NATIONAL CENTER FOR RESPONSIBLE GAMING
Advancing Research, Education and Awareness

INCREASING THE ODDS
A Series Dedicated to Understanding Gambling Disorders

VOLUME 8

Innovative Studies from the NCRG Centers of Excellence in Gambling Research

Increasing the Odds: A Series Dedicated to Understanding Gambling Disorders

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Volume One: *Youth and College Gambling*

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Editor's note: The summaries and information in this publication were compiled with assistance from Christine Reilly, Amy Kugler and Nathan Smith of the NCRG, and Nancy Plemens Mayes, a health and science writer.

FOREWORD

Celebrating Research Excellence

by Alan Feldman

A researcher's impact is not only measured in how many peer-reviewed publications he or she produces, but also in the degree to which study results apply to the public.

Since 1996, the National Center for Responsible Gaming (NCRG) has striven to fund the highest quality research possible, with the goal of translating that research into practical, real-world applications.

Some of the most intriguing and innovative research has been conducted during the first three-year round of funding to the NCRG Centers of Excellence in Gambling Research at the University of Minnesota and Yale University. Both NCRG Centers of Excellence have been leaders in the field, and their studies are vital to gaining a better understanding of gambling disorders and responsible gaming.

For the eighth volume of *Increasing the Odds,* the NCRG is focusing on selected works published by these outstanding institutions as NCRG Centers of Excellence. Both were awarded a three-year grant in 2009 to address a complex set of gambling-related issues through exacting scientific research. The grantees also provide leadership in the field by translating research findings for non-academic audiences and mentoring the next generation of gambling researchers.

Combined with the work of other grantees, the NCRG-funded research portfolio is providing a clearer picture of how a gambling disorder develops and the roads to recovery. This effort spurred the creation of a body of superb NCRG resources available for the public to use.

As you'll see clearly demonstrated in this volume of *Increasing the Odds*, the NCRG Centers of Excellence at the University of Minnesota and Yale University have made impressive progress toward a greater understanding of these important issues.

On behalf of the NCRG Board of Directors, I want to thank Drs. Jon Grant and Marc Potenza, for their outstanding leadership and pioneering work in this field. We all look forward to what we'll learn from both Drs. Grant and Potenza during the next round of funding to the NCRG Centers of Excellence at The University of Chicago and Yale University.

About the author…

Alan M. Feldman is chairman of the NCRG and senior vice president of public affairs at MGM Resorts International.

INTRODUCTION

by Linda B. Cottler, Ph.D., M.P.H.

The NCRG Centers of Excellence in Gambling Research at the University of Minnesota and Yale University are truly living up to their name — excellence. They have published more than 50 articles in peer-reviewed journals, many of which are high impact and extremely competitive, meaning that the authors are contributing in a meaningful way to the science of gambling research. This achievement is exactly what NCRG hoped for when developing this new line of research funding. For this volume, we selected six published studies to exemplify the lines of research pursued at each NCRG Center of Excellence.

FINDINGS FROM THE NCRG CENTER OF EXCELLENCE AT THE UNIVERSITY OF MINNESOTA

This NCRG Center of Excellence has primarily focused on risk factors for the development of a gambling disorder. The ultimate goal is to identify problem gambling behavior earlier among young adults. The following studies are summarized in this volume of *Increasing the Odds:*

- **Can We Predict Future Disordered Gamblers?**
  Is it possible to predict who might develop a gambling problem even before they show symptoms of the disorder? If so, what are the markers of vulnerability? This knowledge could allow us to intervene at an early stage, before the person develops a severe problem. However, little is known about the cognitive or neurobiological precursors of pathological gambling. This study of cognitive function in young adults was designed to begin to answer this question.
- **Does it Run in the Family? A Look at Gambling and Family History**
  Family history and genetic studies have demonstrated a link between addictive disorders like pathological gambling and substance use since, arguably, the same general brain structures and cellular pathways are involved. However, previous studies have not examined the possible familial link between substance use disorders and recreational gambling, a potentially addictive behavior that has not risen to the level of a gambling disorder. This study sampled people with at least one parent with an addictive disorder, hypothesizing that those persons would score higher on measures of impulsivity, have more psychiatric problems and report greater gambling severity.
- **Impulsivity and Cognitive Flexibility in No-risk, At-risk and Pathological Gamblers**
  What role do specific problematic behaviors play in developing a gambling disorder? In this study, researchers examined the influence of response inhibition (a measure of impulsiveness) and cognitive flexibility (a measure of the ability to think about multiple concepts simultaneously). Also, the researchers considered the association between cognitive deficits and recurring gambling problems in assessing which is a risk factor versus an outcome.

FINDINGS FROM THE NCRG CENTER OF EXCELLENCE AT YALE UNIVERSITY

This NCRG Center of Excellence explored three strands of research: an examination of the neurobiology of gambling disorders through brain imaging; an exploration of the influences on youth gambling, using data from a survey of 2,000 Connecticut high school students; and the continuing study of the influence of co-occurring disorders, such as anxiety, on the development, progression, maintenance of and recovery from a gambling disorder. Research included a look at the genetic and environmental factors that contribute to these disorders. The following studies are summarized in this volume:

- **Understanding the Neurobiology of a Gambling Disorder**
  Relatively little is known about which neurons are activated during specific phases of reward and loss processing that occurs among people with gambling problems. This study is the first to use functional magnetic resonance imaging (fMRI) to examine the neural correlates during these different phases of reward and loss. Alterations in this neural circuitry processing appear relevant to gamblers as these distorted appraisals of rewards or punishments could promote risky choices and continued gambling, in spite of adverse consequences.
- **Shared Genetics of Anxiety Disorders and Pathological Gambling**
  Pathological gambling frequently co-occurs with anxiety disorders; however, the extent to which this co-occurrence is related to genetic or environmental factors is unknown. Because people with co-occurring disorders typically have more severe illness, do poorly in treatment and require multiple treatment regimens, a better understanding of the genetic and environmental factors contributing to pathological gambling and anxiety disorders is needed. This study from the Vietnam Era Twin Registry (VET-R) investigates two main points: whether pathological gambling and anxiety disorders frequently occur together, and how genetic, environmental and shared factors relate to co-morbid disorders.
- **The Potential Impact of Giving Lottery Tickets to Teens**
  In this study, researchers studied gambling attitudes and behaviors of high school students given lottery tickets and compared them to those not given tickets. The researchers hypothesized that ticket-gifted adolescents compared with non-ticket-gifted adolescents would be more likely to report at-risk/problem gambling, have family members with gambling problems, purchase lottery tickets, perceive their parents as being more approving of gambling, view problem gambling prevention efforts as less important, and have an earlier age at gambling onset.

These studies address several important and relevant issues that challenge the field today. As the NCRG Centers of Excellence in Gambling Research embark on the next three years of their projects, the Scientific Advisory Board looks forward to their progress on their continuing lines of research as well as their new ventures.

About the author…

Linda B. Cottler, Ph.D., M.P.H., is the associate dean for research and planning in the College of Public Health and Health Professions; Dean's Professor and Chair of the department of epidemiology in the College of Public Health and Health Professions and College of Medicine, University of Florida. She served as the chair of the NCRG's Scientific Advisory Board from 2009 to 2013.

As of this publication date, the American Psychiatric Association has renamed "pathological gambling" to "gambling disorder" in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5).* Because the journal articles for this volume of *Increasing the Odds* were written prior to the revision, we have used the term "pathological gambling" when discussing individuals who have met the criteria for that disorder under the *DSM-IV* diagnostic code. The authors used the term "gambling disorders" to denote all levels of gambling problems, including pathological and subclinical or problem gambling.

RESEARCH SUMMARY

Can We Predict Future Disordered Gamblers?

by Jon E. Grant, J.D., M.D., M.P.H.
The University of Chicago

A summary of:
Grant JE, Chamberlain SR, Schreiber LRN, Odlaug BL, Kim SW. Selective decision-making deficits in at-risk gamblers. *Psychiat Res.* 2011;189(1):115–120.

INTRODUCTION

Is it possible to predict who might develop a gambling problem even before they show symptoms of the disorder? If so, what are the markers of vulnerability? Such knowledge would allow health care providers to intervene at an early stage, before the person's disorder becomes severe. However, little is known about the cognitive or neurobiological antecedents of pathological gambling (PG) — it is not fully understood what causes the poor decision-making and impulsivity that are hallmarks of PG. This study of cognitive function in young adults was designed to begin answering this question. This is the first study to compare separable aspects of decision-making in healthy young adults at increased risk for gambling problems to those who gamble socially without problems.

HIGHLIGHTS

- At-risk participants (i.e. those who have one or two symptoms of a gambling disorder) gambled at greater amounts irrespective of risk; they made significantly fewer rational decisions under conditions of relative risk ambiguity; and they were more likely to continue playing and become "bankrupt" during a gambling task.
- A significantly greater proportion of the at-risk participants met criteria for current alcohol dependence/abuse.
- The results of this study suggest that even at the stage of low-risk gambling, selective cognitive dysfunction is already present in terms of decision-making.

HYPOTHESIS

We recruited young adults (aged 18 to 29 years) who gamble five or more times per year with the goal of investigating cognitive dysfunction in those at risk of developing a gambling disorder, compared to those who were not. In this study, we hypothesized that those at risk of developing a gambling disorder would exhibit impaired decision-making, implicating dysfunction of orbitofronto-limbic circuitry[1] (the region in the frontal lobes of the brain which is involved in the cognitive processing of decision-making) in the development of the disorder itself, suggesting a potential vulnerability to developing a gambling disorder.

SAMPLE AND METHODOLOGY

The research participants were non-treatment-seeking young adults recruited as part of a longitudinal study seeking ultimately to characterize predictive factors in the later development of a gambling disorder. Participants were self-selected in response to media announcements and were compensated with a gift card to a local department store. The only inclusion requirement was that the research participant had gambled in any form at least five times during the past 12 months. The only exclusion criterion was an inability to understand/undertake the procedures or to provide written informed consent. Since the study sought to examine a naturalistic sample of people reflective of the broader

population, subjects with psychiatric and substance use comorbidity, as well as those subjects currently taking psychotropic medications, were allowed to participate.

We used various validated measures and several gambling tasks, such as the Yale Brown Obsessive Compulsive Scale Modified for Pathological Gambling (PG-YBOCS), the Cambridge Gambling Task and the Stop-Signal Task.

Participants were assessed for the following:

- Psychiatric comorbidity (the presence of other psychiatric disorders such as depression or bi-polar disorder)
- PG
- Frequency of gambling and money lost
- Any legal, social, occupational or academic consequences from problematic gambling behavior
- Addictive and psychiatric disorders among first-degree relatives
- Quality of decision-making while performing a gambling task
- Response inhibition as measured by the Stop-Signal Task[2] (a task in which an external stimulus signals the participant to interrupt an already-initiated motor response)

KEY FINDINGS

This study included 186 participants (27.0% females; mean age = 21.5 years). Of this, 112 (60.0%) reported no criteria of PG (social/non-problem gamblers) and 74 (40.0%) had either one or two criteria for PG (at-risk gamblers). Both groups were generally the same age (21.3 years social/non-problem and 21.8 years at-risk), had low percentage of females (28.6% social/non-problem and 24.3% at-risk), had at least some college education (93.8% social/non-problem and 91.9% at-risk), and were largely Caucasian (89.3% social/non-problem and 75.7% at-risk).

The results of the testing revealed the following comparisons of the social/non-problem gamblers with the at-risk gamblers:

- The two groups differed in terms of several measures relating to gambling participation. The at-risk group gambled more frequently, wagered and lost more money. Also, they scored higher on the PG-YBOCS assessment task than the social/non-problem gambler group.
- A significantly greater proportion of the at-risk participants met criteria for current alcohol dependence/abuse.
- The members of the at-risk group who also demonstrated alcohol dependence/abuse did not differ significantly from those without alcohol dependence/abuse on any cognitive variable. The two groups did not differ significantly in terms of proportion meeting criteria for drug dependence/abuse.
- At-risk participants showed abnormally reduced rational decision-making in the gambling task.
- In the Cambridge Gambling Task, there was a significant difference in the number of bankruptcies between the groups with significantly more occurring in the at-risk group.
- The two groups did not differ significantly on stop-signal reaction times.

DISCUSSION

The at-risk subjects demonstrated cognitive impairments relating to several aspects of decision-making on the Cambridge Gambling Task. Specifically, they gambled a greater proportion of points on the task irrespective of risk; they made significantly fewer rational decisions under conditions of relative risk ambiguity; and they were more likely to continue playing and become "bankrupt" while playing the gambling task. Importantly, the at-risk participants did not show any deficits in terms of motor inhibition (as shown by the Stop-Signal Task) demonstrating that impairments in decision-making are not associated with general problems of motor impulsivity.

This is the first study to compare separable aspects of decision-making in healthy young adults at increased risk for gambling problems to those who gamble socially with no problems.

The discovery of decision-making deficits in people at-risk of developing a gambling disorder coincides with recent neurobiological models of PG itself and findings from the broader cognitive research.[3–5]

LIMITATIONS

First, the cognitive tests used in this study assess only certain aspects of cognition. A greater number of tasks with broader examination of cognitive domains (including other aspects of impulsivity) might have detected more differences between the groups. Second, "at-risk" gamblers have been defined as having one or two symptoms of PG. Questions remain whether significant differences in psychopathology between at-risk and problem gamblers exist. Additionally, there are no established standards for categorizing gambling behavior across a continuum. Although these groupings have been used in previous studies,[6] they are not based on empirically-derived thresholds.

Finally, although this study is the initial assessment in a longitudinal examination of these subjects, the cross-sectional nature of these data precludes our ability to establish temporal patterns (cross-sectional research involves observation of a population, or a representative subset, at a specific point in time). The question remains, therefore, whether these cognitive findings will accurately predict the development of a gambling disorder or other impulsive behaviors. Until those data are available, temporal interpretations are not possible.

IMPLICATIONS FOR FUTURE RESEARCH

The results of this study suggest that even at the stage of low-risk gambling, selective cognitive dysfunction is already present in terms of decision-making capabilities. Will the at-risk research participants develop gambling problems later in life? Future work should follow these participants over several years to answer this question, as well as examine whether findings generalize to those at risk of PG across a broader age range (i.e., not just in young adults). Researchers also should investigate the potential moderating influences of comorbidity with other disorders using larger samples.

If these subjects ultimately develop a gambling disorder or other impulsive disorders, findings would suggest that using cognitive measures might lead to improved early detection. Intervention at the cognitive level (i.e., cognitive therapy addressing decision-making instead of gambling behavior) in those who display this impaired decision-making, therefore, could theoretically prevent the development of a serious disorder.

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About the author…

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RESEARCH SUMMARY

Does it Run in the Family? A Look at Gambling and Family History

by Jon E. Grant, J.D., M.D., M.P.H.
The University of Chicago

A summary of:
Schrieber LRN, Odlaug BL, Grant JE. Recreational gamblers with and without parental addiction. *Psychiatry Res.* 2012;196:290-295.

INTRODUCTION

Addictive disorders, encompassing both substance use and behavior addictions such as a gambling disorder, are common and complex illnesses that likely reflect an interaction between individual vulnerabilities, genetics and environmental influences. Family history and genetic studies have demonstrated a link between addictive disorders like pathological gambling (PG) and substance use[1-4] since, arguably, the same general brain structures and cellular pathways are involved in both.[5]

However, previous studies have not examined the possible familial link between addictive disorders and recreational gambling, a potentially addictive behavior that has not risen to the level of psychopathology. Despite the fact that familial studies cannot separate genetics from environmental effects, they provide important information about possible genetic links that can be further examined.

HIGHLIGHTS

- Though recreational gamblers whose parent has been diagnosed with an addictive disorder did not self-report or cognitively display greater impulsivity, they reported greater use of both marijuana and nicotine, two behaviors that may suggest greater risk-taking and impulsivity.
- No significant cognitive differences between groups was found, but a trend was seen in greater delay aversion (smaller immediate reward is chosen over a larger delayed reward) in those with an addicted parent, suggesting possible deficiencies in executive functioning and increased impulsivity in the group.

The family history study presented here has merit for several reasons. First, the sample consists of recreational gamblers, excluding those who met criteria for problem or pathological gambling, investigating familial links in those who have yet to develop a disorder and could offer greater understanding of early intervention and prevention. Second, this study examines the construct of impulsivity in several domains (i.e., decision-making abilities, motor impulsivity and delayed discounting) allowing for the investigation of the familial nature of addictive disorders on a cognitive level, as determined by both genetic makeup and environmental influences. Studying impulsivity in this manner lends itself to identifying differences between those reporting having at least one parent with an addictive disorder and those reporting no parents with an addictive disorder.

HYPOTHESIS

The purpose of this study was to compare the characteristics of recreational gamblers reporting at least one parent with an addictive disorder with those reporting no parental addictive disorders. We hypothesized that participants who reported having at least one parent with an addictive disorder would score higher on measures of impulsivity, have more psychiatric problems and report greater gambling severity.

SAMPLE AND METHODOLOGY

Men and women aged 18 to 29 who gambled (defined as any betting with real money) at least five times in the past 12 months were recruited through poster advertisements within the community, mass mailings and online classified advertisements. We excluded participants who met the criteria for problem or pathological gambling, defined as meeting two or more of the criteria for PG, as well as those unable to understand the study or give informed consent. Participants were recruited from October 2009 to October 2010 and interviewed by trained research staff regarding demographics, gambling behaviors and thoughts, family history, and medical and psychiatric history. After the participants were interviewed, cognitive testing was conducted by research staff in a room with limited cognitive stimulation. They completed self-report questionnaires measuring personality, impulsivity, gambling behavior, self-esteem and emotional regulation.

Characteristics of the sample include:

- 286 recreational gamblers
- 233 recreational gamblers without parental addiction; 53 with parental addiction
- Mean age of 21.33
- 30.5% females
- 66.1% with some college education
- 85.4% Caucasian
- 73.6% (39 of 53) had a parent with alcohol use disorder
- 22.6% (12 of 53) had a parent with drug use disorder
- 17.0% (9 of 53) had a parent with PG
- 11.3% (6 of 53) had a parent with alcohol and drug use disorders
- 1.8% (1 of 53) reported a parent with alcohol use disorder and PG
- 1.8% (1 of 53) reported a parent with drug use disorder and PG

Researchers found that even at a stage of low-risk gambling, those with a possible environmental and/or genetic risk of addiction exhibit a range of problematic behaviors secondary to gambling, such as financial and social problems, despite spending similar amounts of time and money on gambling.

KEY FINDINGS

Research participants with an addicted parent were more likely to have problems with gambling. A significant number with an addicted parent (44.4%) met criteria for a psychiatric disorder at some time in their lives compared to those without a parental addictive disorder (24.1%). More specifically and significantly, these subjects met criteria for a lifetime major depressive episode (40.7%) and had a lifetime anxiety disorder (14.8%) compared to those without an addicted parent (20.4% and 6.7%, respectively).

Additionally, a considerably greater number of those with an addicted parent reported marijuana (38.9%) and tobacco (40.7%) use than those without parental addiction (21.6% and 15.8%, respectively). However, no major differences were found concerning alcohol use or alcohol and drug use disorders. These findings suggest that even at a stage of low-risk gambling, before being diagnosed with a gambling disorder, those with a possible environmental and/or genetic risk of addiction (after controlling for other variables) exhibit a range of problematic behaviors.

DISCUSSION

In comparing the characteristics of recreational gamblers reporting at least one parent with an addictive disorder with those reporting no parental addictive disorders, it was determined that recreational gamblers with parental addiction do not report more severe gambling symptoms and are not more impulsive on self-report or cognitive measures. However, in partial support of the initial hypothesis, it was found that young adults reporting parental addictive disorders had more problems secondary to gambling, such as financial and social problems, despite similar amounts of time and money spent gambling.

Overall, standard self-report measures of impulsivity do not support a strong link between impulsivity and parental addictive behaviors. No significant cognitive differences between groups were found. However, we observed a trend of greater delay aversion (smaller immediate reward is chosen over a larger delayed reward) in those with an addicted parent, suggesting possible deficiencies in executive functioning and increased impulsivity in the group.

Though recreational gamblers with parental addictive disorder did not self-report or cognitively display greater impulsivity, they reported greater use of both marijuana and nicotine — two behaviors that may suggest greater risk-taking and greater impulsivity among those research participants. One might deduce that the positive family history of addictive disorders results in greater impulsivity in offspring in the form of impulsive, reckless behaviors, such as using drugs or alcohol. Another possible deduction is that the use of marijuana and nicotine may be more likely due to modeling parental behaviors and that it is not necessarily a result of greater cognitive impulsivity.

LIMITATIONS

It is possible that results may underestimate the difference between the two groups because the more severe gamblers, who would have most likely been disproportionately included in the parental addictive disorder group, were excluded from this analysis. Another explanation for why few significant differences emerged for impulsivity measures could be that the sample consisted mainly of young adult Caucasian males of a similar age. In this study, both the parental addiction and non-addiction groups scored higher on all subscales of novelty-seeking on the Tridimensional Personality Inventory (TPQ) when compared to U.S. normative data. Therefore, it is possible that differences between groups on cognitive impulsivity could not adequately be detected and differences might have emerged in a sample of recreational gamblers with a race- and gender-balanced group with a larger age range.

IMPLICATIONS FOR FUTURE RESEARCH

These limitations, along with the parental addictive disorders being of a self-report nature, can be improved upon. Future studies should use more rigorous methods of collecting family history, such as the Family History-Research Diagnostic Criteria.[6] Results of this study need to be confirmed by additional longitudinal studies in which first-degree relatives are clinically evaluated, providing a greater knowledge about the origins of impulsivity. A longitudinal study could also inform clinicians about behaviors and thinking patterns that may lead to an addiction, which would be helpful in developing a targeted

intervention for these individuals displaying high-risk cognitions and behaviors to prevent further progression of addictive behaviors and cognitive processes.

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RESEARCH SUMMARY

Impulsivity and Cognitive Flexibility in No-risk, At-risk and Pathological Gamblers

by Jon E. Grant, J.D., M.D., M.P.H.
The University of Chicago

A summary of:
Odlaug BL, Chamberlain SR, Kim SW, Schreiber LRN, Grant JE. A neurocognitive comparison of cognitive flexibility and response inhibition in gamblers with varying degrees of clinical severity. *Psychol Med.* 2011;41(10):2111–2119.

INTRODUCTION

What role do specific problematic behaviors play in gambling disorders? Past research has found that behaviors in people diagnosed with pathological gambling (PG) are often repetitive, hard to suppress and impulsive. Such behaviors can result in negative long-term outcomes. Further, people with the disorder often have difficulty shifting their thoughts and behavior away from gambling toward other areas of life that may be less damaging. In other words, they lack "cognitive flexibility."

This study explored two specific cognitive areas that previous research has suggested may influence PG: response inhibition (a measure of impulsiveness) and cognitive flexibility (a measure of ability to think about multiple concepts simultaneously). Reflecting a chicken or egg scenario, it is not clear whether cognitive deficits stem from recurrent gambling itself or, rather, reflect deficits that pre-date symptoms and exist in people at-risk for developing a gambling disorder. This study attempted to address this issue in part by recruiting a group of research participants with at-risk gambling, viewed as being in an intermediate state between health and the disorder.

HIGHLIGHTS

- Researchers hypothesized that individuals with a gambling disorder would display lower levels of response inhibition and cognitive flexibility when compared to healthy controls.
- Impaired response inhibition and cognitive flexibility exist in people with pathological gambling compared with no-risk and at-risk gamblers.
- In the analysis of cognitive measures for all study recruits, the PG group showed significantly poorer reaction times and more impulsivity compared with the other groups.
- It appears that the impulsivity and cognitive flexibility difficulties manifested in pathological gambling, indexed by these tests, may not exist in people at elevated risk of developing the disorder.

HYPOTHESIS

We hypothesized that those who develop a gambling disorder will display lower levels of response inhibition and cognitive flexibility when compared to their healthy counterparts. We also sought to answer the question of whether these cognitive deficits pre-date onset of PG, or if they follow the onset of the disorder.

SAMPLE AND METHODOLOGY

Research participants were adults aged 18 to 65 years who had gambled in any form at least five times during the past 12 months. Study participant recruitment was conducted through community advertising in local newspapers and posted fliers.

BOX 1
Stop-Signal Task

The Stop-Signal Task quantifies the ability of participants to suppress already-initiated motor responses. Participants observe a series of directional arrows appearing one at a time on a computer screen, and make rapid motor responses depending on the direction of each arrow. On a subset of trials, an auditory beep occurs (the "stop-signal") which indicates to the volunteer that they should attempt to withhold a response on that particular trial. This task uses a dynamic procedure to adjust the time between presentation of the directional cue and the stop signal, which is contingent upon the performance of the particular individual. The paradigm provides a sensitive estimate of the time taken to stop a pre-potent response (that is, a response that has been previously associated with immediate reinforcement), which is referred to as the "stop-signal reaction time." Longer stop-signal reaction times represent poorer response inhibition (i.e., greater impulsivity).

BOX 2
Intradimensional/Extradimensional Set Shift Task

The Intradimensional/Extradimensional Set Shift Task (IDED Task) was derived from the Wisconsin Card Sorting Task. Volunteers observe a series of stimuli on-screen, presented two at a time, and attempt to learn an underlying rule about which stimulus is "correct." This is accomplished via feedback on-screen (the words "correct" or "incorrect" were presented after each choice). Once the research participant reaches the learning criterion of six consecutive choices of the correct stimulus, the underlying rule is changed by the computer, and the user must show learning and flexible responding in acquiring the new rule. There are nine stages to the task in all. The primary outcome measure is the total number of errors made throughout the task, corrected for stages not attempted.

Using various measures and gambling tasks, the potential research participants were assessed for the following:

- PG, number of clinical symptoms
- PG, severity of illness
- Psychiatric comorbidity (the presence of additional psychiatric disorders such as depression or bipolar disorder): We excluded mood disorders such as bipolar disorder, psychotic disorders including schizophrenia, brain injury/trauma, history of seizures and implementation or dose changes of psychoactive medication within six weeks of study enrollment.
- Quality of life
- Demographics and family history

Participants were also given the following cognitive assessments:

- Stop-Signal Task: a measure of impulsivity[1,2] (see Box 1)
- Intradimensional/Extradimensional Set Shift Task: a measure of cognitive flexibility (see Box 2)

KEY FINDINGS

The PG group was significantly older, reported a lower quality of life and a greater likelihood of first-degree relatives with an addiction than the no-risk and at-risk groups. Those in both the PG and at-risk groups showed significantly higher rates of substance use disorders and psychiatric comorbidity, when compared with the no-risk group.

In the analysis of cognitive measures for all study recruits, the PG group showed significantly poorer reaction times and more impulsivity compared with the other groups. The at-risk and no-risk groups did not differ significantly from each other on these task measures. To account for the higher age of the PGs, an age-matched subgroup of PGs was compared to similar at-risk and no-risk gamblers. The findings of significantly worse reaction times were confirmed in this age-matched analysis. In other

words, the PG group's cognitive measures were not the result of age.

The findings were largely similar on the cognitive flexibility task. The PG group made significantly more total errors compared with both other groups, which did not differ significantly from each other on performance. An age-matched comparison also was made to ensure the older age of the PG group was not responsible for the significant difference. In the age-matched examination, the finding that the PG group made more total errors was confirmed.

The finding that significantly more individuals with PG had a first-degree relative with a lifetime history of addiction is potentially valuable from a clinical perspective.

DISCUSSION

The finding that significantly more individuals with PG had a first-degree relative with a lifetime history of addiction is potentially valuable from a clinical perspective. The early identification of PG through targeted screening of individuals with a history of positive for addiction may aid in the reduction of the development of a gambling disorder among these individuals; however, the results indicate no clinically significant differences for those with and without a lifetime history of a substance use disorder. Similarly, the relatively high proportion of individuals in the PG and at-risk groups with a lifetime history of a substance use disorder is worth investigating because of the previously established commonality that research has found between these two conditions.[3] Recent research has indicated that these individuals may represent a specific subtype of gambling addiction, characteristically sharing high rates of impulsivity.[4]

The PG group showed impaired response inhibitions and significantly slower reaction times on "go" trials (independent of stop-signal reaction times), and the age-matched group did not. This suggests that the slower reaction times seen in the PG sample as a whole was due to older age, and that impaired impulse control occurred even when groups were age matched. Participants with in the PG group also made disproportionate errors on the cognitive flexibility task.

Intriguingly, those in the at-risk group did not differ significantly from the no-risk group in terms of these performance indices. Thus, it appears that the impulsivity and cognitive flexibility difficulties manifested in a gambling disorder, indexed by these tests, may not exist in people at elevated risk of developing the disorder. The at-risk category, however, may be too diverse with some at low risk and some at slightly elevated risk of problematic gambling behavior.

LIMITATIONS

This study has several limitations. First, the age of those diagnosed with PG in this study was significantly older than both the no-risk and at-risk sample of individuals. It was confirmed, however, that these findings remained robust in a subgroup of those with PG that were objectively matched to the other groups in terms of age. Second, although the study's participants were respondents to community-based poster or newspaper advertising, many of those in the PG group were treatment-seeking individuals who may differ from a non-treatment-seeking population. No participants, however, were recruited from outpatient or inpatient psychiatric clinics. Third, IQ data, relevant to participants'

cognitive abilities, were not recorded. Fourth, a number of subjects were currently taking psychoactive medications that may influence executive function and confound the neurocognitive assessments. All subjects were required to have been on a stable dose of medication for six weeks before the testing. Lastly, no direct interviews with the first-degree family members of subjects assessed for this sample were conducted, leaving open the possibility of information bias.

IMPLICATIONS FOR FUTURE RESEARCH

Research shows that impaired response inhibition and cognitive flexibility exist in people with a gambling disorder when compared with no-risk and at-risk gamblers. The early identification of such illness in adolescence or young adulthood may aid in the prevention of addiction onset of such disabling disorders.

Future research should follow those at-risk of developing a gambling disorder over time in longitudinal studies; use other cognitive tasks to compare no-risk, at-risk and pathological gamblers; and examine whether pathological gamblers make specific errors on cognitive tests and what these specific errors might signify.

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RESEARCH SUMMARY

Understanding the Neurobiology of a Gambling Disorder

by Iris M. Balodis, Ph.D., and Marc N. Potenza, M.D., Ph.D.
Yale University School of Medicine

A summary of:
Balodis IM, Kober H, Worhunsky PD, Stevens MC, Pearlson GD, Potenza MN. Diminished frontostriatal activity during processing of monetary rewards and losses in pathological gambling. *Biol Psychiatry.* 2012;71(8):749–757.

INTRODUCTION

The reward pathways of the brain are critical for survival because they provide the pleasure drives for eating, love and reproduction.[1] These behaviors have been called "natural rewards" and involve the release of dopamine, a neurotransmitter that plays an important role in behavior and cognition, voluntary movement, motivation, punishment and reward, sleep, mood, attention, memory and learning.[1] The same release of dopamine and production of pleasurable sensations can be created by "unnatural rewards" or potential objects of addiction, including alcohol, cocaine and other drugs, as well as by activities such as gambling.[1]

Changes in reward and loss processing circuitry appear particularly relevant to pathological gambling (PG), as they may generate distorted appraisals of rewards or punishments and promote risky choices and continued gambling, in spite of negative consequences. For example, an individual's internal state when presented with a risky gamble may influence his/her decision to continue or to stop playing. Although we have seen great advances in the study of the neurobiology of gambling disorders in recent years, relatively little is known about the neural connection of specific reward and loss processing phases in PG; namely, 1) the prospect of reward; 2) anticipation of reward/loss; and 3) the outcome phase in which a person is notified of reward or loss.

This study is the first to use functional magnetic resonance imaging (fMRI) to examine the neural correlates during different phases of reward and loss processing among those who have a gambling disorder (see Box 1 for an explanation of fMRI technology).

HIGHLIGHTS

- This study is the first to use functional magnetic resonance imaging (fMRI) to examine the neural correlates during different phases of reward and loss processing among those with a gambling disorder.
- The participants performed the Monetary Incentive Delay Task (MIDT) in which participants make a response within a time window and are potentially rewarded for the response depending on their reaction time. This task has recently been modified to model two distinct anticipatory phases relating to prospect and anticipation of reward/loss.
- The pathological gambling (PG) group, as compared with the control comparison (CC) group, showed diminished brain activity in regions related to reward processing and decision-making.
- The findings from the present study support a role for altered insula activity in PG populations during loss processing, and suggest neural mechanisms that may underlie poor risk estimation in PG.

HYPOTHESIS

In this study, we hypothesized that people with gambling disorders, as compared to people without, might demonstrate differences in three specific brain areas previously implicated in reward processing:

BOX 1

Functional magnetic resonance imaging or functional MRI (fMRI) is an MRI procedure that measures brain activity by detecting associated changes in blood flow. Specifically, oxygenated and deoxygenated hemoglobin have different magnetic properties, and fMRI assesses changes related to oxygenated versus deoxygenated hemoglobin. This technique relies on the fact that oxygenated hemoglobin concentrations increase when a brain region becomes more active due to an increase in blood flow to that region. Since the early 1990s, fMRI has been a major method used in brain-mapping research because it does not require people to undergo shots or surgery, ingest substances, or be exposed to radiation and because it can measure changes in brain function over the course of seconds while people perform behaviors or computerized tasks.

BOX 2

In the **Monetary Incentive Delay Task**, participants first view an incentive cue signaling the potential to win or lose money and then fixate on a crosshair (prospect of reward phase). Then, in the anticipation of reward/loss phase, a target appears. Participants win (or avoid losing) money by pressing a button before the target disappears. Participants then wait for feedback notifying whether they have won or lost the trial (A2). In the outcome phase, participants receive feedback on whether they have won or lost the trial and their cumulative earnings.

1. The ventral striatum (VS), the so-called "reward center" in the brain, is recruited during anticipatory reward processing.[2] Diminished activity in the VS has been reported in alcohol-dependence, correlating with measures of impulsivity.[3] Therefore, it was hypothesized that individuals with gambling disorders might also demonstrate diminished VS activity during the prospect and anticipation of reward or loss. Similar to the literature on alcohol-dependence, it was also predicted that those participants with the highest impulsivity would demonstrate the least VS activity.
2. The ventromedial prefrontal cortex (vmPFC) is the area in the frontal lobe of the brain that is responsible for processing risk and fear when making decisions. This function is heavily used in outcomes of reward/loss processing[4] and in decision-making processes.[5] Given previous reports of diminished vmPFC activity in gambling disorders,[6–9] diminished activity during outcome processing in individuals with gambling disorders was predicted.
3. The insula is involved in financial risk-taking and loss prediction,[2,10–12] as well as decision-making;[13] therefore, it was hypothesized that relatively reduced insula activity would be observed during loss processing in people with gambling disorders (i.e., the insula would not work as well when a person bet and lost).

SAMPLE AND METHODOLOGY

The study recruited 14 individuals who met criteria for PG and 14 healthy individuals for a control comparison (CC). The participants performed the Monetary Incentive Delay Task (MIDT) in which they were asked to make a response within a time window and were potentially rewarded for the response depending on their reaction time. This task has recently been modified to model two distinct anticipatory phases relating to prospect and anticipation of reward/loss. This MIDT structure not only effectively separates anticipatory from outcome processes (i.e., waiting to see if the person will win or lose versus a reaction when they understand if they won or lost), but also further breaks down neural activity associated with prospects from outcome anticipation. In this way, the modified MIDT provides a framework to examine the neurobiology underlying specific aspects of reward and loss processing in PG (see Box 2 for more information on MIDT).

KEY FINDINGS

Consistent with the study's hypotheses, the PG group, as compared with the CC group, showed diminished activity in the regions of the brain related to reward processing and decision-making. During anticipation of a reward, the VS diminished vmPFC activation during reward outcome, and diminished insula activation during loss outcome. However, these patterns were less phase-specific than hypothesized, and involved additional brain regions.

Decreased activity in the PG group as they anticipated an outcome suggests suggests alterations in the ability to signal and integrate the short-term value of an incentive cue. These findings have significant implications, as value integration can influence choice.

The following are the conclusions based on findings:

vmPFC Activity:

Decreased activity in the PG group during anticipatory phases suggests changes in the signaling and integration of the short-term value of an incentive cue. These findings have significant implications, as value integration can influence choice. In healthy populations, vmPFC recruitment during affective judgment is associated with adaptive decision-making (i.e., when the vmPFC is activated, individuals are more likely to be flexible and make beneficial, quick decisions).[14,15] Therefore, reduced vmPFC recruitment in PG may contribute to less adaptive money-related decision-making.

Relatively diminished vmPFC activity in the PG group when anticipating and processing information about wins and losses suggests reduced integration of incentive information that might be used to guide subsequent behavior. In other words, when the vmPFC activity is diminished in those with PG, it is more likely that they will not understand that they should adjust their behavior according to their losses.

Insula Activity

Relatively diminished insula activity in the PG group during the prospect of losing money may relate to altered loss-prediction signaling in this population. This may indicate diminished anticipatory signaling of information related to predicting and monitoring losses, and could result in failures to adjust betting behavior or avoid risks.

Blunted insula activity, particularly during the processing of losses, may relate to clinically relevant behavioral and cognitive processes in PG, such as loss-chasing and cognitive distortions involving inflated confidence or illusions of control. The findings from the present study support a role for altered insula activity in PG populations during loss processing, and suggest neural mechanisms that may underlie poor risk estimation in PG.

Altogether, the role for the insula has led to the proposal of this area as an important target for therapeutic strategies such as pharmacological interventions in both PG and substance dependence.[16,17]

VS Activity

Relatively reduced VS activity in the PG group, during both winning and losing anticipatory phases, suggests an underactive reward system in response to monetary incentives and potential difficulties in maintaining reward expectations.

The data suggest that reduced VS responsiveness during reward and loss processing in PG may be reflected in elevated impulsivity and may influence decision-making and/or reward-seeking behaviors related to PG. Impulsivity may represent an important treatment target for PG. Given the relationship between impulsivity and VS activation during reward and loss processing, drugs that influence VS function and have data supporting efficacy in PG (e.g., opioid antagonists like naltrexone and nalmefene, which act to diminish cravings, and glutamatergic agents like n-acetyl cysteine,[18–20] which moderates impulses by regulating how dopamine functions in the brain), may be exerting their influences through decreasing impulsivity and normalizing VS function.

LIMITATIONS

The study was limited by a sample size that does not permit examination of gender-related differences. Another limitation is the slightly higher number of smokers in the PG sample and the inclusion in the PG group of people with past psychiatric illnesses. However, given the frequencies of comorbid psychiatric conditions in PG, particularly smoking, the current sample is representative of the general PG population. Nonetheless, future studies should examine directly the influences of specific co-occurring disorders.

IMPLICATIONS FOR FUTURE RESEARCH

Given the correlations between VS activity and impulsivity in PG without significant between-group differences in self-reported impulsivity or task performance, future experiments could more closely examine this relationship (i.e., using larger samples and/or behavioral measures of impulsivity). Future studies should use integrative approaches, including subjective, physiological, neural and behavioral measures, to gauge changes in PG. Additionally, such measures should be examined with respect to treatment outcome and include both self-report and behavioral measures, as these may differentially relate to addictive behaviors and their treatment.[21,22]

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RESEARCH SUMMARY

Shared Genetics of Anxiety Disorders and Pathological Gambling

by Marc N. Potenza, M.D., Ph.D.
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A summary of:
Giddens JL, Xian H, Scherrer JF, Eisen SA, Potenza, MN. Shared genetic contributions to anxiety disorders and pathological gambling in a male population. *J Affect Disord.* 2011; 132: 406-412.

INTRODUCTION

Pathological gambling (PG) frequently correlates with anxiety disorders; however, the extent to which this co-occurrence is related to genetic or environmental factors is unknown. As individuals with co-occurring disorders typically have more substantial illness, fare worse in treatment and require different interventions,[1] a better understanding of the genetic and environmental factors contributing to PG and anxiety disorders is important. Despite the importance of the co-occurring disorders, relative genetic and environmental contributions to the co-occurrence of PG and anxiety disorders have not been systematically examined.

This study used data from the Vietnam Era Twin Registry (VET-R) to investigate whether PG and anxiety disorders frequently occur together. Twin studies are particularly important when aiming to disentangle the impact of genetic and environmental influences on traits and behaviors, since their genetic makeup and family environments tend to be similar. We hypothesized that, co-occurrences between PG and generalized anxiety disorder, as well as those between PG and panic disorder, would be accounted for largely by genetic factors (as found for PG and depression).

HIGHLIGHTS

- Findings suggest a genetic relationship contributing to the co-occurrences of pathological gambling and panic disorder, and pathological gambling and generalized anxiety disorder.
- Existence of shared genetic contributions between pathological gambling and both generalized anxiety disorder and panic disorder suggests that specific genes, perhaps those involved in affect regulation or stress responsiveness, contribute to pathological gambling and anxiety disorders.
- Further investigation of the efficacy and tolerability of pharmacological and behavioral treatments for anxiety disorders in those with pathological gambling and co-occurring anxiety disorders may be beneficial.

HYPOTHESIS

The purpose of this study was to investigate whether PG and anxiety disorders frequently co-occur. We hypothesized that, while genetic and unique environmental factors will contribute individually to PG, generalized anxiety disorder and panic disorder, the co-occurrences between them would be accounted for predominantly by genetic factors.

SAMPLE AND METHODOLOGY

Participants were 10,253 male twins from the VET-R, and 7,869 were successfully interviewed in 1992 to ascertain diagnoses. Participants were born between 1939 and 1957 and served in the military during the Vietnam era (1965 to 1975). Questionnaires regarding physical appearance and supplemental blood typing were collected, identifying 1,874 identical and 1,498 fraternal twins.

To determine prevalence rates for PG, generalized anxiety disorder and panic disorder, researchers used the Diagnostic Interview Schedule and interviewers obtained verbal informed consent. Criteria for PG were assessed in participants who gambled 25 times or more in the past year. Meeting criteria for generalized anxiety disorder involved acknowledging a period of at least one month of worry and presence of six or more symptoms of generalized anxiety disorder during a period of worry. For panic disorder, acknowledging a panic attack and four or more symptoms during the panic attack was involved.

Characteristics of the sample include:

- Mean age of 42 years
- 93.4% Caucasian, 6.2% Black, 0.4% Other
- 64.0% with more than a high-school education
- 49.1% annual household incomes between $20,000 and $40,000

KEY FINDINGS

Researchers measured the number of participants who demonstrated lifetime criteria for the three disorders (i.e., the number of respondents who have ever exhibited these issues at the time of their interview), and found the following prevalence rates:

- 1.4% (112) of the participants displayed criteria for PG
- 12.3% (966) displayed criteria for generalized anxiety disorder
- 6.0% (473) displayed criteria for panic disorder

Due to the nature of this type of twin-pair data, statistical software was used to adjust error variance. In unadjusted models, PG frequently co-occurred with both generalized anxiety disorder and panic disorder. After adjusting for sociodemographic (education, age, income) and externalized (alcohol, nicotine and/or drug dependence; antisocial personality disorder) variables, the odds ratio (i.e., the strength of association) for both generalized anxiety disorder and panic disorder remained elevated (1.91 and 2.46). Also, after adjusting for internalizing factors, the relationship with generalized anxiety disorder was no longer significant; however, if major depression (an internalizing factor) was removed from the model, the odds ratio between PG and generalized anxiety disorder, as well as PG and panic disorder, remained significantly elevated.

The dichotomous relationship between PG and generalized anxiety disorder, and PG and panic disorder, is evidenced in the existence of a higher degree of similarity in identical twins than in fraternal twins, particularly for generalized anxiety disorder. On the other hand, the cross-diagnosis correlations appeared more strongly in identical twins for PG and panic disorder. Models examining genetic and environmental contributions to each

disorder and their co-occurrence were conducted. The best-fitting models indicated genetic and environmental factors contributed to the co-occurrences of PG and panic disorder, and solely genetic factors contributed to the co-occurrence of PG and generalized anxiety disorder.

Overall, the existence of shared genetic contributions between PG and both generalized anxiety disorder and panic disorder suggests that specific genes, perhaps those involved in the ability to regulate moods or impulses, contribute to PG and anxiety disorders. The relationship between PG and generalized anxiety disorder appears to be mostly genetic in nature, suggesting that different unique environmental influences contribute to both. In contrast, the relationship between PG and panic disorder appear to be influenced by both shared genetics and unique environmental influences.

Overall, the existence of shared genetic contributions between PG and both generalized anxiety disorder and panic disorder suggests that specific genes, perhaps those involved in the ability to regulate moods or impulses, contribute to PG and anxiety disorders.

DISCUSSION

The hypothesis that both anxiety disorders would co-occur frequently with PG was largely confirmed, particularly in unadjusted models. Alternately, odds ratios between PG and panic disorder remained elevated following adjustments. Odds ratios between PG and generalized anxiety disorder remained significant when accounting for sociodemographic and externalizing psychiatric variables, but not after adjusting for internalizing psychiatric variables. When removing major depression from the model, the odds ratio between PG and generalized anxiety disorder remained elevated. This suggests that some of the variance between the two is attributable to depression, which is consistent with the notion of internalizing disorders sharing elements, particularly depression and generalized anxiety disorders.[2]

This study has multiple clinical implications, and genetics can help pinpoint potential co-morbid disorders. First, in preliminary studies, specific genetic variants (e.g., MAO-A and 5-HTTLPR) have been associated with PG and generalized anxiety disorder.[3-7] Additional genetic variants (e.g., those of DAT1 and TPH) have been associated with PG and panic disorder. [8-11] Ultimately, future research should investigate the extent to which these and other genes might contribute to the co-occurrence of PG and anxiety disorders.

Second, the genetic overlaps between PG and generalized anxiety disorder, as well as PG and panic disorder, suggest that biological mechanisms implicated in PG may also underlie anxiety disorders. For example, genetic and biological factors contributing to reward processing, impulsivity, decision-making, neuroticism and stress responsiveness that have been implicated in PG may hold relevance for anxiety disorders, too.[12-14]

LIMITATIONS

Limitations of this study include the potential applicability of findings to the general population, as this study used data from the VET-R consisting of male twin pairs who were largely well-educated, served in the army, middle-aged and predominantly white. The results may not extend to women or populations that are educationally and ethnically

diverse. The data analyzed were collected close to 20 years earlier when different diagnostic criteria were employed and different environments (i.e., availability of legalized gambling) existed. Additional studies using more recent information are important to examine the extent to which the findings extend to present day.

IMPLICATIONS FOR FUTURE RESEARCH

Future research should attempt to define the specific environmental contributions that factor in to the co-occurrence of PG and panic disorder. Understanding such environmental factors in the implication of PG and panic disorder (e.g., childhood trauma) may result in more targeted interventions.[15-18]

Also, treatment for PG has not been as extensively studied as treatments for anxiety disorders. It may be beneficial to investigate the efficacy and tolerability of pharmacological and behavioral treatments for anxiety disorders in those with PG and co-occurring anxiety disorders. The shared genetic contributions to PG and anxiety disorders also raise questions about how PG best fits into the structure of psychiatric disorders.

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RESEARCH SUMMARY

The Potential Impact of Giving Lottery Tickets to Teens

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A summary of:
Kundu PV, Pilver CE, Desai RA, Steinberg, MA, Rugle L, Krishnan-Sarin S, Potenza MN. Gambling-related attitudes and behaviors in adolescents having received instant (scratch) lottery tickets as gifts. *J Adol Health.* 2013;52:456-464.

INTRODUCTION

High rates of adolescent gambling exist worldwide, despite age restrictions prohibiting adolescent participation.[1-2] Even though the sale of lottery tickets to minors is illegal, parents often buy lottery tickets for their children. Minors who receive lottery tickets as gifts may be more likely to participate in lotteries and possibly other forms of gambling. The receipt of lottery tickets as gifts may also influence adolescents' perceptions of the acceptability of gambling,[3-4] including their views of gambling prevention efforts, parental attitudes toward gambling and underage participation in gambling.

HIGHLIGHTS

- Adolescents gifted with lottery tickets were more likely to report earlier ages at gambling onset, buy instant lottery tickets for themselves, buy other types of lottery tickets and receive as gifts other types of lottery tickets, as compared to those not gifted lottery tickets.
- The relationships between gambling-problem severity and health-functioning characteristics, risk behaviors, and gambling motivations and behaviors were largely the same regardless of lottery gift receipt, with the exception of age at gambling onset.
- Youth who received instant lottery tickets as gifts appear less likely to believe that gambling prevention strategies are important.

HYPOTHESIS

It is important to understand the factors that contribute to problematic gambling behaviors among young people in order to have a clearer picture of youth gambling and direction for developing effective prevention programs. Research has shown that gambling during adolescence, particularly problem and pathological gambling (PG), has been linked to poorer functioning (i.e., higher rates of depression and substance use, abuse and dependence), both in adolescence and later in life.[1, 5-9] In this study, we explored the gambling attitudes and behaviors of high school students according to their status as recipients of gifted lottery tickets. We hypothesized that 1) ticket-gifted adolescents would be more likely to report at-risk/problem gambling; 2) adolescent gambling problem severity, as indexed by at-risk/problem gambling, would be more strongly associated with adverse health measures (i.e., depression, substance use) and participation in forms of gambling related to lotteries in those who received scratch tickets as gifts.

By comparing the factors of at-risk/problem gambling in the teens who did and did not receive lottery scratch tickets as gifts, these findings might help parents, teachers, administrators and clinicians identify youth who exhibit risky or problematic gambling behavior thus facilitating early intervention.

SAMPLE AND METHODOLOGY

This study examined gambling and other risk behaviors among 2,002 high school students in Connecticut, focusing on lottery-gift status defined by "yes/no" responses indicating whether participants had "ever received a lottery scratch ticket as a gift in the past year." Cross-sectional survey data were obtained and analyzed. Interactions between gambling-problem severity and lottery-gift status were examined in relation to multiple outcomes.

KEY FINDINGS

Of the 2,022 adolescent gamblers, 1,052 (52.5%) reported having received lottery scratch tickets as gifts. Among those participants:

- 78.4% (825) received fewer than one ticket a month
- 14.5% (152) received tickets monthly
- 3.1% (33) received tickets weekly
- 4.0% (42) received tickets daily

The sociodemographic characteristics of those who received scratch tickets include the following:

- 61.0% were males; 39.0% were female
- 83.3% were Caucasian
- 71.5% came from two parent households
- 67.8% were between the ages of 15 and 17

Lottery gift status was associated with greater gambling problem severity, as the prevalence of at-risk/problem gambling was 38.7% in adolescents receiving lottery tickets as gifts, versus 29.9% among adolescents who did not receive lottery tickets as gifts.

Adolescents gifted with lottery tickets were more likely to report gambling at earlier ages, buying instant lottery tickets for themselves, and buying and receiving other types of lottery tickets as compared to those not gifted lottery tickets. Parental disapproval of gambling was less prevalent among lottery gift recipients. The lottery-gift group was also less likely than the non-gift group to acknowledge the importance of hanging out with non-gambling friends, participating in non-gambling fun activities, receiving warnings about gambling from family adults or peers, having non-gambling parents, learning about gambling-related risks from parents or at school and having parents who did not permit card games for money at home. Overall, compared to youth who did not receive lottery ticket gifts, ticket-gifted adolescents were less likely to see gambling prevention efforts as important.

> Adolescents who received scratch-ticket gifts were more likely to be Caucasian and live in two-parent households. That suggests that cultural and familial factors represent important considerations in youth lottery gambling prevention efforts.

At-risk/problem gambling respondents were less likely than low-risk gambling respondents to be Caucasian and more likely to be male, African-American, Asian or Hispanic. Among non-ticket-gifted youth, at-risk/problem-gambling respondents were also less likely than low-risk gambling respondents to be Caucasian and more likely to be male, African-American, Asian or Hispanic.

The extent to which receipt of instant lottery ticket gifts may promote gambling behaviors and the development of gambling problems warrants consideration. Strategies for education, prevention and treatment should incorporate findings relating to the receipt of gambling products by underage individuals.

No statistical significance was determined in the relationships between gambling problem severity and health/functioning measures (occasional or regular tobacco use, marijuana use, other drug use, involvement in a serious fight, carrying a weapon, depression). However, a significant interaction effect was observed for those who began gambling at age 15 or older among the gift group: at-risk/problem gambling was associated with lower odds (strength of association) in the gift group, whereas there was no relationship in the non-gift group. These findings indicate a stronger link between gambling problem severity and earlier age at gambling onset in the lottery-gifted group. No other interactions were statistically significant, suggesting that the relationship between gambling problem severity and other gambling measures were similar in both groups.

DISCUSSION

Investigating a large sample of adolescent gamblers who did and did not receive instant (scratch) lottery tickets as gifts has led to additional and essential information on 1) sociodemographic characteristics; 2) differences in gambling attitudes and behaviors; and 3) relationships between gambling problem severity and health/functioning characteristics, risk behaviors, gambling motivations and behaviors.

The current findings linking gift-receipt status to greater gambling-problem severity, along with earlier age at gambling onset, may be important developmentally, particularly if trajectories for gambling are similar to those for drinking alcohol, in which youth drinking alcohol at younger ages appear to have increased risk of alcoholism later in life.[10] Also, the finding that adolescents who received scratch-ticket gifts were more likely to be Caucasian and live in two-parent households suggests that cultural and familial factors represent important considerations in youth lottery gambling prevention efforts.

Since the lottery-gift group was less likely to acknowledge the importance of having non-gambling peers or engaging in non-gambling related activities, they were also less likely to acknowledge the importance of learning about the potential harms of gambling. These data indicate a lesser likelihood of perceiving problem gambling prevention efforts as important, and such views should be considered in the development and implementation of youth problem gambling prevention initiatives.[11] As a result, it may be beneficial to have those who were placed in the gift-recipient groups suggest what strategies may work in preventing adolescent gambling, given that they frequently described many current strategies as unimportant.

With the exception of the age at gambling onset, the second hypothesis was largely not supported, as gambling problem severity correlates were generally similar across the gift and non-gift groups. Therefore, though the receipt of scratch-ticket gifts may relate to gambling problem severity and influence gambling attitudes and behaviors, the correlates of gambling problem severity did not differ greatly in gift and non-gift groups. However, the differential relationship between age of gambling onset and gambling problem severity in the ticket-gifted and non-gifted groups suggests that receiving instant lottery

gambling tickets may promote the earlier engagement in gambling and development of problematic gambling.

LIMITATIONS

The sample for this study is not nationally representative, and the findings may not generalize uniformly. Regarding the cross-sectional design of the survey, the ability to examine the nature of observed associations is limited. For example, it cannot be determined whether receiving scratch lottery gifts leads to specific attitudes, specific attitudes lead to receiving gifts or other factors contribute to the observed relationship. Future studies using more precise measurements may be valuable in understanding the impact of lottery scratch ticket gifts, and they may benefit from including measurements of other "gambling gifts" (i.e., parents allowing children to borrow credit cards for online gambling). Also, the frequency but not quantity of lottery ticket gifting was assessed. As youth gambling participation may vary in states with different laws, it might be pertinent to assess larger geographic regions (including multiple states) to consider the extent to which gambling behaviors and attitudes may vary accordingly.

IMPLICATIONS FOR FUTURE RESEARCH AND PREVENTION

Increasing the awareness of the negative health outcomes and risks associated with gambling disorders may be beneficial to adolescents, their families, educators and other professionals. International campaigns, as well as state campaigns like Connecticut's "Lottery is Not Child's Play" initiative, reflect a widespread effort to target youth lottery gambling and engage adults with respect to limiting youth access to lottery gambling through gifts.[13]

Overall, youth who received instant lottery tickets as gifts appear less likely to believe that gambling prevention strategies are important. The extent to which receipt of instant lottery ticket gifts may promote gambling behaviors and the development of gambling problems warrants consideration, and strategies for education, prevention and treatment should incorporate findings relating to the receipt of gambling products by underage individuals.

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EPILOGUE

FUTURE PLANS FOR THE NCRG CENTERS OF EXCELLENCE IN GAMBLING RESEARCH

by Christine Reilly, National Center for Responsible Gaming

In 2012, the NCRG held an open competition for proposals to establish the NCRG Centers of Excellence in Gambling Research for the three-year grant cycle starting in 2013. Once again, Drs. Jon Grant and Marc Potenza were rated as the top applicants by the peer-review panel and the NCRG's Scientific Advisory Board. Both NCRG Centers of Excellence will build on the foundations established during previous grants to the University of Minnesota and Yale University.

THE UNIVERSITY OF CHICAGO

While Dr. Grant was principal investigator of the NCRG Center of Excellence at the University of Minnesota, he was appointed professor of psychiatry at The University of Chicago in 2012. This move provided a unique opportunity to re-envision the grant as a dual-site research project, maintaining the investigation he started at Minnesota and adding a component that takes advantage of the greater diversity of the Chicago population. This collaboration will allow the NCRG Center of Excellence at The University of Chicago to enlarge and diversify the sample of young adults (aged 18 to 29) and add neuroimaging and genetic components to the study.

Dr. Grant's continuing goal is to develop a model for the early detection of people at risk for developing a gambling disorder. This approach could allow for an intervention before symptoms become ingrained, difficult to treat and functionally impairing. The neuroimaging and genetic aspects of the study will help determine if there is a genetic marker for the future development of a gambling disorder.

What is learned about the susceptibility to a gambling problem will be vital to the development of prevention and treatment. Dr. Grant and his colleagues will test three brief interventions with sub-sets of the sample of young adults: psychoeducation regarding impulsivity and the risks for future problems; participant training for self-control measures; and computerized cognitive interventions that enhances decision-making. All therapies target different aspects of impulsive decision-making in young adults with the goal of preventing the development of gambling disorders.

YALE UNIVERSITY

The NCRG Center of Excellence at Yale University, led by Dr. Potenza, also plans to continue its multi-disciplinary approach, integrating epidemiological, public health, clinical, treatment, prevention, genetic, behavioral and neuroimaging methods to understand gambling disorders. The new grant will continue some of these activities and add components such as: investigating gender-related differences in the motivational and emotional states in pathological gambling; a focus on the role of stress in gambling urges and cravings; a trial of a pharmaceutical drug and nutritional supplement, n-acetyl cysteine (NAc); and positron emission topography (PET) brain scans that allow direct investigation of brain receptors and transporters, and will provide data helpful for the development of a medication for gambling disorders.

Both NCRG Centers of Excellence will accomplish these challenging research goals by collaboration with a variety of departments and institutions and, in some cases, leveraging funding from new sources. To learn more about the advances being made at both NCRG Centers of Excellence, visit the NCRG's Research Center at www.ncrg.org/research.

About the author…

Christine Reilly is senior research director of the National Center for Responsible Gaming.

RESOURCES AND PROGRAMS

While the study of gambling disorders is still a relatively young field of research, it already is yielding valuable information and guiding practical applications. The National Center for Responsible Gaming (NCRG) and the American Gaming Association (AGA) offer a variety of tools to increase awareness of gambling disorders and implement responsible gaming practices and programs. A few examples are listed below.

EDUCATIONAL TRAININGS

NCRG Conference on Gambling and Addiction

www.ncrg.org/conference

Since 1999, the annual NCRG Conference on Gambling and Addiction has brought together researchers, health care providers, regulators, policy makers and gaming industry representatives from around the world to discuss the latest research advances in the field of gambling and related disorders, and how these findings can be incorporated into practical, real-world applications.

Treatment Provider Workshops

www.ncrg.org/public-education-and-outreach/treatment-provider-workshops

As part of its ongoing public outreach initiatives, the NCRG hosts a national Treatment Provider Workshop Series for mental health and addiction treatment providers to help them understand the most up-to-date research on gambling disorders, apply those findings to their clinical practice and earn continuing education units. Each is a free, two-hour training session that is hosted in partnership with various state and regional organizations and features leading researchers and clinicians in the field.

Webinars

www.ncrg.org/public-education-and-outreach/webinars

Created in conjunction with Global Gaming Expo (G2E), the NCRG provides free year-round educational opportunities designed to help individuals better understand and address critical issues related to gambling disorders and responsible gaming — without having to leave their own home or office.

The Discovery Project

www.ncrg.org/discoveryproject

The Discovery Project is the NCRG's newest initiative that provides users with the latest research-based facts about gambling disorders at their fingertips. This easy-to-use online database synthesizes the NCRG's numerous resources, including monographs, guidebooks, fact sheets, brochures and videos — and allows users to search for information by date, keyword, topic or content type. The Discovery Project is continually updated with the latest research on gambling disorders and responsible gaming.

GUIDEBOOKS AND PUBLICATIONS

Research & Resources

www.ncrg.org/press-room/research-and-resources-guide

Research & Resources: A Guide to Gambling Disorders and Responsible Gaming allows quick and easy access to a library of the most significant research findings now available in the field of gambling disorders. It provides an overview of key studies by leading researchers, the industry's major responsible gaming education and outreach initiatives, a glossary of commonly used research terms and helpful online publications and resources.

Gambling and Health Series

www.ncrg.org/gamblingandhealth

The NCRG's *Gambling and Health* series is a suite of publications designed to educate specific audiences about gambling disorders and responsible gaming. It also provides the resources available to refer to those who may need help and encourage responsible decisions when gambling. The first volume, *Gambling and Health in the Workplace*, was developed for human resources and employee assistance professionals. *Gambling and Health in the Justice System* will be released in 2013.

"Talking With Children about Gambling"

www.ncrg.org/public-education-and-outreach/college-and-youth-gambling-programs/talking-children-about-gambling

"Talking with Children about Gambling" is a research-based guide designed to help parents, as well as others who work with youth, deter children from gambling and recognize possible warning signs of problem gambling and other risky behaviors. The guide was developed in consultation with the Division on Addictions at Cambridge Health Alliance, a teaching affiliate of Harvard Medical School.

ONLINE RESOURCES

Gambling Disorders 360° and Social Media Resources

http://blog.ncrg.org, www.facebook.com/theNCRG, www.twitter.com/theNCRG

The NCRG's social media resources explore the latest news, issues and research relating to gambling disorders and responsible gaming. Gambling Disorders 360, the NCRG's blog, is a forum where researchers, clinicians, regulators, policymakers and industry representatives can come together to share knowledge and best practices and discuss the field's most pressing and vital issues. The NCRG also distributes information, updates and resources via Facebook and Twitter.

CollegeGambling.org

www.CollegeGambling.org

Building upon the recommendations of the Task Force on College Gambling Policies, the NCRG created CollegeGambling.org as a tool to help current and prospective students, campus administrators, campus health professionals and parents address gambling and gambling-related harms on campus. The first site of its kind, CollegeGambling.org brings together the latest research and best practices in responsible gaming and the field of addiction awareness and prevention in order to provide a substantive and versatile resource that will help schools and their students address this important issue in the way that best fits each school's needs.

"Your First Step to Change"

www.basisonline.org/selfhelp_tools.html

"Your First Step to Change" is a self-help guide for individuals thinking about changing their gambling behavior. Originally developed as a booklet in 2002 for callers to the Massachusetts Council on Compulsive Gambling's help line, the guide is available in Spanish, Chinese, Khmer and Vietnamese. "Your First Step to Change" was developed by the Division on Addictions and the Massachusetts Council on Compulsive Gambling with support from the Massachusetts Department of Public Health and the NCRG.

The Brief Biosocial Gambling Screen (BBGS)

www.divisiononaddictions.org/bbgs_new/

The Division on Addiction at Cambridge Health Alliance released the BBGS to help people decide on their own whether to seek a formal evaluation of their gambling behavior. Released in 2011, this 3-item survey is based on the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)* criteria for pathological gambling. The researchers' objective was to develop a concise screening instrument that would correctly identify the largest proportion of current pathological gamblers and exclude non-pathological gamblers (i.e., reduce the number of false positives). The development of this screen was funded by the NCRG.

AGA RESOURCES AND PROGRAMS

The American Gaming Association Code of Conduct for Responsible Gaming

www.americangaming.org/social-responsibility/responsible-gaming/code-conduct

The AGA and its members pledge to their employees and patrons to make responsible gaming an integral part of its daily operations across the United States. This pledge encompasses all aspects of the business, from employee assistance and training to alcohol service, advertising and marketing. The AGA Code of Conduct for Responsible Gaming, updated in 2013, also covers the commitment of AGA members to continue support for research initiatives and public awareness surrounding responsible gaming and underage gambling.

The American Gaming Association Responsible Gaming Statutes and Regulations

www.americangaming.org/industry-resources/research/responsible-gaming-statutes-and-regulations

The AGA developed a compilation of statutes and regulations regarding responsible gaming in the 20 states that had commercial casinos or racetrack casinos, also known as "racinos," as of February 2008. The content in each section is divided into seven general categories, including Alcohol Service, Credit/Cash Access, Funding/Revenue Sharing (treatment funding), Self-exclusion, Signage/Help Line/Advertising, Training/Education (employee training, employee responsible gaming prevention, public awareness) and Miscellaneous (loss limits/limited stakes, direct mail/marketing).

"The House Advantage: A Guide to Understanding the Odds"

www.americangaming.org/sites/default/files/uploads/docs/odds_brochure_2012.pdf

This publication explains the house advantage, providing typical ranges for specific games, along with other factors that should be taken into account when betting on casino games, such as the amount wagered, the length of time played and, to a degree, a player's skill level. It also debunks common myths about gambling and provides an explanation of regulatory procedures in place to ensure all the games in a casino are fair.

"Taking the Mystery Out of the Machine: A Guide to Understanding Slot Machines"

www.americangaming.org/sites/default/files/uploads/docs/taking_the_mystery_out_of_the_machine_brochure_final.pdf

While a significant majority of gamblers say slot machines are their favorite form of casino entertainment, most people know very little about how slots are developed or how they work. This brochure provides digestible information about how slots are operated, developed and regulated; it uses common language to debunk many players' most widely held myths about slot machines. The resource has been made available to patrons and employees as an important part of many casinos' standard responsible gaming education efforts.

ABOUT THE NCRG

The National Center for Responsible Gaming (NCRG) is the only national organization exclusively devoted to public education and funding research that will help increase understanding of pathological and youth gambling and find effective methods of treatment for the disorder. The NCRG is the American Gaming Association's (AGA) affiliated charity.

Founded in 1996 as a separate 501(c)3 charitable organization, the NCRG's mission is to help individuals and families affected by gambling disorders by supporting the finest peer-reviewed, scientific research into pathological and youth gambling; encouraging the application of new research findings to improve prevention, diagnostic, intervention and treatment strategies; and advancing public education about gambling disorders and responsible gaming.

More than $25 million has been committed to the NCRG through contributions from the casino gaming industry, equipment manufacturers, vendors, related organizations and individuals. Since its founding, the NCRG has mandated stringent firewalls to separate the gaming industry's contributions from the research it funds. For a list of the NCRG's donors, see page 40.

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