

Should the scope of addictive behaviors be broadened to include pathological gambling?

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ABSTRACT

Aims Pathological gambling is currently considered an impulse control disorder in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM). This paper considers the prospect of reclassifying and broadening the substance use disorders to include non-pharmacological addictions such as pathological gambling. **Methods** Literature reviews were conducted on areas relevant to pathological gambling and its classification and similarities to substance use disorders. **Results** The diagnostic criteria for pathological gambling are outlined across the three versions of the DSM since its initial introduction. The paper also describes instruments that have been used to assess the disorder, basic epidemiology and some biological and genetic data, especially in terms of potential overlap with substance use disorders. Similarities and differences with respect to treatments are reviewed as well. **Conclusions** Both advantages and disadvantages should be considered with respect to expanding the classification system to include pathological gambling within the context of addictive disorders.

Keywords Addictions, pathological gambling, psychiatric classification, substance use disorders.

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INTRODUCTION

Core features define conditions listed as substance use disorders. They include ingestion of a substance to the extent that its use is harmful, and regardless of knowledge of its harm the individual continues to consume it. Substance use along with other behaviors that occur in excess despite their deleterious impacts are referred to colloquially as ‘addictions’. These include, but are not limited to, excessive gambling, internet use, eating, sex and shopping. Only one of these excessive behaviors—pathological gambling—currently carries a diagnosis in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) [1]. Discussions are under way regarding the classification of such conditions in general, and pathological gambling in particular, within a common framework of addictive disorders. This paper examines issues that should be considered in determining whether non-pharmacological conditions should be considered within the same classification system as substance use disorders. Pathological gambling is used as the exemplar because it is the disorder with the most scientific research.

PATHOLOGICAL GAMBLING

History and classification

Pathological gambling was introduced into the DSM in the third edition (DSM-III) [2]. Over the past 25 years criteria for this disorder have changed, and knowledge has expanded about its etiology, comorbidity and treatment. Despite advances in understanding the disorder important issues remain to be addressed, including its diagnosis and classification, the focus of this report. Essential features and diagnostic criteria of pathological gambling are described first across the versions of the DSM in which the disorder was included. Data related to the criteria are then detailed, with an emphasis on features and phenomenology and that are shared with, as well as those that may be distinct from, substance use disorders.

DSM-III

When pathological gambling was first introduced into the DSM, it was listed as a ‘Disorder of Impulse Control, Not Elsewhere Classified’. Essential features of this class of conditions were (i) not resisting impulses or

temptations to engage in an act that is harmful to oneself or others, (ii) rising tension before the act and (iii) pleasure or liberation during the behavior, with guilt or regret later.

Pathological gamblers continue to wager even when they know that it is not in their best interests to keep betting. They describe rising anxiety or excitement prior to gambling [3]. Wagering may engender excitement, pleasure or relief from tension, but it can be followed by guilt or remorse. Individuals who do not fit into this classification but who bet from time to time do not seem to experience these same emotions with gambling. For example, social gamblers appear able to not gamble or to quit betting once losses begin to mount, and any regret or guilt they experience is mild and transitory.

As shown in Table 1, one would need to experience a chronic and progressive inability to resist impulses to gamble and at least three of seven other symptoms to receive a diagnosis. Most criteria addressed financial issues related to obtaining gambling money from legal sources (criteria 2 and 7) and illegal venues (criteria 1, 4), and poor accounting of money (criterion 5). Only two criteria (3 and 6) did not focus on finances; they assessed negative impacts of gambling on family and work. An exclusionary criterion was that pathological gambling could not be related to antisocial personality disorder.

No known studies evaluated these criteria as they apply to pathological gamblers, and the items as well as the diagnostic threshold seemed to be based on clinical impressions. The population evaluated at that time consisted almost exclusively of men who wagered on illegal forms of gambling [4]. The associated features described in the DSM-III seemed to depict this picture, 'These individuals are most often overconfident, somewhat abrasive, very energetic, and 'big spenders'.

In DSM-III-R [5]

Modifications to the criteria included removal of chronic and progressive inability to resist gambling impulses, and a requirement of endorsing at least four of nine criteria (Table 1, middle column) for a diagnosis. The criteria were changed substantially in this version relative to DSM-III. In particular, emphasis on money was reduced and replaced with assessment of the impact of gambling on psychosocial functioning. Many of these criteria were similar to those for Psychoactive Substance Dependence [1, p. 181]. In fact, the only unique criterion for pathological gambling was related to 'chasing' lost money (criterion 5). In DSM-III-R, the restriction upon concurrent diagnoses with antisocial personality disorder was removed. Mood disorders were considered in the differential diagnosis, with the relationship between manic or hypomanic episodes mentioned.

Table 1 Criteria for pathological gambling across versions of the *Diagnostic and Statistical Manual for Mental Disorders* (DSM).

Criterion	Item number in versions		
	DSM-III	DSM-III-R	DSM-IV
Chronically unable to resist gambling impulses	Mandatory		
Arrests for (admits to*) illegal acts (forgery, fraud, embezzlement, etc.) to obtain gambling money	1	8*	
Fails to honor debts or other financial responsibilities	2		
Family or spouse relationship difficulties related to gambling	3		
Borrows money from illegal sources (e.g. loan sharks) to gamble	4		
Not able to account for money (extensive monetary losses or gains, if claimed)	5		
Absences from work because of gambling	6		
Relies on others to provide money for desperate financial situations		7	10
Preoccupied with gambling or with ways to obtain money to gamble		1	1
Gambles more money, or wagers over a longer period of time, than intended		2	
Needs to increase the amounts or frequency of gambling to obtain desired excitement		3	2
Feels restless or irritable if not able to gamble		4	4
Consistently losing money and going back again to try to win back losses ('chasing')		5	6
Tries repeatedly to reduce or stop gambling		6	3
Often gambles when expected to meet social or occupational obligations		7	
Sacrifices or jeopardizes important social, occupational or recreational activities to gamble		8	9
Continues gambling even though unable to pay debts, or regardless of social, occupational, or legal problems that the person knows to be exacerbated by gambling		9	
Gambles to escape from problems or to relieve negative moods			5
Lies to family members, therapist, or others to conceal the extent of involvement with gambling			7

DSM-IV

DSM-IV [1] included 10 criteria for pathological gambling (Table 1, right column), with a threshold of five or more items needed for a diagnosis. Criteria 1–4, 6 and 9 are similar to those in DSM-III-R. The fifth and seventh criteria have no parallel in earlier versions. Criteria 8 and 10 are similar to ones in DSM-III, which were subsequently removed in DSM-III-R. The exclusion of ‘Manic Episodes’ as accounting more effectively for gambling behavior is made explicit in DSM-IV.

Some parallels between substance dependence disorders and pathological gambling remained in DSM-IV. Five of the seven dependence criteria have almost identical criteria in pathological gambling, but the others no longer have a parallel item. These include items related to escaping negative moods, chasing losses, lying to others, committing illegal acts and relying on others for bailouts.

The number of criteria necessary for a diagnosis of pathological gambling has risen from three to four to five across the three DSM versions. More criteria have been added in each revision, but the proportion needed for a diagnosis has increased, with the result that obtaining a diagnosis may have become more stringent across the revisions, and possibly more difficult than substance use disorders.

Instruments for assessing pathological gambling and prevalence rates

Prevalence rates of pathological gambling vary with the definitions and instruments used to define the disorder. Early studies, and a recent nationally representative study in the United States, relied on the South Oaks Gambling Screen (SOGS) [6] to assess prevalence rates. This instrument was developed during the era of DSM-III, and of the 20 items, nine relate to sources of borrowing money. Using the SOGS, rates of pathological gambling are estimated to be 1.6–4.0% in the United States [7,8] and 0.8–6.0% in other countries [9,10]. Although widely utilized, the SOGS may over-diagnose relative to instruments that are tied more closely to DSM-IV criteria. Three recent national surveys in the United States employed DSM-IV based instruments, alone or in combination with the SOGS. In a survey by Welte *et al.* [8], rates of pathological gambling were 4.0% using the SOGS and 2.0% with a DSM-IV based instrument. DSM-IV based instruments used in two other national surveys found rates of 0.4% [11] and 0.8% [12].

Limited data exist regarding psychometric properties of these instruments. The 17-item National Opinion Research Center DSM Screen for Gambling Problems (NODS) is based directly on DSM-IV criteria, and asks some criteria in two forms [12]. Internal consistency is 0.79 when examining affirmative responses to the 10

DSM-IV criteria and 0.84 for the full scale [13]. Principal component analysis identified three factors. Four items reflecting negative behavioral consequences loaded on factor 1, and the second factor consisted of items related to preoccupation and impaired control. Items associated with family, social and employment problems loaded on both factors 1 and 2. Tolerance, withdrawal and relief gambling loaded on factor 3. Toce-Gerstein *et al.* [14] inspected responses to NODS items among 399 people who responded affirmatively to at least one DSM pathological gambling criterion in the Gerstein *et al.* [12] survey. Most people who met only one or two criteria reported chasing losses. Those who endorsed three to four items affirmed most often items related to lying, escape, and preoccupation. Individuals who met diagnostic criteria also reported loss of control, withdrawal, risking social relationships and financial bailouts. Only the most severely disturbed gamblers committed illegal acts to support gambling.

The survey of over 43 000 respondents [11,15] used a 15-item DSM-based instrument. Internal consistency of symptom items ($\alpha=0.92$) and criteria for pathological gambling ($\alpha=0.80$) were adequate.

Although these two national surveys [11,12] utilized different instruments, they found somewhat similar prevalence rates. The proportion of pathological gamblers identified in the surveys [12,15] who endorsed the various criteria are shown in Table 2. Of the five most commonly endorsed criteria, two have parallel items in substance use diagnoses: preoccupation and tolerance. Chasing, lying and escape questions were also reported by relatively high proportions of gamblers in both surveys. These criteria have no direct parallel criteria in drug dependence diagnoses, although aspects of the behavioral patterns may be considered somewhat analogous.

While proportions of pathological gamblers who endorsed the DSM criteria were in some ways similar between the samples, some variations were also noted.

Table 2 Proportions of pathological gamblers endorsing Diagnostic and Statistical Manual-IV criteria.

	Gerstein <i>et al.</i> [12] <i>n</i> = 63	Blanco <i>et al.</i> [15] <i>n</i> = 187
Preoccupation	87.3%	97.8%
Chasing	84.1%	89.8%
Lying	77.8%	80.8%
Tolerance	57.2%	78.5%
Escape	84.1%	66.5%
Loss of control	65.1%	67.3%
Bailout	53.9%	50.1%
Withdrawal	71.4%	48.4%
Risked relationships	61.9%	37.0%
Illegal acts	19.0%	18.0%

These differences may relate to the manner in which criteria were worded, the samples to whom surveys were administered, or the use of in-person versus telephone interviews. To the extent that some diagnostic criteria for substance use and pathological gambling disorders are related, the phenomenology, clinical features and comorbidity may be strengthened artificially. That is, if a criterion is engaging in a behavior to such an extent that it adversely impacts one's family relationships, then individuals who have poor family relationships may be likely to endorse the negative impact of alcohol and gambling, and possibly other behaviors, on family relations.

In sum, defining features of pathological gambling are not yet well established and have varied across versions of the DSM. Some criteria associated with substance use disorders are common in pathological gamblers, but others have no direct parallels in the dependence criteria.

Comorbidities and demographic features

Pathological gambling is highly comorbid with substance use disorders. For example, over 70% of individuals identified with pathological gambling had an alcohol and over 30% a drug use disorder [11]. High comorbidity may suggest that the disorders are part of the same spectrum and should be classified accordingly. However, substance use disorders are not the only psychiatric condition that occurs with pathological gambling. Significant odds ratios of pathological gambling are also noted with mood, anxiety and personality disorders [11]. Thus, comorbidities do not lend support for or refute the notion that these disorders should be classified together as addictive disorders. Many psychiatric conditions co-occur [16], and parallels in diagnostic criteria may explain comorbidities, at least in part.

In terms of demographics, younger age, male gender, minority ethnicity and low socio-economic status increase risk for drug use disorders and pathological gambling [10,17,18]. However, these characteristics are related to many psychiatric conditions and thus may not be useful for determining classifications.

Physiology and biology

Some physiological substrates may be similar with respect to gambling and substance use disorders. Ruge & Melamed [19] reported frontal lobe dysfunction in pathological gamblers relative to controls. Regard *et al.* [20] also found impaired concentration, memory and executive functioning in gamblers. Similar deficits have been reported in substance abusers [21]. Some studies of neural processing are finding that gains and losses may be processed differentially in certain brain regions, primarily the frontal lobe [22,23]. In a functional magnetic resonance imaging (fMRI) study of controls, Gehring &

Willoughby [24] found that choices made subsequent to losses may be riskier and associated with greater brain activity than choices made after gains. Petry [25] showed that substance abusers who also have a gambling problem performed more poorly on this gain-loss task than substance abusers without gambling problems, and both groups performed more poorly than controls. Cavendish *et al.* [26] replicated these results, noting that even 'pure' pathological gamblers performed more poorly on this task than controls. On another decision-making task assessing preferences for sooner, smaller versus later, larger monetary rewards, both substance abusers and gamblers have similar deficits, with an additive effect noted in individuals with both disorders [27,28]. Performance on this task is linked to impulsivity [29]. However, no known studies have conducted brain imaging of gamblers participating in this task, so effects on particular brain regions and their association with substance use disorders are speculative.

Studies investigating neurotransmitters are also limited. Perhaps of greatest interest to the putative link with substance use disorders is dopamine, which is associated with reward and reinforcement and implicated in drug use disorders [30]. Two studies evaluated cerebrospinal fluid (CSF) levels of dopamine in gamblers, but they produced different results. Roy *et al.* [31] found no differences between gamblers and controls in plasma, urinary or CSF dopamine levels, but Bergh *et al.* [32] found a decrease in dopamine and an increase in its metabolites in the CSF of gamblers.

Opioids are another class of abused drugs, and the relationship between endogenous opioids and gambling has been investigated. Shinohara *et al.* [33] found elevated levels of beta-endorphin in gamblers in Japan, which peaked during winning periods. Blaszczynski *et al.* [34] found low plasma levels of beta-endorphin in horse race pathological gamblers but no differences relative to controls in poker machine players. In their study, betting did not alter beta-endorphin levels.

Other neurotransmitter systems have also been studied. Serotonin is of interest because low levels of this neurotransmitter are linked to impulsive behaviors [35]. Moreno *et al.* [36] found some evidence of a hypoactive serotonin system in gamblers. Two other studies [37,38] reported decreased platelet monoamine oxidase activity, and another [39] found low CSF levels of a serotonin metabolite. While these data suggest the possibility of a serotonin deficiency, and possibly post-synaptic hypersensitivity of serotonin receptors, other studies found no serotonin abnormalities in gamblers [31,32,40].

In terms of norepinephrine (NE), Roy *et al.* [31] found lower plasma levels of an NE metabolite, 3-methyl-4-hydroxy phenylethyl glycolol (MHPG) and greater urinary outputs of NE in gamblers relative to controls, but

no changes in CSF NE levels. Roy *et al.* [41] found correlations between personality measures of extroversion and CSF levels of MHPG, plasma levels of MHPG and urinary NE output.

While studies show abnormalities in neurotransmitter levels in pathological gamblers compared to controls, most reports were conducted in very small samples. Some allowed for inclusion of individuals with comorbid conditions, thereby reducing the ability to isolate specific effects of pathological gambling. Discrepant results across studies may also be related to different techniques used to obtain CSF and measure metabolites. Thus, neurotransmitter abnormalities that may share features between substance use and pathological gambling disorders should be considered speculative relationships. In other research, genes are being evaluated as they may influence expression of neurochemicals.

Genetics

Pathological gambling clearly has a genetic component, and it may share some genetic links with substance use disorders. Adults identified as pathological gamblers are more likely than non-pathological gamblers to report having a parent with a gambling problem [42]. Winters & Rich [43] noted greater similarity of gambling behaviors in 42 monozygotic twin pairs compared with 50 dizygotic twin pairs, but this effect was noted only in men and for specific types of wagering.

Only one other twin study of pathological gambling exists. Eisen *et al.* [44] reported that familial factors (inheritance or shared childhood experiences) explained 62% of the variance in developing pathological gambling in a sample of 6718 male members of the Vietnam Era Twin Registry. Further, a linear relationship was observed between alcohol abuse or dependence and severity of disordered gambling in this sample. Slutske *et al.* [45] used biometric modeling and found that 12–20% of the genetic variation in the risk for disordered gambling was accounted for by genetic variation in common with the risk for alcohol dependence. Although these data suggest a role of familial factors in pathological gambling, it clearly is a multi-faceted disorder, with environmental factors also important.

A molecular genetics study [46] found an association between the *Taq-A1* allele of the D2 dopamine receptor gene and gambling. This allele is also associated with impulsive, compulsive and addictive behaviors [47]. Other studies suggest a role of D1 and D4 receptor genes [48,49] in pathological gambling. The DRD4 gene sequence is related to attention deficit disorder, Tourettes and substance abuse [49]. Perez de Castro *et al.* [50] found that the less efficient variant of this polymorphism in the DRD4 gene was common among female, but not male, gamblers. A polymorphism in the MAO-A gene was

found among men with severe gambling problems [51]. These results suggest that genetic contributions may differ between genders, with 5-HT dysfunction more common in men and dopamine dysregulation in women. However, more research with larger samples is needed to confirm these findings.

Another study of 139 gamblers and 139 controls [52] found that DRD2, DRD4 and the dopamine transporter gene DAT1 were associated with pathological gambling, accounting for about 8% of the variance. The 16 genes tested, including dopamine, serotonin and NE, together accounted for 15–21% of the variance. The authors concluded that dopamine, serotonin and NE all play a role in the disorder, but none are unique to it. Rather, they all are associated with a range of psychiatric conditions. Individuals who inherit a threshold number of these genes may be at increased risk of developing impulsive, compulsive and substance use problems.

Treatments and outcomes

Pathological gambling and substance abuse share some commonalities in course and outcomes. Both usually begin in adolescence or early adulthood, although excessive wagering may emerge in a subset of individuals during middle age [53]. They both have waxing and waning courses [54,55]. About 60% of individuals identified as life-time pathological gamblers do not meet current criteria [7]. Similarly, a proportion of substance abusers overcome drug and alcohol problems [56]. Natural recovery may be common in both disorders [57,58]. Motivation to change is an important construct associated with cessation of gambling [59] and substance abuse [60]. Skills deficits in managing situations that are high risk for use of substances or wagering are also noted in both disorders [61,62].

Given these similarities, many psychosocial treatments applied to pathological gamblers were adapted from substance use disorder treatments, including 12-Step, motivational and cognitive-behavioral therapies and even pharmacotherapies [10]. However, similar therapies do not necessarily lend support for similar etiologies, as many of these therapies are used in other psychiatric conditions as well. One type of psychotherapy appears unique for pathological gambling. A cognitive therapy focuses on altering irrational gambling cognitions shows potential efficacy [63,64], and it has no direct parallel in treatment of substance use or other psychiatric disorders.

ADVANTAGES OF EXPANSION TO ADDICTIVE DISORDERS

Studies reviewed above provide some support for reclassifying substance use and pathological gambling under

the umbrella of addictive disorders. Comorbidity is high, presenting features have parallels, demographic features share commonalities and physiology and genetics have some overlap. Some advantages may stem from an addictive disorders classification.

Although awareness of pathological gambling is low in most mental health fields, substance abuse treatment programs seem more likely than general mental health treatment programs to inquire about gambling histories in their patients. Classification of pathological gambling and substance use disorders within the same framework may further increase awareness of the disorder. It may also extend treatments to pathological gamblers within the context of drug abuse treatment clinics.

If pathological gambling were classified along with substance use disorders, the number of criteria needed for a diagnosis may be reduced, thereby perhaps more accurately classifying individuals. Another potential advantage is that a subdiagnostic condition, e.g. gambling abuse, may be considered. Epidemiological studies indicate that a larger proportion of the population has a sub-threshold condition than those who meet full diagnostic criteria [7,12], and the disorder appears to exist along a continuum [15]. Including less severe forms of disorders in the DSM may be appropriate clinically [65]; it may also encourage more research and treatment efforts. Reclassification of the disorders may reduce balkanization of these disorders that appear, at least on some levels, to share similar features.

Funding and research efforts may also increase by combining these disorders within the same classification system. Currently in the United States, the National Institute on Drug Abuse (NIDA) and National Institute on Alcohol Abuse and Alcoholism (NIAAA) fund drug and alcohol research, respectively, but not gambling research, unless it co-occurs with substance use. Thus, there remains a somewhat artificial distinction between research that focuses exclusively on pathological gambling substance abusers and that which includes all pathological gamblers, with or without substance use problems. However, which institute, NIDA or NIAAA, would consider the disorder under its jurisdiction is unclear.

DISADVANTAGES OF EXPANSION TO ADDICTIVE DISORDERS

Despite potential advantages of reclassification, disadvantages can also be highlighted. An obvious, albeit possibly artificial, rationale for keeping the disorders distinct relates to the lack of ingestion of a substance with pathological gambling. Substance abusers often experience significant relief once the acute effects of withdrawal subside, but adverse effects of pathological gambling persist long-term, especially related to financial matters.

Although few data yet support the criteria that define presenting features of pathological gambling, it appears that criteria may not be as similar between pathological gambling and substance use disorders as they are across drug use disorders. The phenomena of chasing, the most common in pathological gamblers, has no direct parallel in substance use disorders. The impact of pathological gambling on finances does not have such a strong component in drug use disorders. Conversely, direct negative impacts of some forms of drug use on health are not as relevant in gambling, although global health is poor in gamblers [66].

Including pathological gambling as an addictive disorder along with substance use disorders may increase stigmatization. Pathological gamblers may feel uncomfortable in group sessions with substance abusers. They may withdraw from treatment prematurely if they do not feel the therapy is addressing their unique needs. Clinics that treat primarily substance abusers may not be as experienced with, or receive a sufficient number of, treatment seeking gamblers to have groups dedicated to them.

Finally, expansion to a category of addictive disorders ultimately may lead to a catch-all of 'disorders', some of which may be inappropriate for diagnosis. For example, television, work, exercise and chocolate addiction have been described [67–70]. One must be cautious of where to draw the line between simply an excessive behavior pattern and a bona fide psychiatric disorder.

Reclassification of all excessive behaviors may also inadvertently impede understanding of some of these conditions. For example, over two-thirds of Americans are overweight, but does this statistic suggest that most Americans are addicted to food? Conversely, a subset of the population may be considered addicted to purging, and another subset to not eating (anorexia). These actual eating disorders, and others that may eventually be considered legitimate psychiatric disorders, may be better understood within the context of eating disorders than addictive disorders. Similarly, excessive internet use is often related to pornography viewing [71] and as such may (or may not) be better understood within the context of a sexual disorder than a behavioral addiction.

SUMMARY

Although only limited data exist about some of these conditions, the pros and cons of altering classification systems should be considered prior to deciding whether pathological gambling is better categorized as an impulse control or addictive disorder. Societal interest with excessive behavior patterns cannot be separated entirely from science or medicine, but weighing the evidence along with the costs and benefits of changing is necessary for advancing the field as a whole. Society and individuals

may benefit from expanding scientific classification systems to include other excessive behavior patterns [72]. Diagnosis of nicotine dependence may be a case in point; it allowed for and encouraged medical and psychological treatment for one of the most cost-effective and life-saving interventions in health care. Further consideration of other non-pharmacological addictions as diagnoses, whether they are included alongside or separate from pharmacological addictions, may similarly stimulate assessment and treatment, and ultimately even prevention efforts.

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References

1. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 4th edn. Washington, DC: American Psychiatric Association; 1994.
2. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 3rd edn. Washington, DC: American Psychiatric Association; 1980.
3. Lesieur H. *The Chase: career of the compulsive gambler*. Oxford, UK: Anchor; 1977.
4. Mark M. E., Lesieur H. R. A feminist critique of problem gambling research. *Br J Addict* 1992; **87**: 549–65.
5. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders*, 3rd edn, revised. Washington, DC: American Psychiatric Association; 1987.
6. Lesieur H. R., Blume S. B. The South Oaks Gambling Screen (the SOGS): a new instrument for the identification of pathological gamblers. *Am J Psychiatry* 1987; **144**: 1184–8.
7. Shaffer H. J., Hall M. N., Vander Bilt J. Estimating the prevalence of disordered gambling behavior in the United States and Canada: a research synthesis. *Am J Public Health* 1999; **89**: 1369–76.
8. Welte J., Barnes G., Wieczorek W., Tidwell M. C., Parker J. Alcohol and gambling pathology among U.S. adults: prevalence, demographic patterns and comorbidity. *J Stud Alcohol* 2001; **62**: 706–12.
9. Orford J., Sproston K., Erens B. SOGS and DSM-IV in the British Gambling Prevalence Survey: reliability and factor structure. *Int Gambl Stud* 2003; **3**: 53–65.
10. Petry N. M. *Pathological Gambling: Etiology, Comorbidity, and Treatment*. Washington, DC: American Psychological Association Press; 2005.
11. Petry N. M., Stinson F. S., Grant B. F. Comorbidity of DSM-IV pathological gambling and psychiatric disorders: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *J Clin Psychiatry* 2005; **66**: 564–74.
12. Gerstein D. R., Volberg R. A., Toce M. T., Harwood R., Christiansen E. M., Hoffman J. *et al. Gambling Impact and Behavior Study*. Report to National Gambling Impact Study Commission. Chicago, IL: National Opinion Research Center; 1999.
13. Hodgins D. C. Using the NORC DSM screen for gambling problems (NODS) as an outcome measure for pathological gambling: reliability and validity. *Addict Behav* 2004; **29**: 1685–90.
14. Toce-Gerstein M., Gerstein D. R., Volberg R. A. A hierarchy of gambling disorders in the community. *Addiction* 2003; **98**: 1661–72.
15. Blanco C., Hasin D. S., Petry N. M., Stinson F. S., Grant B. F. Sex differences in subclinical and DSM-IV pathological gambling: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Psychological Medicine* 2006; **36**: 943–53.
16. Kessler R. C., McGonagle K. A., Zhao S., Nelson C. B., Hughes M., Eshleman S. *et al.* Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: results from the National Comorbidity Study. *Arch Gen Psychiatry* 1994; **51**: 8–19.
17. Furr-Holden C. D. M., Anthony J. C. Epidemiologic differences in drug dependence: a US–UK cross-national comparison. *Soc Psychiatry Psychiatr Epidemiol* 2003; **38**: 165–72.
18. National Research Council. *Pathological Gambling: a critical review*. Washington, DC: National Academy Press; 1999.
19. Rugle L., Melamed L. Neuropsychological assessment of attention problems in pathological gamblers. *J Nerv Ment Dis* 1993; **181**: 107–12.
20. Regard M., Knoch D., Güntling E., Landis T. Brain damage and addictive behavior: a neuropsychological and electroencephalogram investigation with pathologic gamblers. *Cog Behav Neurol* 2003; **16**: 47–53.
21. Goldstein R. Z., Leskovjan A. C., Hoff A. L., Hitzemann R., Bashan F., Khalsa S. S. *et al.* Severity of neuropsychological impairment in cocaine and alcohol addiction: association with metabolism in the prefrontal cortex. *Neuropsychologia* 2004; **42**: 1447–58.
22. Bechara A., Damasio H., Tranel D., Damasio A. R. Deciding advantageously before knowing the advantageous strategy. *Science* 1997; **275**: 1293–5.
23. Breiter H. C., Aharon I., Kahneman D., Dale A., Shizgal P. Functional imaging of neural responses to expectancy and experience of monetary gains and losses. *Neuron* 2001; **30**: 619–39.
24. Gehring W. J., Willoughby A. R. The medial frontal cortex and the rapid processing of monetary gains and losses. *Science* 2002; **295**: 2279–82.
25. Petry N. M. Substance abuse, pathological gambling, and impulsivity. *Drug Alcohol Depend* 2001; **63**: 29–38.
26. Cavedini P., Riboldi G., Keller R., D'Annunzi A., Bellodi L. Frontal lobe dysfunction in pathological gambling patients. *Biol Psychiatry* 2002; **51**: 334–41.
27. Petry N. M. Pathological gamblers, with and without substance use disorders, discount delayed rewards at high rates. *J Abnorm Psychol* 2001; **110**: 482–7.
28. Petry N. M., Casarella T. Excessive discounting of delayed reinforcers in substance abusers with gambling problems. *Drug Alcohol Depend* 1999; **56**: 25–32.
29. Alessi S. M., Petry N. M. Pathological gambling severity is associated with impulsivity in a delay discounting procedure. *Behav Processes* 2003; **64**: 345–54.

30. Koob G. F. Drug of abuse: anatomy, pharmacology and function of reward pathways. *Trends Pharmacol Sci* 1992; **13**: 177–84.
31. Roy A., Adinoff B., Roehrich L., Lamparski D., Custer R., Lorenz V. *et al.* Pathological gambling: a psychobiological study. *Arch Gen Psychiatry* 1988; **45**: 369–73.
32. Bergh C., Eklund T., Sodersten P., Nordin C. Altered dopamine function in pathological gambling. *Psychol Med* 1997; **27**: 473–5.
33. Shinohara K., Yanagisawa A., Kagota Y., Gomi A., Nemoto K., Moriya E. *et al.* Physiological changes in Pachinko players: beta-endorphin, catecholamines, immune system substances and heart rate. *Appl Hum Sci* 1999; **18**: 37–42.
34. Blaszczynski A. P., Winton S. W., McConaghy N. Plasma endorphin levels in pathological gambling. *J Gamb Behav* 1986; **2**: 3–14.
35. Oreland L., Ekblom J., Garpenstrand H., Hallman J. Biological markers, with special regard to platelet monoamine oxidase (trbc-MAO), for personality and personality disorders. *Adv Pharmacol* 1998; **42**: 301–4.
36. Moreno I., Sáiz-Ruiz J., López-Ibor J. J. Serotonin and gambling dependence. *Hum Psychopharmacol* 1991; **6**: S9–S12.
37. Blanco C., Orensanz-Muñoz L., Blanco-Jerez C., Saiz-Ruiz J. Pathological gambling and platelet MAO activity: a psychobiological study. *Am J Psychiatry* 1996; **153**: 119–21.
38. Carrasco J. L., Sáiz-Ruiz J., Hollander E., Cesar J., Lopez-Ibor J. J. Jr. Low platelet monoamine oxidase activity in pathological gambling. *Acta Psychiatr Scand* 1994; **90**: 427–31.
39. Nordin C., Eklund T. Altered CSF 5-HIAA disposition in pathological male gamblers. *CNS Spectr* 1999; **4**: 25–33.
40. Roy A., Linnoila M. CSF studies on alcoholism and related behaviours. *Prog Neuropsychopharmacol Biol Psychiatry* 1989; **13**: 505–11.
41. Roy A., DeJong J., Linnoila M. Extraversion in pathological gamblers: correlates with indexes of noradrenergic function. *Arch Gen Psychiatry* 1989; **46**: 679–81.
42. Volberg R. A., Steadman H. J. Prevalence estimates of pathological gambling in New Jersey and Maryland. *Am J Psychiatry* 1989; **166**: 1618–9.
43. Winters K. C., Rich T. A twin study of adult gambling behavior. *J Gamb Stud* 1998; **14**: 213–25.
44. Eisen S. A., Lin N., Lyons M. J., Scherrer J. F., Griffith K., True W. R. *et al.* Familial influences on gambling behavior: an analysis of 3359 twin pairs. *Addiction* 1998; **93**: 1375–84.
45. Slutske W. S., Eisen S., True W. R., Lyons M. J., Goldberg J., Tsuang M. Common genetic vulnerability for pathological gambling and alcohol dependence in men. *Arch Gen Psychiatry* 2000; **57**: 666–73.
46. Comings D. E., Rosenthal R. J., Lesieur H. R., Ruge L. J., Muhleman D., Chiu C. *et al.* A study of the dopamine D2 receptor gene in pathological gambling. *Pharmacogenetics* 1996; **6**: 223–34.
47. Blum K., Sheridan P. J., Wood R. C., Braverman E. R., Chen T. J., Comings D. E. Dopamine D2 receptor gene variants: association and linkage studies in impulsive-addictive-compulsive behavior. *Pharmacogenetics* 1995; **5**: 121–41.
48. Comings D. E., Gade R., Wu S., Chiu C., Dietz G., Muhleman D. *et al.* Studies of the potential role of the dopamine D1 receptor gene in addictive behaviors. *Mol Psychiatry* 1997; **2**: 44–56.
49. Comings D. E., Gonzalez N., Wu S., Gade R., Muhleman D., Saucier G. *et al.* Studies of the 48 bp repeat polymorphism of the DRD4 gene in impulsive, compulsive, addictive behaviors: Tourette syndrome, ADHD, pathological gambling, and substance abuse. *Am J Med Genet* 1999; **88**: 358–68.
50. Pérez de Castro I., Ibáñez A., Torres P., Sáiz-Ruiz J., Fernández-Piqueras J. Genetic association study between pathological gambling and a functional DNA polymorphism at the D4 receptor. *Pharmacogenetics* 1997; **7**: 345–8.
51. Ibáñez A., Pérez de Castro I., Fernández-Piqueras J., Blanco C., Sáiz-Ruiz J. Genetic association study between pathological gambling and DNA polymorphic markers at MAO-A and MAO-B genes. *Mol Psychiatry* 2000; **5**: 105–9.
52. Comings D. E., Gade-Andavolu R., Gonzalez N., Wu S., Muhleman D., Chen C. *et al.* The additive effect of neurotransmitter genes in pathological gambling. *Clin Genet* 2001; **60**: 107–16.
53. Petry N. M. A comparison of young, middle age, and older adult treatment-seeking pathological gamblers. *Gerontologist* 2002; **42**: 92–9.
54. Slutske W. S., Jackson K. M., Sher K. J. The natural history of problem gambling from age 18–29. *J Abnorm Psychol* 2003; **112**: 263–74.
55. Muthén B. O., Muthén L. K. The development of heavy drinking and alcohol-related problems from ages 18–37 in a U.S. national sample. *J Stud Alcohol* 2000; **61**: 290–300.
56. Institute of Medicine. *Broadening the Base of Treatment for Alcohol Problems*. Washington, DC: National Academy of Sciences; 1990.
57. Hodgins D. C., el-Guebaly N. Natural and treatment-assisted recovery from gambling problems: a comparison of resolved and active gamblers. *Addiction* 2000; **95**: 777–89.
58. Sobell L. C., Cunningham J. A., Sobell M. B. Recovery from alcohol problems with and without treatment: prevalence in two population surveys. *Am J Public Health* 1996; **86**: 966–72.
59. Petry N. M. Stages of change in treatment-seeking pathological gamblers. *J Consult Clin Psychol* 2005; **73**: 312–22.
60. Prochaska J. O., Velicer W. F., Rossi J. S., Goldstein M. G., Marcus B. H., Rakowski W. Stages of change and decisional balance for 12 problem behaviors. *Health Psychol* 1994; **13**: 39–46.
61. Chaney E. F., O'Leary M. R., Marlatt G. A. Skill training with alcoholics. *J Consult Clin Psychol* 1978; **46**: 1092–104.
62. McCormick R. A. The importance of coping skill enhancement in the treatment of the pathological gambler. *J Gamb Stud* 1994; **10**: 77–86.
63. Ladouceur R., Sylvain S., Boutin C., Lachance S., Doucet C., Leblond J. *et al.* Cognitive treatment of pathological gambling. *J Nerv Ment Dis* 2001; **189**: 774–80.
64. Sylvain C., Ladouceur R., Boisvert J. M. Cognitive and behavioral treatment of pathological gambling: a controlled study. *J Consult Clin Psychol* 1997; **65**: 727–32.
65. Kessler R. C., Merikangas K. R., Berglund P., Eaton W. W., Koretz D. S., Walters E. E. Mild disorders should not be eliminated from the DSM-V. *Arch Gen Psychiatry* 2003; **60**: 1117–22.
66. Pietrzak R., Molina C., Ladd G. T., Kerins G. J., Petry N. M. Health and psychosocial correlates of problem gambling in the elderly. *Am J Geriatr Psychiatry* 2005; **13**: 510–9.
67. Flowers C. P., Robinson B. A structural and discriminant analysis of the Work Addiction Risk Test. *Educ Psychol Meas* 2002; **62**: 517–26.

68. McIlwraith R., Jacobvitz R. S., Kubey R., Alexander A. Television addiction: theories and data behind the ubiquitous metaphor. *Am Behav Sci* 1991; **35**: 104–21.
69. Terry A., Szabo A., Griffiths M. The exercise addiction inventory: a new brief screening tool. *Addict Res Theory* 2004; **12**: 489–99.
70. Tuomisto T., Hetherington M. M., Morris M. F., Tuomisto M. T., Turjanmaa V., Lappalainen R. Psychological and physiological characteristics of sweet food 'addiction'. *Int J Eat Disord* 1999; **25**: 169–75.
71. Griffiths M. Excessive Internet use: implications for sexual behavior. *Cyberspsychol Behav* 2000; **3**: 537–52.
72. West R. *Theory of Addiction*. London: Blackwell Publishing; 2006.