this report did not experience the same degree of disordered gambling during their adolescence as current adolescents are experiencing. Therefore, the higher rate of disordered gambling found among contemporary adolescents may be attributable not simply to adolescence but, rather, to some interaction of adolescence and the current social setting (e.g., availability of gambling, changes in the social setting, cultural approval of gambling). If this is the case, the rate of disordered gambling in the general population will increase as these adolescents grow into adulthood and new generations of adolescents repeat this pattern.

However, there are other possible explanations for these findings. One possibility is that the use of liberal screening instruments used with adolescents and more conservative instruments used with adults is responsible for the difference between the prevalence rates of these two groups. The present results, however, do not provide support for this explanation. For example, a comparison of SOGS results for adults and adolescents (using consistent definitions of level 2 and level 3 gambling throughout) indicates that, for both lifetime level 3 and lifetime level 2, adolescents do have higher rates (level 3: adult mean = 1.71%, n = 29; adolescent mean = 4.83%, n = 4; level 2: adult mean = 3.38%, n = 27, adolescent mean = 9.26%, n = 3).

Still another explanation for these relative risk findings exists. Instruments using a lifetime time frame may not measure what these instruments purport to measure. One reason that lifetime prevalence rates may provide a less-than-valid measure is that "poor recall is associated with advancing age" (Stewart, Simon, Shechter, & Lipton, 1995, p. 272). In other words, the adults represented in this study actually may have experienced a rate of disordered gambling during their adolescence that is similar to the rate experienced by the adolescents represented in this study. However, with advancing time and diminishing memories, adult respondents forgot their adolescent experiences and underreported their lifetime symptoms. This circumstance would result in underestimates of lifetime disordered gambling rates among adults. This hypothesis will remain viable until scientists conduct incidence studies that can clarify the waxing and waning of gambling-related memories and support or refute this notion.

Finally, lifetime time frames may provide overestimates of disordered gambling for two very different methodological reasons: symptom clustering and exclusionary requirements. First, we will consider symptom clustering. When scientists identify the prevalence of any psychiatric disorder, it is important to measure the existence of a determined number of symptoms during a specified and meaningful period of time. Instruments with lifetime time frames collect data about lifetime symptom prevalence. However, the reported symptoms may have existed during considerably different time periods, even separated by many years. Under this circumstance, a positive lifetime total score (e.g., 5 or more positive responses on the SOGS) will not reflect the existence of a disorder, just the waxing and waning of subjective experiences. In other words, as Walker and Dickerson (1996) cautioned, survey respondents who report meeting the necessary screening criteria may not have experienced all of the reported symptoms within the time frame necessary to identify a coherent disorder. To illustrate, with a lifetime time frame, a respondent who experienced five SOGS symptoms simultaneously for an extended period of time would receive the same score as a respondent who experienced one symptom during one year, a different symptom four years later, two other symptoms the next year, and a fifth symptom three years later. Theoretically, the phenomenon of overestimating prevalence as a result of "non-clustered" symptoms will increase as the age of respondents increases, since older respondents have more opportunities to experience isolated symptoms; therefore, older respondents have more opportunity to reach the threshold for lifetime pathological gambling. For this reason, we recommend the use of past-year (or other "current") time frames as the most accurate measure of the existence of clustered indicators of a gambling disorder.

The second potential methodological compromise to lifetime time frames is that investigators have neglected to implement exclusionary requirements (Boyd et al., 1984). In virtually every study of disordered gambling included in this review, prevalence estimates fail to distinguish whether the excessive gambling could be better explained by psychiatric illness (e.g., manic episode, anti-social personality). During both lifetime and past-year time frames, investigators must determine whether the presence of another psychiatric illness could better explain intemperate gambling. Respondents with psychiatric illnesses that can confound estimates of disordered gambling must be excluded from survey samples.

Cunningham-Williams, Cottler, Compton, & Spitznagel (in press) calculated odds ratios for the likelihood of recreational and disordered gamblers having higher rates of 13 psychiatric and substance abuse disorders than non-gamblers. The association between gambling and Anti-social Personality Disorder was the strongest: the group of problem gamblers were 6.1 times as likely as non-gamblers to meet diagnostic criteria for Anti-social Personality Disorder. These findings and other preliminary explorations point to a reasonable hypothesis that some percentage of people identified with a gambling disorder may be suffering primarily with another psychiatric disorder. We will discuss this matter in more detail later in the section of the *Discussion* that considers pathological gambling and exclusion criteria.

To assist researchers in their attempt to manage time frame difficulties, we suggest that investigators—after having excluded respondents who qualify as having potentially confounding psychiatric illness—determine if the remaining eligible survey respondents meet specific lifetime criteria for disordered gambling that includes a time frame for symptom clustering. Investigators should then determine whether this level of gambling (e.g., pathological gambling) was present during the past year (i.e., 12 months). Investigators also have the opportunity to determine if the respondent was in remission from their gambling problem. Since DSM-IV does not include remission guidelines, and no standard has been established in the area of gambling disorders, we suggest the following criteria.[46] For full remission, respondents must have previously met criteria for a level 3 gambling disorder, and there should be no evidence of gambling for the past 12 months; in addition, there must be no symptoms present for the past 12 months. To establish partial remission, the respondent must have previously met criteria for a level 3 gambling disorder, but during the past 12 months satisfies only level 2 criteria for subclinical gambling. For respondents who have never met criteria for a level 3 gambling disorder, the guidelines for a level 2 gambling problem place them in the "problem" or "at-risk" group of gamblers; although these gamblers may resolve their difficulties with no further progression, clinicians should consider them at risk for developing a more serious disorder.

Calculating Prevalence Rates

Nearly every study in this meta-analysis conceptualized prevalence rates in the same way: Prevalence was calculated by dividing the number of respondents experiencing disordered gambling by the total number of respondents in the study. Expressing prevalence rates as the percentage of the "general population" that experiences the phenomenon in question is a standard practice in epidemiological research. However, in the gambling research field, there are benefits to including a second method of calculating prevalence rates: in this second method, prevalence rates would be calculated by dividing the number of respondents experiencing disordered gambling by the number of respondents *who are at risk for developing disordered gambling* (e.g., those in the total population who have gambled in their lifetime). This conceptualization of prevalence is based on the premise that if one never gambles, there is no active or practical risk of becoming a pathological gambler.[47] Similarly, if one never drinks alcohol, there is no risk of developing alcohol dependence. This approach is appropriate in a number of prevalence-related research protocols. For example, when determining the prevalence of adverse reactions to a prescription medication or a toxic substance, only those exposed to the substance are considered at risk; thus, this group is used as the reference group among which prevalence is calculated.

[46] These criteria rest upon similar guidelines for research first established by McAuliffe et al. (1995) and Robins et al. (1985).

[47] There always remains the theoretical risk that a non-gambler will begin to gambling and then become a disordered gambler.

Unless the entire population has been exposed to gambling, prevalence rates of disordered gambling are lower when using the epidemiological standard of the entire population as the denominator. Social observers might argue that in contemporary America and Canada, everyone is exposed to gambling because of the extent of lottery and casino advertising. However, being exposed to gambling advertising is not the same as being exposed to gambling experience. Exposure to gambling advertising can be considered a risk factor for determining the incidence of new gamblers. In addition, this secondary approach to prevalence can be used to determine whether different segments of the population (e.g., adolescents, treatment groups) have differential sensitivity to the risk factor of *exposure* to gambling. For example, two groups could have similar prevalence rates of disordered gambling when prevalence is calculated in the standard manner, but have significantly different rates when prevalence is calculated as the percentage of those who have gambled. In this hypothetical scenario, one of the groups could have a lower rate of gambling but a higher rate of disordered gambling among those who have gambled. We recommend that, in future studies, investigators report their data using this method of calculating prevalence as well as the standard method. At the very least, investigators should describe precisely how they calculate and operationally define their reported prevalence rates. This is a conceptual and methodological matter of considerable importance, and it requires significantly more attention and dialogue than it has received.

The Different Purposes of Prevalence and Incidence Studies

As we discussed earlier in this report, prevalence and incidence measures are produced from distinct and different study methodologies and designs. Although several scientists whose work is included in this meta-analysis use the terms "prevalence" and "incidence" interchangeably (e.g., Allen, 1995; Kallick et al., 1979; Laventhol & Horwath et al., 1990), it is important to keep the differences between these concepts in mind. For example, although we identified 120 prevalence studies of disordered gambling, there have been virtually no incidence studies conducted in this field.

In lieu of conducting incidence studies, most researchers in the gambling field have opted to conduct cross-sectional baseline and replication prevalence studies in an attempt to identify trends. Under these circumstances, baseline and replication studies will provide little useful information about trends unless sampling, methodological design, and study implementation are very similar. Absent such duplication of methods, a replication study will simply provide another prevalence estimate that may evidence errors now compounded across two separate studies. Although prevalence estimates are not optimally suited to distinguish trends, these rates are useful to identify the extent of disordered gambling and the potential treatment needs within a particular region or population. In addition, prevalence researchers have not yet devoted attention to the prevalence of disordered gambling among specific segments of the population (e.g., homeless, senior citizens, gay men and lesbians). If investigators are interested in identifying trends in prevalence, they should conduct incidence studies. It is time for the field of disordered gambling studies to conduct true incidence research by prospectively exploring the factors and circumstances that shift the scope and severity of disordered gambling in the United States and Canada.

The Validity of Disordered Gambling Prevalence Estimates

"Most of the change we think we see in life is due to truths being in and out of favor."

- Robert Frost (1914)

This section of the *Discussion* brings our examination of disordered gambling prevalence estimates full circle. The results of this meta-analysis suggest that there is a relatively stable and robust phenomenon that we have called "disordered gambling." These results also suggest that estimates of disordered gambling remain stable in spite of various statistical maneuvers and wide variation in study quality and

characteristics. Although these results do encourage confidence about the *reliability* of this phenomenon, the stability and robustness of this phenomenon should not be interpreted as a proxy for *validity*. To determine if the results of this meta-analysis provide a "valid" estimate of disordered gambling in the United States and Canada, we must first consider what the constructs of disordered gambling and validity mean within the context of American and Canadian society and contemporary scientific theory.

At the outset of this report, we noted that scientists tend to view the world through three different frameworks: (1) realism, (2) instrumentalism, and (3) relativism (Casti, 1989). We have taken a relativistic perspective on the concept of prevalence. From this standpoint, scientists *manufacture* prevalence estimates. This relativistic perspective provides room for culturally diverse views of gambling. For example, unlike Americans and Canadians, Chinese do not recognize the construct of pathological gambling, only "bad" gambling (Pathological gambling as a reflection of cultural norms, 1997). Certainly, some Chinese gamble to excess; however, within their view of the universe, this intemperate gambling can be only bad or good; it cannot be an illness. Within the Chinese culture, pathological gambling has no validity. This issue may seem incredible to some, but validity is indeed a relative idea. Validity is fluid, dynamic, and not fixed by any single research finding or data set. Validity is only as serviceable as the current theory that provides it safe haven. In this section, we will explore some of the central issues that relate to validity in general (Cochrane & Holland, 1971; Dohrenwend, 1995; Malagady, Rogler, & Tryon, 1992; Robins, Helzer, Ratcliff, & Seyfried, 1982) and construct validity in particular (Cronbach & Meehl, 1955).

Paradigms for Understanding: The Relative Nature of Disordered Gambling

Burke (1985) reminds us that the universe is best understood through a shifting theoretical lens known as a paradigm. Our social and scientific paradigms provide meaning to the social and natural order while simultaneously blinding us to alternative perspectives. "When we observe nature we see what we want to see, according to what we believe we know about it at the time. Nature is disordered, powerful and chaotic, and through fear of the chaos we impose system on it. We abhor complexity, and seek to simplify things whenever we can by whatever means we have at hand. We need to have an overall explanation of what the universe is and how it functions. In order to achieve this overall view we develop explanatory theories which will give structure to natural phenomena: we classify nature into a coherent system which appears to do what we say it does... All communities in all places at all times manifest their own view of reality in what they do. The entire culture reflects the contemporary model of reality. We are what we know. And when the body of knowledge changes, so do we" (Burke, 1985, p.11).

When primitive peoples watched the sun move across the heavens, they saw evidence that the sun was rotating around the earth. Today, people watching the same sun crossing the same sky see it as evidence for a very different phenomenon: now, the earth is revolving around the sun. Although the evidence is precisely the same, our experience of it is dramatically different. Our theory has changed, and therefore so has the universe. Today, we recognize excessive and intemperate gambling as the result of a confluence of biological, psychological, and social factors (e.g., Shaffer, Stein, Gambino, & Cummings, 1989). This understanding, or paradigm, provides the lens through which the construct of disordered gambling comes into focus. With the emergence of this gambling construct, we can address the matter of its validity.

When considering the validity of any construct, scientists and policy makers must ask the primary question: valid for what? A construct can have considerable validity and utility, only to lose these attributes in a technological instant when a new finding shifts our understanding of the universe. For example, though modern ge-

netics had its roots in the—apparently concrete—construct of 48 chromosomes, the development of the electron microscope shifted our paradigm and revealed the presence of only 46 chromosomes. Instead of simply assuming that a "true" prevalence estimate awaits our capacity to identify it accurately, we believe that a dynamic interplay of factors influences and determines every prevalence estimate: which measurement instrument, with which population, with which sampling strategy, with which administrative procedure, at which historical point in time, under the direction of which scientists; all of these factors influence the outcome of an effort to estimate prevalence. This observation is particularly true when we try to estimate the prevalence of a latent class in the absence of a gold standard (Faraone & Tsuang, 1994). A latent class is the "actual" state of a person under consideration, for example, a patient subjected to psychological evaluation. "Simple examples of latent classes from everyday life are seen in the human tendency to classify people according to personality attributes (honest or dishonest), emotional states (happy or sad), or intellectual ability (intelligent or unintelligent). We cannot directly observe honesty, happiness, or intelligence, but we can observe behavior from which we infer these latent (i.e., unobservable) characteristics" (Faraone & Tsuang, 1994, p. 651). By adopting a relativistic posture to the analysis of the state presumed to underlie disordered gambling, we can explicate the manufacturing process responsible for generating prevalence estimates; in turn, this posture will allow us to improve the quality controls associated with these production activities.

Reconsidering Clinical Diagnoses as the "Gold Standard"

Investigators of gambling prevalence often have assumed that clinicians provide the "gold standard" against which the accuracy of screening instruments should be measured (e.g., Lesieur & Blume, 1987; Volberg, 1996b; WEFA Group, ICR Survey Research Group, Lesieur, & Thompson, 1997). For example, Volberg (1996b) uses the term "probable pathological gambling" rather than "pathological gambling" and states that "the term ***probable*** distinguishes the results of prevalence surveys, where classification is based on responses to questions in a telephone interview, from a clinical diagnosis" (p. 3). Drawing a similar conclusion, the WEFA Group et al. (1997) state that, "Because only a clinical evaluation using DSM-IV can diagnose pathological gambling, we have used the term 'probable' pathological gambling" (p. 5-2). "Since the survey is not a clinical diagnosis, we cannot say that respondents can be 'diagnosed' as pathological gamblers, rather we use the term 'probable' pathological gamblers" (p. 5-5).

However, clinicians who perform diagnostic evaluations are not as reliable as many people have assumed. Meehl (1954; 1973) and others (e.g., Rosenhan, 1973; Ziskin, 1970) demonstrated long ago that clinicians are extremely vulnerable to biases in clinical judgment. Because of the many problems associated with clinical judgment, Kleinman (1987) reminded clinicians to sustain a tentative posture as they considered diagnostic classification: "If [classification] ...is applied as a tentative model, … with serious concern for its likely inadequacy to grasp the subtlety, ambiguity and obdurate humanity of the sick, if it is distrusted, received as a mere shorthand, regarded as one vision among others, then it is more likely to be adequate to what should be the humane core of clinical work ..." (pp. 51-52). In addition, Faraone and Tsuang (1994) emphasize the fact that psychiatric diagnoses should not be considered a gold standard and that it is important to assess the adequacy of these diagnoses. Therefore, the assumption that gamblers should be grouped into a tentative class, for example, ***probable*** pathological gamblers, partly because clinicians have not yet determined the accuracy of that categorical assignment, is faulty. There is little evidence suggesting that clinicians are more accurate instruments of classification than screening instruments. In fact, Lee Robins has concluded that, "'clinical practice is not an adequate standard against which to measure the validity of a research instrument'" (cited in Malagady, Ro-

gler, and Tryon, 1992, p. 63).[48] Nevertheless, as Kleinman encouraged, we suggest that all diagnostic classification—whether clinician- or instrument-based—be held as tentative, and not the final word (Shaffer, 1986b).

Validity as a Theory-Driven Construct

The problems associated with determining validity begin with its very definition. Validity is the capacity of an instrument to measure what it purports to measure. Validity is neither a static nor an inherent characteristic of a screening instrument. As Goldstein and Simpson (1995) suggest, "validity refers to the questions 'for what purpose is the indicator being used?'... and 'how accurate is it for that purpose?'" (pp. 229-230). Determining instrument validity is an unending and dynamic investigative process. We cannot simply conclude that an instrument has been shown to be valid for all purposes and all settings. "An indicator (e.g., an instrument, such as a test, a rating, or an interview) can be valid for one purpose, but not for another" (Goldstein & Simpson, 1995, p. 230). Directed by theoretical and ultimately practical purposes, validity is the dynamic consequence of applying an instrument to a measurement task. In the field of gambling studies, theory is conspicuously absent from most prevalence research. As we mentioned earlier, when conventional wisdom and theory shift or change, the validity of an instrument can be terminated abruptly. The history of the SOGS provides an example of the relative nature of validity. Although for some time researchers considered that the SOGS lifetime measure had "been found valid and reliable" (Volberg, 1994b, p. 238), some investigators now suggest that the SOGS lifetime measures "…over-state the actual prevalence of pathological gambling" (Volberg, 1997, p. 41).

In addition to a paucity of theory-driven gambling-related epidemiological data, there also is a shortage of objective-driven prevalence research. In the absence of clearly stated purposes, it is virtually impossible to determine the standard against which the validity of the construct underlying a prevalence estimate of disordered gambling should be judged. "It is ordinarily necessary to evaluate construct validity by integrating evidence from many different sources. The problem of construct validation becomes especially acute in the clinical field since for many of the constructs dealt with it is not a question of finding an imperfect criterion but of finding any criterion at all" (*Psychological Bulletin Supplement*, 1954, pp. 14-15; as cited in Cronbach & Meehl, 1955, p.285). In the absence of a criterion, or gold standard, "…many such tests have been left unvalidated, or a finespun network of rationalizations has been offered as if it were validation. Rationalization is not construct validation" (Cronbach & Meehl, 1955, p. 291).

Given that the field of psychiatry in general, and disordered gambling in particular, has no gold standards (Faraone & Tsuang, 1994), there is little rationale for placing one instrument, or clinical diagnosis, as the gold standard against which another instrument is measured. As Faraone & Tsuang (1994) note, "many studies of psychiatric diagnosis compute accuracy statistics. However, these assess the accuracy of one diagnostic approach (e.g., DSM-IV) with respect to another (e.g., expert clinical diagnoses). They do not assess the accuracy of diagnostic procedures with reference to the 'true' but unobservable latent state of illness" (p. 651).

Like the MAGS[49] (Shaffer et al., 1994), the SOGS has its roots in the DSM-based criteria (Lesieur & Blume, 1987). Similarly, clinical assessment is, in theory, based on DSM criteria. Consequently, it is a tautological error to use clinical diagnosis or the DSM criteria as an index of validity for the SOGS or the MAGS. In

[48] Interested readers should see Ziskin (1970) and Faraone & Tsuang (1994) for a more complete analysis of this problem.

[49] The MAGS also has its roots in the shortened version of the Michigan Alcoholism Screening Test (Pokovny, Miller, & Kaplan, 1972).

each of the disordered gambling instruments derived from criteria established by the American Psychiatric Association (e.g., SOGS, MAGS, and psychiatrists or other professionally trained clinicians who diagnose disordered gambling according to DSM criteria), DSM criteria do not provide an ***independent*** standard against which any of these clinical instruments or activities can be judged (Malagady et al., 1992). The following observations made by Malagady et al. (1992), although originally made in reference to the development of the Diagnostic Interview Schedule (DIS), apply equally to the development of a valid instrument for disordered gambling: "The flaw in setting psychiatrist's clinical skills as the standard of criterion-related validity is the fact that psychiatric diagnoses are not *external* to lay diagnoses because both come from the DIS ....in the absence of empirical research linking DIS diagnoses to external (non-DIS) criterion-related standards, there is simply little that can be said regarding the psychometric validity of the DIS at the present time. Lay-psychiatric concordance is praiseworthy because of the economic utility gained in epidemiological research. On the other hand, lay-psychiatric concordance is not praiseworthy when it is taken as a proxy for validity" (Malagady et al., 1992, pp. 62-63). Economic, emotional, and procedural inertia encourage scientists to continue using existing standards of construct validation. Nevertheless, economic, personal, and administrative advantages do not necessarily provide a solution for the formidable matters of validity.

Absent a "gold standard" for determining pathological gambling, we do not know whether the SOGS over-estimates the prevalence rate of gambling disorders or whether clinical assessment and DSM-based instruments underestimate the prevalence rate. This problem of anchoring reveals itself often as scientists attempt to determine how best to frame prevalence estimates. To illustrate, while discussing the results of her recent New York replication study, Volberg (1996b) suggests that "...the cut-off point for the DSM-IV Screen (5^+ = pathological gambling) is too severe and should be moved back to include individuals with less severe gambling difficulties." This adjustment "...would allow the screen to capture individuals whose pathology is well-developed but perhaps not yet extreme" (p. 50). However, the practice of using an instrument originally based on DSM criteria (i.e., the SOGS) as the anchoring standard against which the DSM is held for comparative evaluation is questionable. This conceptual confusion has plagued epidemiological measurement for many decades, and psychological screening instruments from their earliest days (Cronbach & Meehl, 1955). We should not be surprised that these issues also surround the construct of pathological gambling.

In spite of Volberg's notion that screening can identify a "true" or "actual" prevalence rate of disordered gambling (Volberg, 1997, p. 41), she tacitly recognizes that prevalence rates are flexible and relative depending upon the purpose for which the estimates will be used. For example, in her study of Washington state adolescents, Volberg states that "Our approach, while conservative, is intended to focus as clearly as possible on those adolescents who show incontrovertible signs of problematic involvement in gambling" (Volberg, 1993a, p.17). Volberg uses this conservative approach, in part, because she is "…uncomfortable with a method [i.e., the SOGS] that classifies 8% of adolescents as problem or probable pathological gamblers" (1993a, p. 34). In other words, the criteria for identifying pathological gambling are not fixed, but vary depending on whether a given set of criteria yields an "acceptable" prevalence rate among a particular group.

Considering False Positives and False Negatives: The Need for Theory

The often-repeated debate about false positives and false negatives contributes little to our understanding of gambling disorders. An instrument may yield useful prevalence indices even if it has only moderate sensitivity and specificity. So long as false positives are "balanced" by false negatives, an instrument will perform very

well as a general population screen.[50] Only when these faulty classification assignments fail to balance does a screening instrument begin to deteriorate as an index of population prevalence. The major problem with the debates surrounding faulty classification is the same as the debates about validity: to determine a false assignment, scientists must invoke a standard against which we judge the classification system. Without a gold standard, there is the risk of an "infinite frustration"—always trying to refer to a higher standard for construct validity (Cronbach & Meehl, 1955). Consequently, the only way out of this conceptual chaos is to develop what Cronbach & Meehl called a nomological network: an interlocking system of laws that constitutes a theory.

As we have described, with few exceptions the prevalence estimates reviewed in this study seem to have been promulgated, at best, by the question of "let's find out," and, at worst, in a conceptual vacuum. The goals and objectives of disordered gambling prevalence estimation have not been made sufficiently clear by the various research teams who set out to generate such estimates. Without knowing whether investigators want the estimates of disordered gambling prevalence to guide the development of public policy, allocate limited public health resources, expand scientific knowledge, identify economic needs, or inform some other activity, observers are left to project their own needs on prevalence estimates. Absent a driving set of objectives, gambling epidemiologists have not provided policy makers with some of the basic information essential to building an effective system of treatment (e.g., estimates of the obstacles to treatment entry and how often people encounter these difficulties). Similarly, because prevalence research has not been driven by explicit theory, investigators have not identified the direction of movement among level 2 gamblers either toward or away from more disordered states. Without this information, social cost estimates are less than precise, and the challenges to conceptual validity continue without a foreseeable end.

Is Pathological Gambling a Primary Disorder?

The various versions of the DSM that have included pathological gambling as a distinct disorder also have drawn attention to the possibility that other disorders may coexist and negate the diagnosis of pathological gambling. The DSM-III (APA, 1980) instructed clinicians to avoid making the diagnosis of pathological gambling if the gambling was secondary to a primary diagnosis of Antisocial Personality Disorder, hypomanic or manic episode, or social gambling. The DSM-III-R (APA, 1987) revised the exclusion criteria by removing Antisocial Personality Disorder. The DSM-IV (APA, 1994) indicates that a diagnosis of pathological gambling should not include behavior patterns better explained by manic episodes. DSM-IV also includes a comment that pathological gambling must be distinguished from social and professional gambling, and that "problems with gambling may occur in individuals with Antisocial Personality Disorder; if criteria are met for both disorders both can be diagnosed" (p. 617). In addition, DSM-IV notes that pathological gamblers "may be prone to developing general medical conditions that are associated with stress… Increased rates of Mood Disorders, Attention-Deficit Hyperactivity Disorder, Substance Abuse or Dependence, and Antisocial, Narcissistic, and Borderline Personality Disorders have been reported in individuals with Pathological Gambling" (p. 616).

Although clinicians may be heeding these exclusion criteria for purposes of treatment planning, for the most part, researchers simply have ignored the implications of exclusion criteria (Boyd et al., 1984). One of the research implications of these clinical recommendations is that prevalence estimates of pathological gambling may be overestimates when other disorders such

[50] In clinical practice, however, quality patient care requires a very different standard of accuracy; when there is only one case under consideration, there is no one to "balance" a misdiagnosis. Therefore, the consequences of clinical errors may be quite severe.

as manic episodes are not identified by the survey instrument. Another implication is that, as attested to by the shifting of the exclusion criteria from antisocial personality disorder to manic episode within a seven-year period, investigators of disordered gambling phenomenon are still struggling to develop a clear definition of pathological gambling. Much remains unknown about the nature of the overlap among antisocial personality, manic episodes, and pathological gambling. Future research that measures the prevalence of related psychiatric disorders along with pathological gambling will provide important insight into these questions.

Ultimately, the field of gambling studies is in need of research that can provide additional construct validity. While the evidence from this meta-analysis provides considerable support for a recognizable and identifiable pattern of behaviors that we have considered to be disordered gambling, there are important conceptual questions that still remain. A primary construct validity question requires scientists to focus on whether disordered gambling is a primary or a secondary disorder. For example, according to the DSM-IV, a person meeting all of the criteria for pathological gambling is *not* considered a pathological gambler if he or she also meets the criteria for a Manic Episode, and the Manic Episode is responsible for excessive gambling (APA, 1994). In this case, pathological gambling is not considered a unique disorder, but rather a cluster of symptoms associated with another disorder. If pathological gambling represents a primary disorder, then it can emerge in the absence of other co-morbidity and cause sequelae independent of any other condition. However, if it is a secondary disorder, subordinate to other dysfunctional behavior, then pathological gambling will only exist as a consequent of another condition (e.g., manic episode, anti-social personality, alcohol abuse, obsessive-compulsive disorder or adolescence; Jessor & Jessor, 1977). Although this meta-analysis suggests that researchers of disordered gambling have measured a relatively stable and robust phenomenon, the field of gambling studies has not yet established with ample certainty that this phenomenon represents a *unique* construct.

Does disordered gambling reflect a unique primary or dominant psychiatric disorder? For example, consider the following hypothetical scenario: A survey investigates pathological gambling, depression, and alcoholism by using the SOGS, a depression inventory, and the CAGE (Ewing, 1984) with a general population sample. The results of this survey indicate that respondents' scores on the depression inventory and the CAGE successfully discriminate pathological gamblers from non-pathological gamblers (i.e., these scores not only correlate, but also predict a respondent's level of gambling problems on the SOGS). In this scenario, pathological gambling may not be a discrete syndrome, but rather may reflect a cluster of symptoms associated with alcoholism and/or depression. In other words, disordered gambling may be the expression of other underlying factors which also are common to alcohol abuse and depression.

Rosenthal and Rosnow (1975) remind us that we must be sensitive to the relationship between appropriate and inappropriate criteria during the process of establishing construct validity. Adapting an example originally provided by Rosenthal and Rosnow (1975), suppose we find that the SOGS correlates .85 with a criterion of the pooled judgment of expert clinicians. While this would appear to provide concurrent validation for the SOGS, suppose further that we also administer the CAGE questionnaire and an index of depression. If we also learned that the total SOGS score correlated significantly with the composite CAGE and depression index, would the SOGS be a reasonably valid test of gambling, alcoholism, depression, all three, or of none of these? As Rosenthal and Rosnow (1975) conclude in their analysis about a similar example of test validation, "That question is difficult to answer, but we could not claim on the basis of these results to understand our [SOGS] test very well. It was not intended, after all, to be a measure of [alcoholism or depression]. In short, our test has good concurrent validity but poor differential validity. It does

not correlate differentially with criteria for different types of observation" (p. 70).

Since gambling researchers have paid very little attention to this important conceptual issue of discrete and comorbid phenomena[51]—and the associated matter of differential validity—the possibility remains that pathological gambling is not a discrete primary disorder. Alternatively, it also is possible in some cases that pathological gambling will represent a discrete and primary disorder (i.e., it will exist independent of any other disorder), but in the majority of cases other primary disorders will provide better explanations of excessive gambling (i.e., disordered gambling will be subordinate to other primary disorders). Figure 18 illustrates this possibility. Currently, according to the DSM-IV, pathological gambling can have either primary or secondary status: in some cases it is considered to be a primary disorder (i.e., independent of other diagnoses), and in other cases it is considered to be the sequelae of another disorder. The implications of this issue are potentially significant for both the development of treatment prescriptions and social policy initiatives designed to ameliorate or regulate gambling-related problems.

Whether we view disordered gambling as primary or secondary, intemperate gambling inflicts human suffering. If pathological gambling is a primary disorder, it often will require professional assistance; if it is a disorder secondary to another problem, it still may require specialized care or assistance focusing on gambling issues in addition to the problems related to the primary disorder. Future research will help clarify these theoretical, research, and clinical issues.

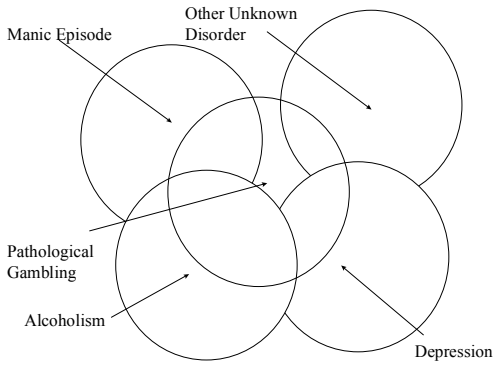


Figure 18: Is Pathological Gambling a Discrete Phenomenon?

Toward an Understanding of Disordered Gambling in Context: The Interaction of Social Setting and Personality

"Excess on occasion is exhilarating. It prevents moderation from acquiring the deadening effect of habit."
- W. Somerset Maugham (1938)

It may seem very difficult to understand and integrate the shifting patterns of disordered gambling prevalence. Levine (1978) reminds us that our perception of addictive behaviors in general and drunkenness in particular readily shifts over time; our conception of a disorder changes as new experiences color understanding. Social learning provides a similar conceptual model to provide insight into the prevalence findings reported earlier. Norman Zinberg adapted the traditional three-part model of host, agent, and environment used by public health workers to understand infectious disease processes so that he could gain better insight into drug effects (Zinberg, 1974; 1984). During the middle 1980s, this model was modified to explain the social psychology of intoxicant use in general (Zinberg & Shaffer, 1985; Shaffer &

[51] Briggs, Goodin, & Nelson (1996) have conducted preliminary research on this issue. Their "findings indicate no significant cross over of addictions between the two samples. This would seem to indicate that alcoholism and pathological gambling are independent addictions. One might infer from this that they also involve independent processes" (Briggs et al., pp. 517-518). In spite of these conclusions, the Briggs et al. study employed a unique subject sample (e.g., use of self-help group members) that likely represents the tails of two special self-selected distributions; they also employ a small sample size. Taken collectively, these factors encourage us to view their results as tentative and their conclusions as uncertain.

Zinberg, 1985). Zinberg's (1984) model suggested that a drug and its effects were not isomorphic; in other words, to understand the effects of any psychoactive drug, it would be necessary to understand the drug, set (i.e., psychological expectations), and setting as an interactive whole. Similarly, to study the psychological and social effects of gambling, and patterns of disordered gambling in particular, it is necessary to consider gambling, set, and setting as an interactive whole. This three-factor model provides insight into the effects of any activity that holds the potential to shift subjective states (Shaffer, 1996). Now, we will adapt this model to provide a conceptual context for understanding the prevalence patterns of disordered gambling.

Gambling represents the specific activities associated with playing a particular game (e.g., determining what numbers to play in a lottery and buying a ticket; determining what version of poker to play [5 or 7 card] and participating in the game; playing a slot machine). ***Set*** refers to the personality structure of the individual, including their attitudes toward the experience and any values that might be associated with the activity. ***Setting*** is considered to be the influence of the physical and social environment within which gambling (or any intoxicant use) takes place.

To understand an individual's decision to initiate or sustain gambling, we must consider the gambling/set/setting interaction, since these factors directly influence the gambling experience. The relationships among gambling, personality, and social structure seem straightforward initially. For example, most observers of human behavior know that psychological states vary greatly and are influenced by the environment and, of course, that gambling can make an impact on these states. Gambling can excite the spirit, temporarily reduce feelings of depression, and help people dissociate from day-to-day problems (e.g., Jacobs, 1989). While easy to grasp in the abstract, surprisingly, these issues are very difficult to understand and accept in practice. Most of us have become so accustomed to thinking about gambling as an exciting recreational activity that we too often assume the effect of gambling to (1) be the same for everyone and (2) remain relatively constant over time for each person. The operators and promoters of gaming establishments and activities are not eager to dispel this belief. To maximize the impact of gambling experiences, advertisements of the full array of gaming activities avoid reminding gamblers that the experience may have different effects on different people and, further, that the effects of any particular activity on the same person may vary over time.

In spite of the overwhelming aura of hope and excitement that gaming promoters have encouraged people to expect when they gamble, most gaming experts have come to accept the influence of set and setting on gambling experiences. For those not experienced with the gambling, set, and setting interaction, consider another even more common illustrative situation: alcohol, set, and setting. Most people recognize, either from observing their own behavior or the behavior of others, that the effects of alcohol vary from person to person, and vary for the same person over time. For example, Zinberg and Shaffer (1985) remind us of the range of drinkers: happy drinkers, morose drinkers, belligerent drinkers, and flirtatious drinkers. Sometimes alcohol can be a relaxant (e.g., the martini after a hard day at the office), and sometimes it can be a stimulant (e.g., the first drink at a party). At times alcohol can release inhibitions, and at other times those who already have put aside their inhibitions will take a drink or two to provide themselves with a socially acceptable alibi. Often, alcohol is a mood accelerator, deepening depression or heightening elation, depending on the preexisting conditions. From the pharmacological and neurophysiological perspectives, alcohol suppresses the action of certain inhibiting centers in the brain and can have no result inconsistent with this action. Yet the range of actual effects observed, both behavioral and psychological, is extremely wide. It may be precisely this wide range of possibilities that makes alcohol such a popular drug. The multidimensional effects of alcohol serve to emphasize the importance of the interaction of drug, set, and setting.

Similar to alcohol, the interaction of gambling, set, and setting yields multifaceted effects. We have observed exhilarated, ecstatic, timid, angry, and depressed gamblers. Like alcohol, gambling is a mood accelerator that can deepen depression or facilitate elation. Like alcohol, gambling can encourage some people to separate from their consciousness into another psychological realm where time passes rapidly and few worries exist (Jacobs, 1989). Similar to Khantzian's self-medication hypothesis for intoxicant use (e.g., Khantzian, 1975; 1985; 1989; 1997) and Wagner's (1986) humorous idea about the value of separating from reality since it is a primary source of stress, Jacobs (1989) also suggested that the experience of gambling can serve as an anodyne to painful emotional states. Most "recreational" activities provide emotional diversion, relief, and opportunity for affective renewal; this is the sine qua non of recreation. While gambling may be work for the professional gambler, the amateur gambler expects to experience a positive shift in their subjective experience when they participate in gambling (Shaffer, 1996).

The Impact of Social Setting on Gamblers and Gambling

As a result of changes in the social setting during the 1960s and 1970s, people quite different from their earlier gambling counterparts began to gamble. To illustrate, consider Zinberg and Shaffer's (1985) description of a pattern of shifting events associated with the history of drug use. Weil, Zinberg, and Nelson (1968) were the first to notice that chronic marijuana users were more anxious, antisocial, and likely to be dysfunctional than the naïve subjects who were just beginning to use marijuana in 1968. These early users were closer in spirit to the few disenchanted musicians and other groups that used marijuana before the drug revolution of the 1960s. By the late 1960s, drug use was being experienced as a more normative choice than it had been before 1965. Later, during the early 1970s, marijuana use was sufficiently widespread that it was not possible to describe these smokers as driven to drug use by deep-seated, self-destructive, unconscious motives. If we had drawn conclusions about the effects of marijuana based only upon people's early experience with the drug and failed to consider the historical moment of its use, then we would have assumed incorrectly that marijuana alone causes profound psychiatric and personality disturbance.

In the 1990s, gamblers are quite different from their earlier 1970 counterparts. The gamblers who first tested the opportunities to gamble legally were different from those who began to gamble only when playing these games was sufficiently widespread that it was normative. Before casino gambling became widely accessible during the last quarter of the 20th century, legal gamblers had to have the motivation, time, and financial means to travel to Nevada or Atlantic City to gamble. The relative isolation of most people from these settings provided an informal social control over who would gamble, and how much they could gamble in casinos. Similarly, before New Hampshire resurrected legal numbers gaming by implementing a state lottery, gambling on numbers was limited strictly to illicit bookmaking. Today, numbers gaming is so common that many people do not even consider lottery playing to be gambling.

The data presented earlier suggests that disordered gambling prevalence can be explained in large measure by knowing something about the gambler. If we assume that the something we need to know about the gambler is their personality, then we would be adopting a psychodynamic perspective on gambling behavior. However, it is incorrect to assume that the prevalence of disordered gambling is simply a function of personality patterns. This inaccurate assumption is common among clinician theorists who tend to see only one very small segment of disordered gamblers—that is, help-seeking gamblers. Help-seeking gamblers likely are very different from their non-help-seeking counterparts. To illustrate, when researchers examine patients who enter treatment for addictive disorders, they tend to find very high rates of trauma and psychiatric disorder. This relationship often leads to the conclusion that these very

serious problems cause addiction. However, when researchers first identify people with high rates of addiction (independent of help-seeking behavior), and then identify the pattern of their psychiatric disorders and trauma experience, the strength of this apparent causal relationship diminishes or disappears (e.g., Gendreau & Gendreau, 1971). There are many people with mental illness and traumatic experiences who do not develop addictive behaviors; therefore, these complex conditions cannot be the necessary and sufficient causes of addiction, though these conditions qualify as meaningful risk factors.

Risk Factors and Social Sanctions

Youthful gamblers represented among the general population and college students have what Vaillant once quipped was a "time-limited disorder." This "disorder"—best thought of as a risk factor for gambling-related problems and a variety of other social problems—is adolescence. The prevalence rates of disordered gambling reflected among the treatment and prison populations also distinguish groups with higher rates of psychiatric disorder than observed among the general public. Like adolescence, psychiatric disorders represent a cluster of risk factors for disordered gambling. In addition, adolescents, treatment, and prison groups are among the least likely to avoid gambling simply because it is illicit, unavailable, or socially proscribed. These groups engage in more socially deviant or anti-social behavior—including gambling—than the general adult population. These groups will tend to gamble regardless of the availability of legalized gambling. Consequently, for these groups, the prevalence rates of disordered gambling will be influenced less meaningfully by the growth of legally available gambling. In fact, it is possible that as gambling becomes even more mainstream—if indeed it does—then these more deviant groups might begin to move away from any form of licit gambling because it will not offer the opportunity for the expression of anti-social motives.[52] If we examine only these atypical groups, absent any influence from the social setting (e.g., a historical perspective), we might conclude that higher rates of gambling experience caused their psychological problems. However, this conclusion would be faulty: these groups, traditionally and developmentally associated with anti-social motives and behavior patterns, are the least likely to be influenced by the legal availability of gambling (Shaffer & Zinberg, 1985; Zinberg, 1984).

Alternatively, the general adult population, having relatively low rates of psychiatric comorbidity and having already matured beyond their anti-social, independence-seeking stage of development, is the most likely population segment to be influenced by the availability of socially approved gambling opportunities. This group is the least likely to gamble illicitly, and the most likely to begin gambling only when gaming is perceived as mainstream precisely because of the absence of risk factors. Like wearing bell-bottoms or having pierced ears—activities of different eras that once were limited only to small counterculture groups with anti-social motives and later adopted by the larger society—gambling, which once was limited to groups with anti-social behavior patterns, gradually is becoming a mainstream activity in the United States and Canada. Consequently, more people from the cultural mainstream will continue to be exposed to gambling experiences as gaming becomes more accessible. The first people to try a new social activity will be those who are more deviant than their successors. We will describe this phenomenon in more detail in the next section of this discussion.

Interestingly, if gambling falls out of social favor, which already has happened during at least two other historical eras in the United States (Rose, 1986; 1995), then the gamblers who remain active likely will have attributes similar to their deviant counterparts who first pioneered

[52] This observation should not be taken as implicit support for the "legalization" of underage gambling since there are many other social issues that bear on this question.

each of the preceding social movements that brought gambling into favor. Those who are most pro-social will be the first to stop gambling when the activity falls out of social favor. This pattern is similar to the current observation—now that cigarette smoking is unpopular in America—that smoking will become a marker for psychiatric disturbance. This observation asserts that only those with psychiatric disturbance will continue to smoke in the face of mounting social pressures not to smoke. The attitude that a culture has toward gambling will determine which segments of the population are willing to "gamble" with gambling. The more unfavorably society views gambling, the more deviant groups will be represented disproportionately among those who participate in the activity.

This theory raises an interesting question: will the higher-than-adult prevalence rates of disordered gambling reported by young people continue to be identified years from now when this cohort evolves into the adult respondents in general population studies, or will they conveniently experience memory distortion (Schacter, 1995) that will lower the rate of lifetime disordered gambling prevalence?

The Natural History of Illicit Activities: The Shift from Socially Sanctioned to Socially Supported Activities

Observers of gambling history often quip that the church and the state once were the two most ardent opponents of gambling; now, these two institutions are the two most active supporters of gambling. Shaffer and Zinberg (1985) and Zinberg and Shaffer (1985) described the natural history of an illicit activity and its evolution to widespread popularity. When an illicit activity—marijuana use or gambling—is (1) newly introduced into a social setting, (2) modified by statute so that it shifts in status from illicit to licit, or (3) modified by the folkways or mores of society so that it is more commonly experienced, the previously illicit activity is still perceived as deviant by the larger culture. Generally, those who seek out new experiences with previously illicit or currently illicit activities have strong motives for doing so, and are therefore considered by the larger social group to be misfits or psychologically disturbed. First experiences of the new activity usually are accompanied by high anxiety because participants fear society's disapproval, and are accompanied by little knowledge of the activity's effects. Gradually, as the new or deviant behavior becomes more prevalent and popular—as marijuana use did during the mid-1960s and gambling did during the 1980s and 1990s—knowledge about the activity and its effects increases. Slowly, as experience with gambling grows, gamblers correct misconceptions. New misunderstandings may develop, however: for example, the idea that all excessive gamblers are very intelligent or hyperactive. In the midst of the inevitable controversy and questioning that develops between the first-generation gamblers and the "mainstream" culture, a second generation of gamblers appears. Instead of attempting to break with the larger society as did the first-generation gambler, this second-generation gambler, motivated by curiosity or an objective interest in the effect of gambling, stimulates a more comprehensive cycle of information acquisition about gambling and its consequences. As a result of this social evolution, gambling has become a relatively average and expectable activity among adolescents (e.g., Shaffer, 1993; Zinberg, 1984). As a cohort, young people now participate in gambling just as they consistently have used tobacco and alcohol in spite of the illicit status of this group of activities (Shaffer, 1993). When this second generation of gamblers supports the experiences of the first generation, gamblers are more likely to be heard by the larger culture. These new gamblers are greater in numbers, more diverse in background, and their motives less antagonistic than those of the first generation; therefore, this social group is more acceptable to the mainstream. This second generation of gamblers has the opportunity to explode many of the stereotypical myths that have existed about gamblers and gambling.

As the second generation of gamblers matures, the larger society tends to move away from its formerly rigid position toward gambling. As a result, society often becomes more confused

about its attitudes. This confusion tends to motivate non-gamblers and communities or states without gambling—those not energized by social rebellion—to experiment with gambling. The experience of this group has more influence on the larger social setting than either of the first two groups of gamblers described earlier. Finally, as increasingly diverse groups of people participate in gambling and represent active gamblers, it becomes more probable that various gambling styles will work better and cause less difficulty. Nevertheless, Rose (1986; 1995) reminds us that the growth of gambling can recede with short notice when corruption and scandal occur, as was the case in each of the previous two waves of gambling expansion in the United States.

In sum, as each generation of gamblers acquires more knowledge about the activity and as this information is disseminated, there is less likelihood that users who have disturbed personalities will predominate. A very few years from now, large numbers of people who were born after the modern advent of widespread legalized gambling will have children entering adolescence; the roles these parents may play in socializing their children about gambling may be very different from the roles played by their own parents in socializing their gambling behaviors.

Toward the Future: Implications for New Prevalence Research

Applications of Prevalence Estimates

The vast majority of studies reviewed in this meta-analysis failed to describe how principal investigators, sponsors, health providers, or policy makers intended to use the newly constructed estimates of disordered gambling prevalence once these appraisals became available. Most studies simply generated prevalence estimates because people wanted to know. Without a specific, well-defined project purpose—in advance of developing a study protocol—prevalence estimates provide little more than a sumptuary rejoinder to an active curiosity. While prevalence rates provide interesting information for inquiring minds, there are more important applications available for this information. For example, will the prevalence data be used to plan for prevention, treatment, or law enforcement activities?

This section of the discussion will briefly describe some of the important ways that investigators can use prevalence estimates to guide the allocation of limited resources. In each instance, however, the objectives of prevalence research will require that investigators adjust their study methods and instruments to provide the specific information necessary and relevant to their designated purpose. Absent specific project objectives, prevalence researchers will be left to study aimlessly, unable to produce the essential findings, or the level of precision in their findings, that policy makers require if they are going to decide judiciously how to allocate limited financial, human, and other resources. In the absence of explicit goals, investigators have not implemented the rigorous methods necessary to generate the representative samples, ample sample sizes, adequate numbers of disordered gamblers, or a set of overall findings that permit health policy makers to build prevention and treatment systems for disordered gamblers by allocating resources in a definite manner. For example, after conducting a statewide and state-funded study to identify the impact of legalized gambling in Connecticut, the WEFA Group et al. (1997) concluded that the sample of pathological gamblers identified by their telephone survey was inadequate to allow them to address issues related to (1) the social costs of gambling or (2) any of the important psychological, social or treatment characteristics of intemperate gamblers in Connecticut. This deficiency is remarkable, since the project's primary purpose was to complete "A study concerning the effects of legalized gambling on the citizens of the state of Connecticut."

Health policy makers need to know not only how many disordered gamblers there are in a given jurisdiction, but also what the obstacles to treatment may be for this group, how many people would use treatment if it were available, and what level of treatment (e.g., inpatient or outpa-

tient) people in their catchment area might require.

Social Objectives

There are a number of social objectives that prevalence research can achieve. For example, estimates of disordered gambling prevalence can help monitor socio-cultural trends. These trends assist policy makers, city planners, and others to forecast the future behavior of broad segments of the population. An understanding of these trends is essential to building an adequate system of public health services. To prepare for moving people to and from leisure time activities, transportation, recreation, and other services that have the capacity to assure customer comforts also can make use of this data.

The identification of risk factors for disordered gambling is another benefit of properly conducted prevalence studies. Identified risk factors will allow social scientists to develop programs that minimize the risks for populations with specific characteristics (e.g., young males, psychiatric patients with major depression).

Knowledge of population attributable risks has important public health implications. For example, a measure of population attributable risk for "maleness" addresses the question, "Out of all risk factors, how much of disordered gambling can be attributed to maleness?" The importance of this measure is twofold: First, it allows administrators and public health program managers to prioritize the allocation of limited resources by identifying the more important causes from the set of known possible causes; further, it provides insight about where investigators should look for additional information about risk factors that exert meaningful influence on disordered gambling. Second, an attributable risk assumes more importance if, in addition to a specific risk factor being attributable for a meaningful percentage of the problem, it identifies a risk factor that is mutable. Under these conditions, public policy and public health interventions would be of benefit to those most harmed by the risk factor. Technically, under these circumstances, we can interpret population attributable risks to represent the percentage of the gambling disorder that could be reduced if the risk factor were eliminated. For example, if gambling after 1 A.M. was identified as having a total attributable risk of 25% for a level 3 gambling disorder, then we will be able to reduce level 3 disordered gambling by 25% if a public policy effectively limited late night and early morning gambling. Similarly, if drinking alcohol while gambling was identified as having an attributable risk of 40% for level 3 gambling, then we will be able to reduce level 3 gambling by restricting the use of beverage alcohol while gambling.

Economic Applications

Economically, prevalence data can be used as one essential component of a mathematical algorithm to determine the social costs or social benefits of gambling. Prevalence data can help to determine the nature of illicit gambling markets, and the impact of these markets on law-abiding industries. Estimates of disordered gambling behaviors can help the banking industry to better understand how people save, invest, and borrow money, goods, and services.

Psychological Purposes

Finally, from a psychological perspective, estimates of disordered gambling prevalence help to provide important insight into the relationships between risk-taking and risk-avoiding, immediate gratification and delayed gratification, treatment needs and treatment seeking, natural recovery and treatment-based recovery, hope and hopelessness, mindfulness and mindlessness, and euphoria and dysphoria. Epidemiological studies of disordered gambling also provide the opportunity to study how depression emerges, develops, and passes.

Prevalence and Treatment Planning

While many prevalence investigators tout building a treatment system as the ultimate utilization of disordered gambling rates, none have deter-

mined what are the obstacles to using treatment, what is the likelihood of using treatment, or what is the history of treatment utilization across various segments of the provider network for gamblers with various levels of disorder. Prevalence research in the field of gambling rarely has contributed direct guidance to establishing a treatment system.

The relationships among social, economic, and clinical forces can influence how individual clinicians diagnose and prescribe a course of treatment for patients struggling with addictive disorders. The confluence of contemporary social paradigms (e.g., Schlesinger, Dorwart, & Clark, 1991; Shaffer, 1986a; Shaffer & Robbins, 1991) can influence both individual clinicians (Shaffer, 1986b) and social policy makers (Schlesinger & Dorwart, 1992); as a result, both treatment prescriptions and treatment resource allocations are sometimes made on the basis of social perception instead of empirically determined need. For example, Schlesinger et al. (1991) examined the availability of treatment resources in United States cities; they noted that clinical resources were not always proportionately related to need. The availability of clinical services can reflect media and political emphasis rather than current substance abuse trends.

Instead of examining what clinicians, politicians, and social policy makers speculate or assume that people with excessive behavior patterns need, it is imperative to examine the best available evidence. Only on a few rare occasions does a pound of anecdote yield an ounce of proof. Since gambling prevalence studies often reflect more emotional heat than light when it comes to understanding the causal influence of gambling and the development of disordered gambling, we must examine the available evidence carefully and conservatively. This caution will protect us from drawing premature conclusions about a complex social matter.

Currently, we can match only a limited number of treatment modalities to the array of treatment needs. This problem exists because the available clinical resources are quite limited. Once researchers can identify the extent of treatment need by conducting empirically derived "needs" assessment, the development of a full range of treatment resources will become possible and the clinical matching process can proceed with precision. To design optimal needs assessment data models, program planners should have a clear understanding of the data requirements and needs assessment purposes. Clinical considerations largely determine these requisites. After data is obtained from a needs assessment, planners must decide how to allocate clinical treatment services to meet these identified needs. Unfortunately, some gambling treatment planners have strong statistical backgrounds, but less knowledge of the clinical aspects of gambling and addiction treatment.

Toward New Theoretical Maps: Guiding Future Research & Practice

"Categories are the outcomes of historical development, cultural influence, and political negotiation. Psychiatric categories – though mental illness will not allow us to make of it whatever we like – are no exception."

- Arthur Kleinman (1988)

Similar to the shifting definition of AIDS and diabetes (Centers for Disease Control and Prevention, 1992; Knox, 1997), the concept of pathological gambling likely will undergo transformations as scientists refine gambling-related theory, instrumentation, and research findings.[53] As science advances our understanding of gambling disorders, a "gold" standard likely will emerge. This development will permit clinicians to improve the diagnostic sensitivity and specificity of screening instruments; in turn, this advance will make available improved opportunities for more effective treatment matching. Similarly, researchers should become better able to distinguish people most in need of clinical services from those who do not require intervention. In addition, screening instruments for adolescents, psychiatric patients, inmates, and vari-

[53]Similar conceptual shifts and compromises have been observed with regard to definitions of hypertension and elevated cholesterol levels.

ous ethnic groups will improve as scientists develop more focused techniques for estimating the impact and consequences of gambling on these population segments. To accomplish these objectives, we must understand the relationship between theory and research.

Theory guides research. Prevalence research is no exception to this rule. Research without theory is like a person who has a very large check in their possession—a check capable of shifting how the owner experiences life on a daily basis—but no banking mechanism available to deposit or cash it. If this person with latent wealth cannot transform the check into cash, the check's financial potential will have little practical consequence. To advance scientific understanding and public welfare, new gambling-related research initiatives will require theoretical maps. In addition, scientific investigators, working as explorers, will need to identify where to apply their theoretical maps; this terrain will become the new territory of future prevalence research.

Nomenclature & Classification: A Conceptual Map for Future Prevalence Research

"Just as the largest library, badly arranged, is not so useful as a very moderate one that is well arranged, so the greatest amount of knowledge, if not elaborated by our own thoughts, is worth much less than a far smaller volume that has been abundantly and repeatedly thought over."

- Arthur Schopenhauer (1893)

Meta-analytic research requires a conceptual architecture that permits the synthesis of different and sometimes quite disparate study results. Without trans-theoretical concepts to provide a higher-level system than individual research findings provide, it would be virtually impossible to integrate diverse data. The level system (Shaffer & Hall, 1996) provided the necessary intellectual bridgework to complete this integrative research without adding any stigmatizing language. While there is little magic in the continuum of levels suggested by Shaffer and Hall (1996), this scheme emerged as a central cog in this meta-analysis. Consequently, we suggest that researchers who promulgate estimates of disordered gambling prevalence begin to report their findings using the level system. By employing the level system, investigators do not have to abandon their theoretical preferences. It still remains possible to refer to disordered gambling as pathological, probable pathological, compulsive, or excessive gambling. However, by recognizing that prevalence estimates disseminated by one study inevitably will be compared with rates from other studies, investigators can provide the common currency to relate these rates with more precision than is available now. Rather than leave the level assignment and interpretation of their results to others, we suggest that investigators report prevalence rates (1) using nomenclature of their choosing as well as (2) a specific level estimate of their results.

Estimates of level 0 (i.e., people who have never gambled) and level 1 (i.e., people who have gambled but do not experience any adverse symptoms associated with their gambling) prevalence allow social policy makers the opportunity to employ primary prevention programs that delay or prevent the onset of activities that can lead to gambling and its potentially harmful consequences. Absent estimates of level 0 and level 1 gambling, it is not possible to evaluate the effectiveness of prevention programs designed to interrupt the initiation of gambling.

Several of the studies reviewed in this report included categories resembling level 1 gambling. However, the majority of these studies (e.g., Volberg, 1993a; Winters et al., 1993b) integrated respondents who had never gambled (level 0) with non-problem gamblers (level 1) in this category; by failing to distinguish these two groups, these findings cannot be employed to improve our understanding of gambling incidence and primary prevention efforts designed to delay or stop the onset of gambling. Furthermore, by identifying level 1 prevalence rates, future studies will allow public policy makers and clinical service providers the opportunity to apply and evaluate secondary prevention programs that hold the promise of minimiz-

ing the likelihood of gamblers developing problems related to gambling.

The level system also encourages scientists to develop new instruments that can distinguish between sub-clinical gamblers (i.e., level 2) who are moving toward pathological gambling states (i.e., level 3) and those who are moving away from level 3 difficulties. By making these sophisticated distinctions among gamblers and their gambling disorders, scientists permit health care planners to begin developing clinical services that employ a treatment matching strategy. These distinctions among gamblers who experience different levels of adversity in their relationship to gambling holds the potential to have broad impact on the development of new social policies and estimates of the clinical services necessary to treat the next generation of pathological gamblers. For example, armed with the ability to distinguish patients who are progressing toward more disordered levels of gambling from those who are moving in the direction of less disordered levels, clinicians can begin to identify those who require early treatment programs to arrest the progression of gambling related problems and those who require relapse prevention programs to facilitate and sustain recovery. Future research must begin to identify and attend to the needs of level 2 gamblers. Similarly, by improving their ability to recognize level 3 gambling, policy makers and treatment providers can plan a full range of clinical programs, as well as tertiary prevention programs that can minimize the harm already caused gambling activities.

The final category of this scheme, level 4 gambling, is actually a subset of level 3 gambling. This group includes respondents who meet level 3 criteria and also seek treatment for their gambling-related problems. We could not measure the extent of level 4 gamblers in this study since there is a paucity of this type of prevalence data. Estimates of level 4 prevalence will be more useful to social policy makers and clinical service providers than level 3 estimates alone, since level 4 rates provide an estimate of "caseness" (i.e., how many people with the observed symptoms and signs might actually enter and benefit from treatment; Vaillant & Schnurr, 1988).

The recognition of level 2 gamblers raises another important question: the estimates of gambling disorders reported in this article and others (e.g., Wallisch, 1993; Lesieur et al., 1991; Jacobs, 1989) suggest that the rate of youth gambling problems exceeds that of adults. During the next decades, either these young people will continue to evidence higher lifetime rates of disordered gambling than their adult counterparts, or the measurement of lifetime gambling prevalence contains flaws and fails to reflect accurately the level of gambling that adults experienced during their youth. If young people lower their past-year rate of disordered gambling without treatment as they age, this may provide another example of natural recovery from addictive behavior (e.g., Shaffer & Jones, 1989). Existing studies have not determined whether young people have used self-help groups, clergy, school counselors, friends, or many other resources to help them withdraw from gambling activities.

Some prevalence researchers have stated that the difference between lifetime and current prevalence rates represent individuals who can be regarded as disordered gamblers in natural recovery (e.g., Volberg, 1995b) or "spontaneous remission"[54] (e.g., Wynne Resources Ltd., 1994, p. 51). This conjecture rests on the observation that there are few treatment services for disordered gamblers in the United States. However, Wallisch (1993) offers several explanations for higher lifetime than current prevalence rates of disordered gambling; these explanations apply equally to research that identifies a lower rate of lifetime gambling or gambling disorders during a follow-up or replication study. Groups that

[54] Shaffer & Jones (1989) demonstrated that natural recovery is anything but spontaneous. People who recover from addictive disorders naturally actually move through a series of well-defined but overlapping stages. Readers interested in these stage changes should review Shaffer (1992, 1994, 1997a) for a comprehensive and detailed analysis of these events.

evidence this curious pattern actually may (1) still be disordered gamblers who just do not report a current problem, (2) be recovering gamblers or gamblers in remission who have undergone treatment and no longer think of themselves as they had previously, or (3) truly be disordered gamblers who really have quit or cut back on their own.

Scientists need to determine whether the differences between adolescent and adult prevalence rates result from comparisons of meaningfully different groups of cohorts. There remains still another complex possibility: if adults are more defensive about gambling activities than adolescents and, consequently, disguise or minimize their self-reported levels of gambling and its consequences, then prevalence estimates of pathological gambling among adolescents and adults are more similar than current evidence reveals. Given the array of alternative explanations, suggestions about natural recovery rates in the current literature must be considered highly speculative. Shaffer and Jones (1989) were the first investigators to document the process of natural recovery from cocaine addiction. Their research reveals some of the major difficulties associated with making a precise determination of recovery without treatment. New, carefully crafted research must address these questions of natural recovery from gambling disorders with the same level of rigor as investigators have exerted in other areas of addiction studies (e.g., Cunningham, Sobell, Sobell, & Kapur, 1995; Sobell, Cunningham, & Sobell, 1996). Only by developing precise estimates of natural recovery can economists accurately estimate the social costs of disordered gambling.

Understanding the behavior of level 2 gamblers also holds considerable potential to lower the social costs associated with gambling disorders. "The common risk factors for many diseases are present in a large proportion of the population, and therefore, most of the cases of disease arise from the intermediate- and low-risk groups. Relatively small changes in risk among the middle-risk group can result in a greater overall reduction in disease burden than do greater changes in the high-risk group" (Brownson, Newschaffer, & Ali-Abarghoui, 1997, p. 736). To illustrate, although level 3 gamblers represent people with a more intense and potentially destructive relationship with disordered gambling than their level 2 counterparts, this group is considerably smaller in numbers. In spite of the more moderate nature of the problems experienced by level 2 gamblers, their larger numbers are likely responsible for producing more adverse impact on American and Canadian society than their more disordered level 3 counterparts. This circumstance is very similar to the observation that problem drinkers are responsible for more aggregate social problems than their alcohol dependent counterparts (e.g., Sobell & Sobell, 1993). As was the case with research on problem drinkers, future gambling research likely will reveal that level 2 gamblers are more responsive to treatment and social policy interventions than level 3 gamblers.

Finally, future research must continue to examine the prevalence of gambling disorders among young people to determine if the prevalence of gambling problems increases as gambling opportunities become more readily available and more socially sanctioned. Jacobs (1989) speculated that the prevalence of these problems will increase; however, it is possible that while gambling proliferates, the prevalence rate of disordered gambling will remain constant or actually begin to diminish after people have sufficient experience with gaming activities to begin adapting to the experience and protecting themselves from the potential adversities that accrue to some gamblers. This social learning process is similar to the experience of hallucinogen users during the 1970s (Bunce, 1979). Unfortunately, both of these rather positive social possibilities include the likelihood that the rate of level 2 gambling will continue to increase until informal and formal social controls emerge to help young people better regulate their gambling behavior (e.g., Zinberg, 1984). Even if adverse consequences from gambling do diminish, over time, inter-generational forgetting occurs, and new generations of young people will tend to develop problems with self-destructive activities that previously had been better controlled. For example, after many years of declining rates,

and after significant education and prevention efforts, drug abuse rates among young people are beginning to rise again (e.g., Johnston, O'Malley, & Bachman, 1996). Just as we might have expected from the previous discussion, scientists observed this increase in substance use and abuse about a generation ago.

Collinearity and Its Implications for Future Prevalence Research

The existing set of disordered gambling prevalence estimates revealed a consistent pattern of collinearity. The largest and most methodologically sound studies evidenced the lowest overall rates of disordered gambling among broad population segments. The smallest and often most methodologically weak studies focused on narrow population groups and yielded the highest estimates of disordered gambling prevalence. This pattern of multiple correlations can confuse observers of the gambling prevalence literature, public health workers and social policy makers alike. For example, the common impression that gambling disorders have increased proportionally among the young and often disenfranchised social groups (e.g., those suffering with major psychiatric illness) is revealed to be a function of the pattern of new emerging prevalence research during the 1990s, and not a characteristic of disordered gambling trends. Similarly, if we examine only these atypical population groups, failing to recognize their unique psychological attributes, and ignoring the important influences from the social setting (e.g., a historical perspective), we might conclude that higher rates of gambling experience caused their psychological problems. The confusion that collinearity can cause should serve as a clarion call to scientists.

To better understand the nature of disordered gambling prevalence, investigators must begin to conduct larger scale studies of special populations, and smaller but prospective studies of the adult and youth segments of the general population. Scientists will need to improve their sampling methods and evaluate how these methods can influence and bias estimates of prevalence. Policy makers likely will balk at this suggestion, claiming that the proportionally small segments of the total population with the highest rates of disordered gambling contribute relatively little to the overall population prevalence rates. While this may be true mathematically, it misses the purpose of having prevalence rates. Having a purpose is critical to utilizing prevalence estimates effectively. Policy makers need to understand the rates and characteristics of small segments of the population who will use resources disproportionately. To plan an effective health care system, planners will need to know which gamblers will enter treatment and which will not. They also will need to know the obstacles that exist to treatment entry for each of these often ethnically diverse groups. To facilitate the impact of these services, planners must learn how to engage level 2 and level 3 members of these groups into treatment, and then how to keep them there long enough for the therapeutic experience to be effective.

To assist investigators as they implement prevalence research, we recommend a minimum set of standards to guide future research. The following section will describe these suggestions, and Appendix 3 includes a brief guide to conducting prevalence research.

Recommended Standards for Future Prevalence Research

To accomplish the import tasks and objectives of estimating the prevalence rates of gambling and its associated disorders, future investigators must develop improved standards for research. To expedite this process, we suggest that scientists observe at least the following eleven basic standards to prepare and conduct investigations of disordered gambling prevalence.

1. Establish a precise statement of purpose and objectives;

2. Select, modify, or create an instrument that can satisfy the study objectives;

3. Determine a time frame for the gambling disorder as well as its associated cluster of signs and symptoms;
4. Determine how best to eliminate alternative psychiatric disorders;
5. Determine a sampling design to select respondents;
6. Use a power analysis to plan for adequate representation of the population(s) of interest;
7. Properly calculate response and completion rates;
8. Provide a protocol for selecting and training interviewers;
9. Supervise the collection of data;
10. Check the integrity of data coding and data entry;
11. Apply the results.

A full review of these issues is beyond the scope of this report. However, in Appendix 3 we provide a brief guide to these principles as well as an examination of these methodological principles.

Caveats & Limitations

Similar to Miller et al. (1995) in their groundbreaking meta-analysis of alcohol treatment methods, we wish to emphasize that this analysis of the prevalence of gambling-related problems should be regarded a "first approximation" to summarizing the literature while taking into account the methodological quality of studies. Some would differ with the logic of our prevalence coding system. Others would disagree by adding or subtracting items or algorithms to our methodological rating system. Still others would quarrel with our data weighting strategies or multi-method approach to drawing conclusions about the point values or confidence intervals of our prevalence estimates. Miller et al.'s (1995) caveat applies to this project as well: despite our multi-step "…review process to minimize errors, it is likely that in any project of this size there are overlooked details, and surely judgment calls for specific studies on which reasonable colleagues would disagree" (p. 31).

In addition to the strategic caveats described above, there are some specific sampling limitations that require consideration. With the exception of some treatment studies and some in-school adolescent studies, the vast majority of the study samples included in this meta-analysis were unable to survey the entire population of interest. Consequently, prevalence studies employ sampling strategies; in turn, sampling strategies can introduce bias to research findings (e.g., as a result of a weak sampling strategy or an incomplete implementation of a sound strategy) (Walker & Dickerson, 1996). Walker and Dickerson note that sources of sampling bias can include (1) excluding particular groups from the sample, (2) under-sampling specific ethnic or cultural groups, and (3) under-representing pathological gamblers among the selected sample. Although we examined many other potential sources of bias that could compromise the internal validity of research included in this study (e.g., response rates, coverage issues, data integrity, sample size), this meta-analysis was unable to explore every potential source of research bias (e.g., whether the study samples adequately represented the racial or ethnic distribution of the populations from which the samples were taken).

This meta-analysis was limited by the breadth and depth of the prevalence studies that met the criteria for inclusion in this study. Collinearity of the data is also a result of the nature of these included studies. It is striking that investigators conducted the large studies in this meta-analysis only among general populations, and the treatment population studies were all small. This may be a reflection of the limited sources of funding for gambling research; it also may indicate that researchers often are attracted to study topics and employ methods that can be accomplished with the most convenience. It would benefit the field of gambling research to examine the gaps in knowledge that have resulted

from these research patterns, and begin to address these gaps. For example, a large-scale study of psychiatric patients would have sufficient power to inform clinicians, researchers, and policy makers regarding the health care needs and treatment needs of pathological gamblers who are among the psychiatric patient population.

Meta-Analyses of Prevalence Estimates: Advancing the Field

This meta-analysis has both similarities to and differences from the growing body of meta-analyses currently being published in the scientific literature. All meta-analyses, including this one on the prevalence of disordered gambling in the United States and Canada, attempt to synthesize and integrate a select body of scientific evidence into a more streamlined, quantitative summary. This report has produced synthesized estimates of disordered gambling prevalence across segments of the population. However, like all meta-analysts, we encountered conceptual and procedural elements that made this integration complex. These elements included outliers, missing information, implicit assumptions in the included studies, and conceptual and methodological inconsistencies across the included studies. In addition, the collinear nature of the data complicated the exploration of specific influences (e.g., region, researcher) on the prevalence estimates. Throughout the scientific literature, the pool of prevalence-related meta-analyses is still quite limited. New research likely will contribute innovative methodologies that can advance our understanding of prevalence and its potentially shifting patterns.

Conclusions

One of the benefits of a meta-analysis is the ability to answer and pose new questions that may not be raised in each of the included studies (Colditz, Berkey, & Mosteller, 1997). For example, there is indirect evidence suggesting that, like legalization of psychoactive substances in other countries (e.g., MacCoun & Reuter, 1997), increases in gambling may be due more to advertising than simply legalization (WEFA Group et al., 1997). Future analyses of prevalence estimates across jurisdictions that are matched for differential exposure to advertising may provide additional insight into this situation. The implications of this research for future social policy is considerable.

Regardless of the scope of future studies that await inevitable scientific inquiry, this meta-analysis provides empirical evidence that disordered gambling is a relatively reliable and robust phenomenon, capable of resisting a range of methodological variation. Given the stability of prevalence estimates across a wide array of studies, some final conclusions are in order. Adolescents and college students have higher rates of level 3 gambling than adults in the general population. Males have higher rates of level 3 gambling than females.

Keeping the caveats that were described earlier in this discussion in mind, some additional conclusions can be drawn. Both gambling and gambling studies have proliferated during the past 20 years: as gaming in the United States and Canada expanded rapidly during the 1980s and 1990s, so did the scientific investigation of gambling disorders. To date, half of the gambling prevalence studies conducted in the United States and Canada were completed after 1992. In addition, the newer prevalence studies have focused more on youth and treatment populations; these groups evidence higher relative risk for gambling disorders than adults from the general population. Consequently, casual observers of these recent findings are likely to perceive an increase in the prevalence of gambling-related disorders as a consequence of expanded gaming (e.g., lotteries, keno, casinos, charitable gaming, etc.). Nevertheless, the findings reported earlier failed to provide evidence that disordered gambling has increased among young people from the general population, college students, or adults who are receiving some form of treatment or incarceration. Despite these results, prevalence studies examining adults from the general population do reveal an increasing pattern of

gambling-related problems. For example, the prevalence of level 3 gambling appears to have increased over time among adults in the general population.

A number of important factors influence the estimation of disordered gambling prevalence. These elements include individual risk factors or personal attributes (e.g., age, gender, psychiatric status), and the components of the research process. It is time for epidemiological science and public health demands to exert a stronger influence on the nature of this methodology and the future of disordered gambling research studies.

Primary Prevalence Studies[55]

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Appendix 1: Multi-method Estimators

The following tables present multi-method estimators within each of the four populations segments. "LT" refers to lifetime estimates; "PY" indicates past-year estimates.

Adults				
	Level 3 LT	Level 2 LT	Level 3 PY	Level 2 PY
median	1.54167	3.32750	.95000	2.28333
mean	1.59639	3.85156	1.13876	2.79570
M: Huber	1.58588	3.26593	1.01987	2.30772
M: Tukey	1.58564	3.09290	.95781	2.18396
M: Hampell	1.59756	3.17876	1.00113	2.20707
M: Andrews	1.58553	3.09403	.95691	2.18415
5% trimmed mean	1.59375	3.49565	1.08240	2.48452
Winsorized median	1.51667	3.39650	.91667	2.31667
Winsorized mean	1.58354	3.63091	1.08832	2.79605
median weighted by quality score	1.5	3.08600	.9	2.3
mean weighted by quality score	1.58646	3.78426	1.13036	2.80753
weighted M: Huber	1.56500	3.16798	.99686	2.30635
weighted M: Tukey	1.56384	2.96199	.94338	2.17917
weighted M: Hampell	1.57920	3.08130	.96918	2.20437
weighted M: Andrews	1.56342	2.95418	.94377	2.17935
weighted 5% trimmed mean	1.58133	3.42929	1.07381	2.49188
Mean of 16 estimation methods	1.57037	3.29992	1.00433	2.37674

Adolescents				
	Level 3 LT	Level 2 LT	Level 3 PY	Level 2 PY
median	3.46667	9.15	4.485	14.7
mean	3.87931	9.44875	5.76959	14.82303
M: Huber	3.70154	9.26592	5.46617	13.78063
M: Tukey	3.73990	9.15895	5.27702	12.98932
M: Hampell	3.83458	9.31347	5.40209	13.85322
M: Andrews	3.73971	9.15921	5.27565	12.89331
5% trimmed mean	3.85	9.45417	5.46699	14.49226
Winsorized median	3.4	8.7	4.69850	15.11950
Winsorized mean	3.59	9.01023	5.96668	16.25383
median weighted by quality score	3.4	9.9	4.363	13.4
mean weighted by quality score	3.89493	9.62105	5.93010	14.64040
weighted M: Huber	3.69682	9.65738	5.22038	13.52199
weighted M: Tukey	3.73975	9.60731	5.12656	12.86780
weighted M: Hampell	3.83267	9.63580	5.27337	13.35033
weighted M: Andrews	3.73974	9.60688	5.12426	12.86618
weighted 5% trimmed mean	3.86919	9.64561	5.55479	14.28933
Mean of 16 estimation methods	3.71093	9.39592	5.27501	13.99007

College				
	Level 3 LT	Level 2 LT	Level 3 PY	Level 2 PY
median	4.93333	6.41667	--	--
mean	4.67370	9.27896	--	--
M: Huber	4.51701	7.39346	--	--
M: Tukey	4.48378	6.63890	--	--
M: Hampell	4.56345	7.31493	--	--
M: Andrews	4.47721	6.64025	--	--
5% trimmed mean	4.58946	8.63101	--	--
Winsorized median	5	6.25	--	--
Winsorized mean	4.91331	8.11435	--	--
median weighted by quality score	5	6	--	--
mean weighted by quality score	4.64466	8.84256	--	--
weighted M: Huber	4.51641	7.07916	--	--
weighted M: Tukey	4.48653	6.44433	--	--
weighted M: Hampell	4.55570	6.92359	--	--
weighted M: Andrews	4.48618	6.44173	--	--
weighted 5% trimmed mean	4.55681	8.14612	--	--
Mean of 16 estimation methods	4.64985	7.28475	--	--

Treatment				
	Level 3 LT	**Level 2 LT**	**Level 3 PY**	**Level 2 PY**
median	13.45550	13.00000	4.69350	--
mean	14.22567	15.00508	4.69350	--
M: Huber	13.51374	13.78262	4.69350	--
M: Tukey	12.95594	13.56683	4.69350	--
M: Hampell	13.24120	14.10941	4.69350	--
M: Andrews	12.95979	13.57589	4.69350	--
5% trimmed mean	13.72296	14.59403	--	--
Winsorized median	13.45550	13	--	--
Winsorized mean	13.63111	13.90964	--	--
median weighted by quality score	13.13100	14	2.3	--
mean weighted by quality score	14.38404	15.09467	4.04073	--
weighted M: Huber	13.41216	14.17917	--	--
weighted M: Tukey	12.71613	14.21022	--	--
weighted M: Hampell	13.18334	14.60859	--	--
weighted M: Andrews	12.72056	14.21373	--	--
weighted 5% trimmed mean	13.89893	14.69357	3.96820	--
Mean of 16 estimation methods	13.41297	14.09647	--	--

Appendix 2: Study Characteristics

The following table lists and provides information on all of the studies included in this meta-analysis. Some of these studies reported prevalence rates for multiple study samples (e.g., Volberg 1994b); for these studies, each separate study sample is listed. This table organizes study samples in groups according to population type (i.e., adult, adolescent, college, and treatment); within each population type, study samples are organized first by region, then by state or province, then by instrument. Data for some of the study samples included in this meta-analysis was published in more than one source (e.g., Emerson & Laundergan, 1996 and Emerson, Laundergan, & Schaefer, 1994); although data for these samples was weighted in our data set to avoid overrepresentation of these samples, each publication is listed in this table for readers' reference.

Region	State/ Province	Instrument	Time frame[56]	N	Author	Year Released
			ADULT			
New England	Connecticut	SOGS	lifetime	1000	Christiansen/ Cummings et al.	1992
New England	Connecticut	DIS	lifetime	1224	Laventhol & Horwath et al.	1986
New England	Connecticut	3-item scale	lifetime	568	Abrahamson & Wright	1977
New England	Massachusetts	SOGS	lifetime	750	Volberg	1994b
Middle Atlantic	Maryland	SOGS	lifetime	750	Volberg	1994b
Middle Atlantic	Maryland	SOGS	lifetime	750	Volberg & Steadman	1989c
Middle Atlantic	New Jersey	SOGS	lifetime	1000	Volberg	1994b
Middle Atlantic	New Jersey	SOGS	lifetime	1000	Volberg & Steadman	1989c
Middle Atlantic	New York	SOGS	lifetime	1000	Volberg & Steadman	1988b
Middle Atlantic	New York	SOGS	both	1829	Volberg	1996b
Middle Atlantic	New York	DSM-IV	past year	1829	Volberg	1996b
Middle Atlantic	Combination	IGB scale	lifetime	534	Culleton & Lang	1985
Middle Atlantic	Combination	ISR scale	lifetime	534	Culleton & Lang	1985
Middle Atlantic	Combination	IGB scale	lifetime	534	Sommers	1988
Southeastern	Georgia	SOGS	both	1550	Volberg & Boles	1995
Southeastern	Mississippi	SOGS	both	1014	Volberg	1997
North Central	Indiana	DSM-IV mod.	lifetime	1015	Laventhol & Horwath et al.	1990
North Central	Iowa	SOGS	lifetime	750	Volberg	1994b
North Central	Iowa	SOGS	lifetime	750	Volberg & Steadman	1989a
North Central	Iowa	SOGS	both	1500	Volberg	1995a
North Central	Minnesota	SOGS	past year	1028	Emerson & Laundergan	1996
North Central	Minnesota	SOGS	past year	1028	Emerson et al.	1994
North Central	Minnesota	SOGS	past year	1251	Laundergan et al.	1990
North Central	Missouri	DIS	lifetime	2954	Cunningham-Williams et al.	In press
North Central	North Dakota	SOGS	both	1517	Volberg & Silver	1993
North Central	Ohio	Custer criteria	lifetime	801	Transition Planning Associates	1985
North Central	Ohio	clinical signs	lifetime	801	Transition Planning Associates	1985
North Central	South Dakota	SOGS	both[57]	1767	Volberg & Stuefen	1994

[56] Time frames are listed as lifetime, past year, or both lifetime and past year unless otherwise noted. Readers should note that, as we described in the *Methods* section of this report, prevalence rates for which no time frame was indicated were included in the lifetime category.

[57] Six-month and lifetime rates

Region	State/ Province	Instrument	Time frame[56]	N	Author	Year Released
North Central	South Dakota	SOGS	both[58]	1560	Volberg et al.	1991
North Central	Wisconsin	DSM-IV mod.	lifetime	1000	Thompson et al.	1996
South Central	Louisiana	SOGS	lifetime	1818	Westphal & Rush	1996
South Central	Louisiana	SOGS	both	1818	Volberg	1995b
South Central	Texas	SOGS	both	6308	Wallisch	1993b
South Central	Texas	SOGS	both	7015	Wallisch	1996
Northwestern	Montana	SOGS	both	1020	Volberg	1992a
Northwestern	Washington	SOGS	both	1502	Volberg	1993c
Southwestern	California	SOGS	lifetime	1250	Volberg	1994b
Southwestern	Nevada	ISR scale	lifetime	296	Kallick et al.	1979
Southwestern	New Mexico	DSM-IV mod.	past year	1279	New Mexico Dept. of Health	1996
British Columbia	British Columbia	SOGS	both	810	Angus Reid Group	1996
British Columbia	British Columbia	SOGS	both	1200	Gemini Rsrch. & Angus Reid Grp.	1994
Prairie Provinces	Alberta	SOGS	both	1803	Wynne Resources Ltd.	1994
Prairie Provinces	Alberta	DIS	both[59]	7214	Bland et al.	1993
Prairie Provinces	Saskatchewan	SOGS	both	1000	Volberg	1994a
Prairie Provinces	Manitoba	SOGS	past year	1212	Criterion Research Corp.	1993
Prairie Provinces	Manitoba	SOGS	past year	1207	Criterion Research Corp.	1995
Ontario	Ontario	SOGS	lifetime	1030	Ferris & Stirpe	1995
Ontario	Ontario	SOGS	past year	2682	Govoni & Frisch	1996
Ontario	Ontario	SOGS	past year	3843	Govoni & Frisch	1996
Ontario	Ontario	mod. SOGS	past year	1200	Insight Canada Research	1993
Ontario	Ontario	DSM-IV	both	1030	Ferris & Stirpe	1995
Ontario	Ontario	Life areas	past year	1030	Ferris & Stirpe	1995
Ontario	Ontario	gambling problems scale	past year	1737	Smart & Ferris	1996
Quebec	Quebec	SOGS	lifetime	1002	Ladouceur	1991
Quebec	Quebec	SOGS	lifetime	1002	Ladouceur	1993
Atlantic Provinces	New Brunswick	SOGS	both	800	Baseline Mkt. Research	1992
Atlantic Provinces	New Brunswick	SOGS	both	800	Baseline Mkt. Research	1996b
Atlantic Provinces	Nova Scotia	SOGS	both	801	Baseline Mkt. Research	1996a
Atlantic Provinces	Nova Scotia	mod. SOGS	lifetime	400	Baseline Mkt. Research	1996c
Atlantic Provinces	Nova Scotia	mod. SOGS	lifetime	810	Omnifacts Research Ltd.	1993
Combined regions	Combination	ISR scale	lifetime	1736	Kallick et al.	1979
does not specify	does not specify	2-item scale	lifetime	900	Ubell	1991
		ADOLESCENTS				
New England	Connecticut	MAGS	past year	3886	Steinberg	1997
New England	Connecticut	DSM-III-R	lifetime	1592	Steinberg	1997
New England	Connecticut	SOGS-RA broad	past year	3886	Steinberg	1997
New England	Massachusetts	MAGS	past year	856	Shaffer et al.	1994

[58] Six-month and lifetime rates

[59] Six-month and lifetime rates

Region	State/ Province	Instrument	Time frame[56]	N	Author	Year Released
New England	Massachusetts	MAGS	past year	854	Shaffer & Hall	1994
New England	Massachusetts	MAGS	past year	466	Vagge	1996
New England	Massachusetts	mod. MAGS	past year	1500	Allen	1995
New England	Massachusetts	DSM-IV	past year	854	Shaffer & Hall	1994
New England	Massachusetts	DSM-IV	past year	856	Shaffer et al.	1994
New England	Massachusetts	DSM-IV	past year	466	Vagge	1996
Middle Atlantic	New Jersey	Path. Gamb. Signs Index	lifetime	892	Lesieur & Klein	1987
Southeastern	Florida	SOGS-RA other[60]	past year	1882	Lieberman et al.	1996
Southeastern	Georgia	SOGS	lifetime	1007	Volberg	1996a
Southeastern	Georgia	Multi-factor method	lifetime	1007	Volberg	1996a
North Central	Minnesota	SOGS-RA narrow	past year	532	Winters & Stinchfield	1993
North Central	Minnesota	SOGS-RA narrow	past year	532	Winters et al.	1995
North Central	Minnesota	SOGS-RA narrow	past year	532	Winters et al.	1995 (follow-up)
North Central	Minnesota	SOGS-RA broad	past year	1094	Winters et al.	1990
North Central	Minnesota	SOGS-RA broad	past year	702	Winters et al.	1993b
North Central	Minnesota	SOGS-RA broad	past year	532	Winters et al.	1995
North Central	Minnesota	SOGS-RA broad	past year	532	Winters et al.	1995 (follow-up)
North Central	Minnesota	SOGS-RA other	past year	460	Winters et al.	1993a
North Central	Minnesota	mod. adolescent SOGS	lifetime	277	Zitzow	1996a
South Central	Texas	Multi-factor method	lifetime	924	Wallisch	1993a
South Central	Texas	Multi-factor method	lifetime	3079	Wallisch	1996
South Central	Texas	mod. adolescent SOGS	lifetime	924	Wallisch	1993a
Northwestern	Washington	SOGS	lifetime	1054	Volberg	1993a
Northwestern	Washington	SOGS-RA broad	past year	1054	Volberg	1993a
Northwestern	Washington	Multi-factor method	lifetime	1054	Volberg	1993a
Prairie Provinces	Alberta	mod. adolescent SOGS	past year	972	Wynne Resources Ltd.	1996
Ontario	Ontario	SOGS	past year	935	Govoni et al.	1996
Ontario	Ontario	SOGS-RA narrow	past year	935	Govoni et al.	1996
Ontario	Ontario	SOGS-RA broad	past year	935	Govoni et al.	1996

[60] Winters, Stinchfield, & Kim (1995) describe two methods of scoring the SOGS-RA, the *narrow criteria* and the *broad criteria*. In addition to these two methods, Winters, Stinchfield, and Fulkerson (1993a) describe another method of scoring the SOGS-RA. In this table we will refer to this third, less common method as the "SOGS-RA other."

Region	State/ Province	Instrument	Time frame[56]	N	Author	Year Released
Ontario	Ontario	mod. adolescent SOGS	past year	400	Insight Canada Research	1994
Quebec	Quebec	SOGS	lifetime	289	Gaboury & Ladouceur	1993
Quebec	Quebec	DSM-III	lifetime	1612	Ladouceur & Mireault	1988
Quebec	Quebec	Path. Gamb. Signs Index	lifetime	1612	Ladouceur & Mireault	1988
Atlantic Provinces	Nova Scotia	mod. SOGS	lifetime	300	Omnifacts Research Ltd.	1993
Atlantic Provinces	Nova Scotia	Self- assessment	past year	3857	Nova Scotia Dept. of Health	1996
		COLLEGE				
New England	Connecticut	SOGS-Plus	lifetime	238	Devlin & Peppard	1996
Middle Atlantic	New Jersey	SOGS	lifetime	636	Frank	1990
Middle Atlantic	New Jersey	SOGS	lifetime	636	Frank	1993
Middle Atlantic	New Jersey	SOGS	lifetime	227	Lesieur et al.	1991
Middle Atlantic	New York	SOGS	lifetime	446	Lesieur et al.	1991
North Central	Michigan	SOGS	lifetime	1147	Lumley & Roby	1995
North Central	Minnesota	SOGS	lifetime	529	Winters et al.	1996
North Central	Minnesota	SOGS	lifetime	868	Winters et al.	1996
North Central	Minnesota	SOGS	lifetime	373	Winters et al.	1996
North Central	Wisconsin	Self- assessment	past year	604	Cook	1987
South Central	Oklahoma	SOGS	lifetime	583	Lesieur et al.	1991
South Central	Texas	SOGS	lifetime	299	Lesieur et al.	1991
Southwestern	Nevada	SOGS	lifetime	219	Lesieur et al.	1991
Southwestern	Nevada	SOGS	lifetime	544	Oster & Knapp	1994
Southwestern	Nevada	SOGS	lifetime	350	Oster & Knapp	1994
Southwestern	Nevada	DSM-III-R	lifetime	544	Oster & Knapp	1994
Southwestern	Nevada	DSM-IV	lifetime	544	Oster & Knapp	1994
Southwestern	Nevada	DSM-III-R	lifetime	350	Oster & Knapp	1994
Quebec	Quebec	SOGS	lifetime	1471	Ladouceur et al.	1994b
Combined regions	Combination	SOGS	lifetime	1771	Lesieur et al.	1991
does not specify	does not specify	SOGS	lifetime	384	Lesieur & Blume	1987
does not specify	does not specify	DSM-III-R	lifetime	384	Lesieur	1988a
does not specify	does not specify	DSM-III-R	lifetime	384	Lesieur & Blume	1987
		TREATMENT				
New England	Connecticut	DSM-III-R	lifetime	298	Steinberg et al.	1992
New England	Connecticut	DSM-III-R	both	298	Rounsaville et al.	1991
New England	Massachusetts	SOGS	lifetime	85	Gambino et al.	1993
New England	Massachusetts	SOGS	lifetime	93	Shepherd	1996
Middle Atlantic	Maryland	SOGS	lifetime	467	Ciarrochi	1993
Middle Atlantic	New York	SOGS	lifetime	220	Feigelman et al.	1995
Middle Atlantic	New York	SOGS	lifetime	297	Lesieur & Blume	1987
Middle Atlantic	New York	SOGS/ SOGS-Plus	lifetime	117	Spunt et al.	1995
Middle Atlantic	New York	SOGS	lifetime	105	Lesieur & Blume	1990
Middle Atlantic	New York	SOGS/ SOGS-Plus	lifetime	462	Spunt et al.	1996
Middle Atlantic	New York	clinical judgment	lifetime	297	Lesieur & Blume	1987
Middle Atlantic	Pennsylvania	SOGS	lifetime	363	Walters	1997
Middle Atlantic	does not specify	Path. Gamb. Signs Index	lifetime	458	Lesieur et al.	1986
North Central	Illinois	SOGS	lifetime	276	Daghestani et al.	1996

Region	State/ Province	Instrument	Time frame[56]	N	Author	Year Released
North Central	Minnesota	SOGS	lifetime	201	Miller & Westermeyer	1996
North Central	Minnesota	SOGS	lifetime	211	Miller & Westermeyer	1996
North Central	Ohio	SOGS	lifetime	2171	McCormick	1993
North Central	Ohio	SOGS	lifetime	154	Castellani et al.	1996
North Central	South Dakota	SOGS	lifetime	85	Elia & Jacobs	1993
Southwestern	Nevada	SOGS	lifetime	136	Templer et al.	1993
Ontario	Ontario	SOGS	both	508	Donwood Problem Gamb. Prog.	1996

Appendix 3: A Brief Guide to Planning Prevalence Study Protocols

All problems are finally scientific problems.
- George Bernard Shaw (1911)

Introduction

Developing and implementing a research protocol that will yield reliable and meaningful prevalence estimates of disordered gambling among a general adult or youth population can be a formidable task for both new and experienced investigators. There are common elements to this endeavor that should be present in a research design regardless of the population being studied. By applying tested research design principles, investigators can ease the difficulties associated with these projects (Rosenthal & Rosnow, 1991). When developing a research protocol, experienced investigators have found that there is no substitute for detail, clarity and precision. All too often, when things can go wrong during the conduct of clinical research, things will go wrong. Researchers interested in developing and implementing research protocols for the conduct of a general population telephone-based prevalence research can use this brief guide to minimize the possibility of problems during both the conduct of a prevalence survey and the application of the survey results.

There are many basic characteristics of a research protocol that investigators often overlook. At the most fundamental level, for example, protocols and research guides should be readable so the research team and others can use these guides effectively. It is advisable to have colleagues examine research protocols for organizational, logical, and written errors *before* either submitting the document for funding review or going into the field to collect data. Similarly, each aspect of the prevalence survey—from the purpose of the study, to how respondents will be identified and their data analyzed—deserves careful attention. In this very brief guide, we will consider the cardinal aspects of a disordered gambling prevalence survey protocol. Many of these principles derive from the review of existing prevalence studies originally described in this meta-analysis. A comprehensive analysis of epidemiological survey research is well beyond the scope of this brief guide. However, we believe this document can serve as a model to help administrators and investigators alike move toward more useful studies of disordered gambling. In addition, this brief guide includes a description of methodological principles that will help investigators avoid the casualties of epidemiological research—for example, discovering after much hard work and expense that your response rate precludes a scientific analysis, or having identified too few respondents with the target attributes.

We suggest that there are 11 basic or core elements necessary for investigators to develop high-quality population prevalence estimates. These elements are as follows:

1. Establish a precise statement of purpose and objectives;
2. Select, modify, or create an instrument that can satisfy the study objectives;
3. Determine a time frame for the gambling disorder as well as its associated cluster of signs and symptoms;
4. Determine how best to eliminate alternative psychiatric disorders;
5. Determine a sampling design to select respondents;

6. Use a power analysis to plan for adequate representation of the population(s) of interest;
7. Properly calculate response and completion rates;
8. Provide a protocol for selecting and training interviewers;
9. Supervise the collection of data;
10. Check the integrity of data coding and data entry;
11. Apply the results.

As we begin to address these essential methodological issues in more detail, we also will consider some of the important organizational and strategic concerns that set the stage for determining the details of a research design and its accompanying protocol.

In the remainder of this brief guide, we will introduce and highlight the central principles and activities that must be addressed in planning prevalence research; readers should note once again that this appendix is not offered as a definitive guide, just a blueprint for the core issues that await those interested in entering the precarious world of prevalence research.

Purpose

A general population gambling survey research project should begin with a protocol that includes a very precise statement of purpose. A statement of purpose begins with a precise statement of the data needs. This statement may answer some of the following questions: What do you want the prevalence estimate to do for you, and how do you intend to use it? How will the development of a detailed assessment of prevalence direct the planning, development and implementation of existing or new prevention, education, or treatment services? How will the assessment of prevalence affect the availability of gaming in the region? We cannot overstate the importance of carefully determining the data needs of a project. While few estimates of disordered gambling to date have a stated a specific purpose, one of the primary reasons for conducting a prevalence survey in this and other fields is to gather the information essential to guide state and sub-state resource allocation (e.g., treatment planning). This activity requires research that is different from the survey traditionally designed to provide prevalence estimates of gambling and gambling related disorders; this endeavor is more similar to substance abuse needs assessment surveys which typically have been conducted to determine "caseness" (e.g., Rose & Barker, 1978; Vaillant & Schnurr, 1988).

A "case" represents someone who qualifies for treatment services (i.e., meets the treatment eligibility requirements), or who would qualify for treatment services if these services were available. Although many people who meet diagnostic standards do not enter treatment, and many who fail to satisfy such standards do enter treatment, the long-standing assumption of disordered gambling prevalence investigators has been that the estimates of those who meet some diagnostic standard represent the treatment need of a particular area. Investigators also should keep in mind that, in addition to those who currently satisfy diagnostic criteria, there exists a proportion of the population who already have met their treatment need—either through natural recovery, self-help, or professional treatment services. To date, no study has examined the extent of "met need" among those who have experienced disordered gambling. A prevalence estimate for resource allocation would take these factors into consideration and would assist regional, state, and local planners to determine the clinical resources that must be allocated to meet the demands of a disorder that exists at a particular level in the community.

Literature Review

A careful review of the literature is necessary before conducting a prevalence study so the conceptual and practical pitfalls of this research can be identified and addressed. The literature review also will

prove helpful as the research team and their administrative group select the measurement instrument or instruments. A literature review should be relevant to, and make a cogent and succinct argument for, the necessity to conduct the prevalence research. Further, the literature review should address the specific data needs or interests of the study. Authors should present a brief review of the pertinent prevalence literature and the methods for gathering sensitive gambling-related information. This literature review also should summarize any existing regional data. Have any relevant regional, state, or local surveys been completed? In addition, if previous statewide data is unavailable, are there regional or national gambling prevalence rates that bear directly on your state, region or community? Are there any observed national trends that concern your state treatment planners?

Selecting An Instrument

A gambling prevalence research protocol must consider the full range of available measurement instruments and determine which specific instrument provides the best fit for the study's stated purpose. There are a variety of instruments available for investigators to employ that provide estimates of disordered gambling prevalence (e.g., Diagnostic Interview Schedule, DSM-IV, South Oak Gambling Screen, Massachusetts Gambling Screen). The use of an established instrument will expedite the survey process and assure the inclusion of key variables. In addition, researchers always should choose instruments that reflect their project's particular purpose and data needs. The choice of instrumentation may differ depending upon whether the prevalence study targets households, schools, treatment, prison, or other "special populations."

On Instrumentation

We urge investigators to select instruments with great care and caution. If you select an existing instrument, do not make significant modifications to the survey; instead, consider adding questions relevant to your particular data needs. In this way, the psychometric properties of the original survey instrument will be maintained. However, if any additions or deletions are made to existing survey instruments, these changes should be noted in the research protocol with a detailed description of the reasons for the adjustments—after some time, the research team may forget their original motivations. If investigators are interested in integrating the gambling prevalence survey with other surveys, this procedural scheme also should be noted in the protocol and evaluated with great care. Caution should be taken to clarify in advance the many possible relationships that can exist among the surveys so that the data collectors can measure the necessary variables in each of the pertinent surveys with the least burden for the respondent and lowest risk to the integrity of the collected data.

Forms of Gambling

The protocol must determine which forms of gambling the survey will examine; for example, lottery, pari-mutuel, charitable, casino-based games, cock fighting, etc. If the prevalence survey targets games of chance that are not included on the original survey (e.g., pogs, non-casino-based card playing), investigators should describe these targets in detail and the rationale for adding these forms of gambling to those already included. For example, perhaps your state, province, or community currently provides treatment services for a certain number of persons with a specific pattern of gambling disorder; in this case, you may want to survey this group to determine their pattern of gambling, and the games they play. Alternatively, there are social indicators (e.g., arrest statistics) suggesting that a particular pattern of gambling may exist among arrestees; you may want to survey this group and their pattern of gambling if it is not already included in the research instrument selected for use. Both of these examples demonstrate a rationale for the need to examine specific forms of gambling that may not have been included in the set of games originally associated with a particular research instrument.

Time Frame & Symptom Clusters for Gambling Disorders

Estimates of disordered gambling derive traditionally from lifetime and past-year time frames. Absent a time frame, it is difficult to make sense of a prevalence estimate. Perhaps just as important, lifetime estimates of gambling are suspect because researchers have failed to assure that the cluster of symptoms and signs necessary to identify a respondent as a disordered gambler coexisted. For example, during the early prevalence research with the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987), investigators did not assure that the 5 positive signs necessary to meet the SOGS criteria occurred concurrently. To illustrate, consider a 40-year-old man who has been gambling for 25 years. It is quite possible—though admittedly unlikely—that each positive sign existed in isolation during separate life eras (e.g., every 5 years). This man would be classified according to the SOGS as a probable pathological gambler, yet would never have had more than a single sign or symptom every five years. Past-year estimates are not subject to this type of error, since the time frame automatically requires symptom clustering. Therefore, to secure precise data, researchers must assure the clustering of lifetime symptoms within a specified period.

Eliminating Other Psychiatric Disorders: Exclusion Criteria

If researchers fail to exclude psychiatric disorders that can mimic or influence intemperate gambling behaviors, there will be an absence of precision among the existing estimates of disordered gambling prevalence (Bland, Newman, Orn, & Stebelsky, 1993; Boyd et al., 1984). "There are several problems with all of these [prevalence] studies.... DSM-III uses antisocial personality disorder as an exclusion criterion for pathological gambling. None of the studies… appear to have even checked for a diagnosis of antisocial personality disorder, and presumably their prevalence figures included people with this disorder" (Bland et al., 1993, pp. 108-109). Although Bland et al.'s important comments predated DSM-IV (American Psychiatric Association, 1994)—which excludes those with manic disorders from receiving a diagnosis of pathological gambler—they did not correct the exclusionary diagnostic problems that they first accurately identified in their own prevalence research. Future prevalence research must become more precise about distinguishing and then excluding respondents who have other psychiatric disorders that better explain excessive gambling from those identified as having primary gambling disorders.

Sampling Design I: Selecting Respondents

The sampling design is crucial to the development of any household telephone survey protocol (Frankel, 1983; Kish, 1965; Sudman, 1983). The research protocol must specify how households and respondents will be selected (e.g., random digit dialing and most recent birthday), and how sites and individual respondents will be excluded from survey participation. We encourage investigators to employ random digit dialing to minimize the problems associated with failing to access unlisted telephone numbers. In addition, McAuliffe et al. (1995) recommend three major principles for determining respondent eligibility. Applying these principles will help secure the internal validity of the survey.

1. All eligible people should have the same probability of being sampled. For example, households with more than one telephone line have an increased chance of being contacted and present problems for telephone surveys. Problems of this nature can be addressed by developing precise eligibility standards.

2. To be eligible, contacted persons must be in a setting that permits administration of the interview in a manner that will allow valid data to be collected. Thus, a shared living situation with many residents (e.g., more than five is a reasonable cutoff) who all access a single

phone line is an example of an inappropriate setting for a moderately private interview that could require 20-40 minutes of uninterrupted time. Too often these settings interfere with data collection despite a respondent's best intention to comply fully. In addition, shared living situations hold more potential for contaminated data because of social pressure on the respondent that might not be evident to the interviewer.

3. For a treatment needs or resource allocation prevalence study, investigators should exclude individuals who could not be served by the state's or agency's treatment resources. To illustrate, out-of-state or foreign visitors and military personnel represent two groups of individuals who might utilize emergency services but who are not eligible for state-funded treatment programs. Since this principle does not cover every situation, protocols should provide an operational definition of eligibility that interviewers can apply both easily and consistently (McAuliffe et al., 1995).

Since these suggestions represent only a brief set of guidelines, for interested readers more information about inclusion and exclusion guidelines is available from Boyd et al. (1984), Kish (1965), and McAuliffe et al. (1995).

Sampling Design II: Power Analysis and Planning for an Adequate Representation of the Population of Interest

All research protocols should include a statistical power analysis (e.g., Cohen, 1988; Fleiss, 1981; Kish, 1965). A power analysis will yield an estimate of the number of respondents necessary to achieve the specific research purposes specified in the protocol. For example, if we expect a pathological gambling prevalence rate of 1.5%, then, under typical circumstances, a survey sample of 2000 will yield only 30 pathological gamblers. This sample is woefully inadequate for treatment planning or other resource allocation purposes, since we would not want to generalize from 30 people to the entire population of disordered gamblers. Therefore, a larger total sample will be required. To assure that an adequate sample of pathological gamblers is obtained, in the following section, we recommend an optimal allocation strategy. Before turning to this section, however, we want to encourage investigators and others interested in prevalence research to consider with care the smallest comparisons of interest. To illustrate one of the most common power issues that emerges from these comparison, consider the following example:

If the purpose of a prevalence research project includes the need to determine whether disordered gamblers who play instant lottery games display more or less intense symptoms than disordered gamblers who limit their wagering to extended state lottery games (e.g., weekly drawings), then we will need to compare a sample of respondents who represent these two primary groups. However, if the investigators also are interested in examining any gender differences that might exist between these two groups of gamblers, than there really are four groups of interest (i.e., male and female instant and extended lottery players). To compare these four groups of interest in a 2 x 2 analysis of variance design (ANOVA), at the .05 level of statistical significance, assuming a moderate effect size of .25 for the gender, gambling type, and interaction effects, and a power level of .80, we would require 33 disordered gamblers in each of the four groups, or a total of 132 disordered gamblers.

However, if the effect size was small instead of moderate for these comparisons, then the number of disordered lottery gamblers required for this analysis would become dramatically different. For example, to compare the four groups of interest in the same analysis described above, but now assuming an effect size of .25 for the gender comparison, .10 for the gambling type comparison, and .10 for the interaction effects, and a power level of .80, we would now require 198 disordered gamblers in each of the four groups, or a total of 792 disordered gamblers.

To randomly identify 792 adult disordered gamblers using a general population telephone screen, assuming the requirement of a 70% or greater survey response rate and a level 3 gambling prevalence rate of 1.5%, would require more than 72,000 telephone calls taking common rates of refusals and conversions into consideration.[61] This research strategy is likely to be prohibitively expensive for most funding sources. Therefore, investigators must consider alternative designs to randomly stratifying and selecting samples to compare the attributes and characteristics of disordered gamblers. In the next section we will consider one of these strategies: optimal allocation. However, for now, the examples above provide a simple illustration of how the purpose and power analysis of a study can dramatically influence the planning and implementation of a research project.

Alternatives to Stratified Random Sampling: Optimal Allocation

If the purpose of the research is to understand the attributes or clinical needs of disordered gamblers, we suggest a survey sampling strategy that is different from the traditional stratified random sampling approach. This strategy does not simply concentrate on respondents selected at random from the general population. Instead, this strategy encourages investigators to focus on selecting respondents who most likely will represent disordered gamblers. This approach to respondent selection is optimal allocation (Kish, 1965; McAuliffe et al., 1995). The optimal allocation strategy yields a sampling plan that directly reflects the goals of a disordered gambling treatment needs assessment project by establishing a respondent sample that best represents those who would require or demand treatment services. This strategy is sensitive to the central goals of an objective-driven population survey: to obtain the optimal information about respondents who will qualify for (i.e., meet diagnostic criteria), and make use of, gambling treatment services. Unlike the traditional epidemiological approach to conducting household surveys that simply yields an estimate of disordered gambling among people in the general population, this research strategy does not simply identify rates of people who meet some diagnostic screen, and then assume that this group is in need of treatment. Traditional epidemiological surveys disregard the essential treatment planning aspect that serves as the centerpiece of a genuine treatment needs assessment project. Conventional gambling prevalence studies still have not addressed the issues associated with each of the following: (1) whether people actually would enter treatment for a gambling disorder if it were available, (2) identifying the obstacles to entering treatment, for those who would be eligible to receive such clinical services, or (3) identifying the rates of natural recovery among disordered gamblers (i.e., those who will not enter treatment but still satisfy their need to change; e.g., Cunningham, Sobell, Sobell, Kapur, 1995; Sobell, Cunningham, & Sobell, 1996).

An optimal allocation sampling strategy is directly responsive to social indicators (e.g., bankruptcy, loan defaults, gambling hotline calls, treatment utilization) that point to the severity of gambling-related problems and suggest the need for treatment services. This methodology begins with samples proportional to the population in each sub-state area and then adjusts the number of respondents to be sampled as a function of the estimated prevalence of disordered gambling. Scientists should sample from regions that have higher rates of gambling disorder more heavily than areas where there are indications of fewer gambling problems. This approach is quite different from traditional epidemiological survey strategies that generate simple prevalence rates for gambling problems because this approach "purposively" samples the major attribute of interest (i.e., respondents who are

[61] Actually, the number of telephone calls would be considerably larger, since the disordered gamblers we are targeting must have either instant or extended lottery gambling as their main problem. Therefore, we would have to exclude gamblers who have problems with other forms of wagering (e.g., charitable, casino, pari-mutuel); this would have the effect of reducing the assumed 1.5% prevalence rate.

likely to make use of gambling treatment services).[62]

Respondent Selection Method

Investigators should select respondents for prevalence studies randomly. For example, once a household or "cluster" is contacted in a telephone survey, we recommend that research teams select respondents randomly by using the nearest birthdate method. Research protocols should specify the respondent selection method in detail. Protocols also should specify how the survey will address non-English-speaking respondents.

Connection Attempts, Call-Back Procedures, and Conversion of Refusals

We suggest that survey protocols specify a minimum of eight connection attempts to initially contact a respondent and ten call-backs to respondents once they have been contacted. A special effort should be made to call during "off" hours when problem gamblers are more likely to be home. Previous survey research demonstrates that as many as 35% of households initially refuse to participate in telephone surveys. We also suggest that research protocols specify that at least 15% of the initial refusers will be converted to active study participants. Throughout the survey, the actual number of calls depends upon the contractor's success in achieving an acceptable response rate. This criterion for determining an acceptable response rate is determined by the sampling parameters and the need to draw a scientific sample. Sample response rates of less than 50% are unscientific and offer little to our understanding of disordered gambling. As we suggest in the following section, investigators, funding agencies, and administrators, must establish response rates of 70% as a minimum for satisfactory prevalence research.

[62] For additional detailed information about optimal allocation procedures, see McAuliffe et al. (1995).

Response and Completion Rates

Given the considerations introduced in the power analysis and sampling section above, it is important to remember that people with gambling disorders represent a very small proportion of the general population but compose a major portion of the consumers of state-funded treatment services—where these exist. A well-designed sampling procedure will increase the number of disordered gamblers who are surveyed. However, this increase will produce an absolute number of respondents that is large enough to support confident data analyses and interpretation only if the total survey sample is sufficiently large and the response rate is adequate. Therefore, we suggest that, for general population studies, 5,000 surveys be completed. In this meta-analysis, we examined 106 prevalence estimates, of which 50 were adult general population studies; of these adult general population studies, the average sample size was only 1,581. This sample size—while acceptable for managing measurement error—is insufficient for treatment planning purposes or understanding the attributes of disordered gamblers. For example, an inadequate sampling design forced the recently released Connecticut population survey (WEFA Group, ICR Survey Research Group, Lesieur, & Thompson, 1997) study to conclude that, "...there were only 12 individuals in the telephone survey of the general population who indicated probable pathological gambling on a lifetime basis. To generalize social costs from such a small number of individuals is not possible" (p. 10). "...only 12 persons on a lifetime basis, 6 of them on a current basis" (p. 6-14). "The present study was unable to produce generalizable data on the social costs of pathological gambling or the demographic profile of pathological gamblers. A survey of at least 6,000 adults is required in order to obtain reliable information on these topics" (p. 11). Careful planning will help investigators avoid spending valuable resources and then being forced to conclude that they could not deliver critical information about the specific topic under investigation.

To achieve the suggested goal of 5,000 completed surveys, investigators should plan to contact at least 7,143 households. This represents an approximate response rate of 70% and should be considered as minimally acceptable for scientific analysis. We suggest that every investigator require at least a 70% response rate from their survey data collection team. While this rate applies to the overall study response rate, this rate of completion also should be achieved in all sub-state areas (i.e., sampling strata) (McAuliffe et al., 1995). In areas where respondents are difficult to contact, the number of call-backs should be increased (e.g., to 15) until the target completion rate—as determined by the optimal allocation sampling design and power analysis—is obtained.

Calculating Response and Completion Rates

This meta-analysis identified a variety of problems associated with the calculation of response rates for general population telephone surveys. Frankel (1982) describes the most widely accepted standard for calculating response rates. The general formula for calculating a response rate is as follows:

$$\text{Response rate} = \frac{\text{\# of respondents participating in the study}}{\text{total \# of respondents eligible to participate in the study}}$$

In this meta-analysis, we observed a very common calculation problem: many investigators used an improper denominator; that is, they improperly calculated the total number of people eligible to participate in their studies. For example, investigators often inflated their response rates by deleting randomly selected households that failed to answer the phone from the denominator of their response ratio. This method is incorrect. All eligible random numbers reflect items that must be included in the denominator. When a household fails to answer, the only way investigators can increase the response rate is to increase the number of call-backs and vary the time of day these call-backs are made.

Calculation of response rates for multi-stage sampling protocols can be simplified with the use of the following guideline: when there are multiple stages to a survey protocol (e.g., selection of sites, then selection of respondents from the selected sites), investigators should calculate a *completion* rate for each stage. Investigators can then calculate the final *response rate* for the study by multiplying these completion rates. Investigators who are conducting household telephone surveys can consider the selection of households to be the first stage of sampling and the selection of respondents from these households to be the second stage of sampling. Using this model, the ratio of calls answered to eligible households represents the *site completion rate*. The ratio of participating respondents to eligible households contacted represents the *respondent completion rate*. The *response rate* for the entire study is calculated by multiplying the *site completion rate* by the *respondent completion rate* (Frankel, 1982).

To illustrate these calculations, readers should consider the following hypothetical set of randomly selected household telephone numbers that correspond to a particular jurisdiction. This set was selected in accordance with the objectives of a household survey and a power analysis that considered the comparisons of interest.[63] As the discussion above describes, the response rate for this illustrative project is calculated based upon two different levels of analysis: (1) the household (site) completion rate; and (2) the within-site respondent completion rate. Imagine a sample of 1,000 telephone numbers representing households with the following rates of participation: 800 homes answered; 100 homes did not answer; 100 telephone numbers were disconnected or not valid for the purposes of the study (e.g., these numbers represented fax lines or business organizations); the 100 invalid sites

[63] This particular example reflects a survey protocol in which one respondent per household is surveyed. Other protocols could require multiple respondents to be sampled in each household (e.g., in parent-child surveys).

were eliminated from the set of eligible homes and were replaced with 100 new randomly selected telephone numbers from the appropriate pool of numbers. Of these 100 new households, 70 answered and 30 did not answer. Thus, the first-stage (i.e., site) completion rate was calculated as follows:

Site completion rate =

$$\frac{(800 + 70) \text{ participating sites}}{1{,}000 \text{ total eligible sites}} = 0.87$$

For the second stage, 700 respondents completed the survey, 100 eligible participants refused to participate, and 70 agreed to participate but were unable to complete the survey according to the established methodology or were unable to re-schedule the survey within the time limits of the study. Thus, the second-stage (i.e., within-site respondent completion rate) was calculated as follows:

Respondent completion rate =

$$\frac{700 \text{ participating respondents}}{870 \text{ eligible respondents within participating sites}} = 0.80$$

Finally, as a result of these operations, the data set in this hypothetical prevalence study represents an overall response rate of (0.87)*(0.80) = 0.70, or 70%.

Although we have illustrated the calculation of the response rate using an example of a household telephone survey, this method applies to other sampling designs as well, including the selection of respondents from treatment programs and schools.

Interviewer Selection and Training

Disordered gambling survey protocols should include a section that specifies how the interviewers who conduct the survey will be trained and monitored. In addition, details about pre-testing are essential to the development of a quality survey protocol—even if it rests in large part on instruments previously used in field studies. Finally, the interviewer selection and training part of the research protocol should include a consideration of how issues of ethnicity and knowledge of gambling and addiction treatment modalities will be addressed during the interviewer training activities.

Data Coding and Entry

Research protocols should specify how data will be coded and entered. This information is vital to data integrity. Computer-Aided Telephone Interviews (CATI) result in data that is coded and entered in a single step. The quality of data should be carefully monitored. We suggest that a research monitor observe a minimum of 10% of the interviews, selected at random, complete a coded interview, and compare it to the CATI interview to check for accuracy. The comparison between the monitored interviews and the CATI data should yield an error rate of less than 1%. Finally, provisions must be made that assure confidentiality and anonymity of respondent data.

Data Analysis

The survey protocol should anticipate how investigators will analyze the obtained data. A variety of descriptive and multivariate techniques will provide state planners with a range of indicators that will assist statewide and sub-state planning activities so long as an adequate sample of qualified respondents was obtained during the data collection process (i.e., optimal allocation across statewide treatment planning regions). When smaller samples are available, scientists should consider non-parametric statistics as the tools of choice. Research protocols should not simply list a variety of statistical instruments as the analytic choices. Data sets should be diagnosed and evaluated for the proper statistical "fit." Investigators should provide a rationale for using specific statistical devices and be certain that their obtained data set matches the requirements of these statistics.

Applying the Results

To ensure that a survey protocol includes the essential sampling and design elements necessary to meet each investigator's unique data needs, we suggest that the proposed survey protocol consider how the study results will be applied once the analyzed data is obtained. What are the critical treatment planning decisions that face health planners? Who will be involved in the development of new gambling treatment programs? Which jurisdictions (i.e., level of analysis) will use the survey results for treatment planning? Each of these and other key questions will assist health planners to make key sampling decisions that will assure adequate respondent samples in key sub-state or respondent attribute strata.

State and Sub-state Approaches for Treatment Planning

Within any state, prevalence data for treatment planning will be most useful if it is categorized by county, city, or town, depending upon clinical and treatment planning considerations. Linking the survey results with state and sub-state social indicator data is particularly important. These goals should be specified in the protocol so that appropriate sampling strategies can be devised to assure researchers that an adequate group of respondents will be contacted in each sampling stratum. More information about estimating sample size can be found in the previous sections on power analysis and optimal allocation.

Summary

This brief guide provided only the most basic architecture necessary for investigators to develop quality research protocols for the conduct of disordered gambling prevalence research. In this guide, we emphasized the use of prevalence research for treatment planning or resource allocation. Administrators, policy makers, and legislative bodies can use this guide during the development of requests for proposals and contract negotiations with potential research vendors. In addition, this guide can help non-scientist consumers of research better understand the basic elements of research design for estimating the prevalence of disordered gambling.

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