

Severity of gambling is associated with severity of depressive symptoms in pathological gamblers

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The objective of this study was to investigate the relationship between gambling severity and depressive symptoms in pathological gamblers addicted to slot machines, with the hypothesis that comorbid depressive symptoms are associated with exacerbated gambling symptoms and behavior. Twenty controls and 20 pathological gamblers with different levels of depressive symptoms were studied during slot machine gambling. We found exacerbated gambling behavior in gamblers with high compared to low levels of depressive symptoms in terms of self-reported gambling urge ($P < 0.01$) and excitement from gambling ($P < 0.05$), number of games played ($P < 0.01$), and duration of gambling ($P < 0.05$). A correlation between depressive and gambling symptoms was found ($r = 0.602$, $P < 0.01$), thereby questioning which symptoms contribute to the exacerbated gambling behavior. Regression analyses showed that the symptoms influenced gambling behavior albeit in different ways. Although gambling symptoms predicted the rate of games played ($P < 0.001$), depressive symptoms predicted gambling urge ($P < 0.01$) and duration of gambling

($P < 0.05$). We discuss whether gambling symptoms only co-occur with other disorders; the need to look beyond the classification of pathological gambling as an impulse control disorder; and the potential role of anhedonia in depressed gamblers. *Behavioural Pharmacology* 00:000–000 © 2009 Wolters Kluwer Health | Lippincott Williams & Wilkins.

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Introduction

There is a high rate of comorbidity between pathological gambling and mood disorders (Kim *et al.*, 2006; Kessler *et al.*, 2008). In a recent large-scale study by Kessler *et al.*, the lifetime comorbidity of mood disorders among pathological gamblers was 55.6%, which was significantly higher compared with the rest of the sample ($P < 0.05$). This is in line with previous findings of prevalence rates of major depressive disorder (MDD) among pathological gamblers. According to a review from 2006, the prevalence of comorbid MDD among pathological gamblers ranged from 28 to 76%, with the majority of studies reporting comorbid MDD in more than 50% of pathological gamblers (Kim *et al.*, 2006).

Investigating how pathological gambling and depressive symptoms affect each other, and hence the clinical condition, is of high clinical and theoretical interest. One way of dealing with the reported high rates of comorbidity with other *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (DSM-IV) disorders is to view pathological gambling as a heterogeneous disorder. In this view, pathological gamblers with comorbid MDD constitute an important subgroup.

Accordingly, knowledge of subgroups of pathological gamblers is important in the development of more individualized and effective treatments.

Effect of comorbid depressive symptoms on the clinical condition

From earlier studies, which have included questionnaires measuring depressive symptomatology, it is clear that both severity of the actual condition and prognosis is exacerbated in pathological gamblers with high levels of comorbid depressive symptoms. Studies of suicidal ideation and behavior have shown that comorbid depressive symptoms increase the risk of completed suicide (Blaszczynski and Farrell, 1998), suicidal ideation, and attempts (Maccallum and Blaszczynski, 2003; Newman and Thompson, 2003; Battersby *et al.*, 2006). Other studies have shown that comorbid depressive symptoms: increase the use of maladaptive coping strategies and decrease the use of adaptive coping strategies (Getty *et al.*, 2000); are associated with longer time to achieve stable abstinence (Hodgins *et al.*, 2005); and increase the risk of relapse in female, but not in male pathological gamblers (Hodgins and el-Guebalay, 2004).

Effect of depressive mood on gambling behavior

Studies looking at pathological gamblers' self-reported reasons for gambling have shown that a large group of gamblers report using gambling as a way of escaping problems or temporarily relieving depressive symptoms (Blaszczynski and McConaghy, 1989; Dickerson *et al.*, 1996; Gupta and Derevensky, 1998; Beaudoin and Cox, 1999; Wood and Griffiths, 2007). Several studies have looked at mood in connection with gambling, either by looking at associations between depressive mood and starting or continuing gambling (Blaszczynski and McConaghy, 1989; Corless and Dickerson, 1989; Dickerson *et al.*, 1991), or by examining possible mood changes from gambling (Griffiths, 1993; Griffiths, 1995; Hills *et al.*, 2001; Stewart *et al.*, 2002; Brown *et al.*, 2004; Gee *et al.*, 2005). Findings from these studies offer some support for an association between negative mood and gambling persistence, but less in terms of starting a session. Results from studies of mood changes before, during, and after gambling activity are mixed, but generally offer sparse support for a mood improvement from gambling.

Objective and hypotheses

The objective of this study was to investigate the relationship between gambling severity and depressive symptoms in pathological gamblers with different levels of depressive symptoms. We examined pathological gamblers addicted to slot machines, because slot machines are among the most addictive types of games (Petry, 2003). The relationship between gambling severity and depressive symptoms was investigated through analyses of differences between pathological gamblers with high and low levels of depressive symptoms. Our main hypothesis was that gambling symptoms and behavior are exacerbated in pathological gamblers with high levels of depressive symptoms. This is also in line with previous studies showing an association between induced depressed mood and increased craving for other sensory stimuli (Willner *et al.*, 1998a, b). Owing to a strong correlation between gambling and depressive symptoms, which made it difficult to untangle the relative contribution of each, post-hoc regression analyses were conducted with gambling and depressive symptoms as independent variables. In addition, analyses of differences in scores on Beck Depression Inventory (BDI) items between pathological gamblers with high and low levels of depressive symptoms were conducted, to investigate whether the groups differed on BDI items reflecting anhedonia (lacking or lowered ability to experience pleasure).

This study was part of a larger study investigating how specific structural characteristics of slot machines affect gambling behavior in pathological gamblers and controls. According to earlier findings, the high prevalence of addiction to slot machines is attributed to properties that closely resemble optimal conditions

for classical and operant conditioning (Griffiths, 1999) including short intergame duration (i.e. short time interval between games) and high reward return (i.e. high ratio of rewards relative to wages). These characteristics were manipulated in two slot machines of the same brand. The incentive for the present study of the relationship between gambling severity and depressive symptoms arose *post hoc*, as a result of finding high levels of depressive symptoms in the pathological gambling group (in which MDD or antidepressant medication was an exclusion criteria). Results regarding the effect of differences in structural characteristics on gambling behavior, as well as differences between pathological gamblers and controls will be reported elsewhere (Linnet *et al.*, in preparation), and are only included here to the extent that they are relevant to the present investigation.

Methods

Participants

Participants were selected through local newspaper advertisement and from a waiting list at *Center for Ludomani*, which is the largest treatment facility for pathological gamblers in Denmark. Participants who were unfamiliar with the slot machine had a training session where the rules were explained and they had the opportunity to play for a short while to ensure game familiarity. (This was done on a separate day prior to the day of testing). This procedure was necessary only in the control group, because all members of the pathological gambling group were familiar with the game. The study was approved by the local ethics committee (De Videnskabetiske Komitéer for Region Midtjylland) and written consent was obtained from all participants before participating.

Pathological gamblers were included if they had a score on South Oaks Gambling Screen (SOGS) of at least 5, were actively gambling (excessive gambling activity during the past two weeks), primarily addicted to slot machines, did not meet criteria for any other DSM-IV disorder, and were not taking medication. Controls were included if they had a score on SOGS below 3, and did not meet criteria for any DSM-IV disorder, and were not taking medication. One pathological gambler and one control were excluded because they were taking antidepressant treatment. Despite exclusion of participants with MDD and antidepressant use, scores on BDI revealed significant differences in levels of depressive symptoms between controls and pathological gamblers, which gave rise to the present investigation of associations between gambling severity and depressive symptoms.

In total, 20 nonmedicated pathological gamblers (seven females, 13 males) and 20 nonmedicated controls (10 females, 10 males) were included. The mean age of pathological gamblers and controls was 42.5 years

(SD \pm 10.3) and 35.2 years (\pm 13.5), respectively. The unequal distribution of male and female pathological gamblers was not intended, but became a necessity owing to problems recruiting female pathological gamblers.

Procedure

In cooperation with Dansk Automatspil A/S, two commercially available slot machines of the brand, The Orient Express, were placed in our laboratory. The Orient Express was chosen because it is one of the most popular slot machines in Denmark. Commercially available slot machines, as opposed to computer-simulated tasks, were used to increase the ecological validity of the study. The two slot machines were manipulated in terms of intergame duration (i.e. time interval between games) and reward return (i.e. ratio of rewards relative to wages). On one machine, intergame duration was set at 2 s per game (30 games per minute), and reward return at 83%, which is the normal setting used commercially for this type of slot machine. On the other machine, intergame duration was set at 3 s per game (20 games per minute), and reward return at 50%. Subsequent analysis, however, showed that over the course of the session (maximum 60 min), there was no significant difference between the two machines in reward return. On one machine (intergame duration of 2 s per game) the reward return was 50.8% and on the other (intergame duration of 3 s per game) it was 47%. We refer to the two slot machines as the 2-s and 3-s versions (as they represent two different versions of The Orient Express).

The participants were presented with the two slot machines next to each other, and were told that they differed in the way they responded, and that the objective of the study was to investigate slot machine gambling behavior under different conditions. All participants gambled individually on both machines and were randomly allocated to start on the 2-s or the 3-s version. After gambling on one version, participants answered questions about their subjective experience of gambling on this version, and were then asked to gamble on the other version, followed by the same questions. Participants were instructed not to use the 'auto play' function (which allows the reels to spin automatically), to ensure active participation. Before participants arrived, 2400 credits (\$100) had been put in each machine, yielding a total playing time of at least 60 min. To resemble real-life gambling, participants could keep 10% of their gains up to \$40 on each machine. Participants received the following instruction before gambling: 'You can gamble as long as you please, and when you do not feel like gambling on this machine anymore, just let me know'. Participants were stopped if they played longer than 60 min (because of ethical considerations), but this information was not disclosed to them.

Measures

The SOGS (Lesieur and Blume, 1987, 1993) is a 20-item self-report questionnaire that assesses lifetime gambling-related difficulties. A score of 5 or greater indicates probable pathological gambling as validated against clinician ratings (Stinchfield, 2002). As SOGS measures lifetime gambling problems, participants were asked additional questions to ensure that gambling problems were current. The maximum SOGS score is 20.

The BDI-II (Beck *et al.*, 1996a, b, 1988; Steer *et al.*, 1997) is a 21-item self-report questionnaire that assesses the presence and severity of depressive symptoms within the past 2 weeks. The BDI-II is an upgraded version of the BDI-IA (Beck, 1979; Beck *et al.*, 1961, 1993, 1988) that was made in an attempt to make the symptom content more consonant with DSM-IV criteria for MDD. According to Beck, scores above 10 indicate clinical depression, although others have argued for 16 as the cut-off score (Kendall *et al.*, 1987). In this study, BDI was used to measure levels of depressive symptoms and to group participants into (i) pathological gamblers with low levels of depressive symptoms (BDI \leq 15), and (ii) pathological gamblers with high levels of comorbid depressive symptoms (BDI \geq 16). The maximum BDI score is 63.

The Zuckerman Sensation Seeking Scale (SSS; Zuckerman *et al.*, 1978; Zuckerman, 1979, 1994, 1996, 2005) is a 40-item self-report questionnaire that assesses the degree of the personality trait sensation seeking. We used the Danish version, which has shown good reliability with American standards (Ripa *et al.*, 2001). SSS has been widely used in studies of impulse control disorders, including pathological gambling, and was used here to clarify any possible interactions with severity of gambling symptoms and depressive symptoms. The maximum SSS score is 40.

Duration of gambling was measured by timing how long participants gambled on each machine, with a maximum of 60 min. This was done manually, using a digital stopwatch, by one of the investigators (K.R.T. or M.B.C.), who was sitting in the lab at approximately 5 m from the participant. No interobserver agreement checks were carried out.

Gambling urge was measured using a 10-point self-report scale from 1 (no gambling urge) to 10 (very high level of gambling urge). Participants were asked to report their gambling urge when they arrived and after gambling on each slot machine.

Subjective measures of excitement from gambling and desire to play again were obtained using a structured interview after each gambling session. Questions were phrased as 'How exciting was it to play on this machine?' and 'How much would you like to play on it

again?', and answered using a 10-point scale from 1 (no excitement/gambling desire) to 10 (very high excitement/gambling desire).

Information on intergame duration (i.e. time interval between games), total number of games played, and reward return (i.e. ratio of rewards relative to wages) was retrieved from each slot machine after participants had left, using a hyper terminal. Rate of games played, which is a measure of how fast the participant is playing (i.e. number of games played per minute), was measured as total number of games played/duration of gambling in minutes.

Statistical methods

All statistical analyses were conducted using SPSS version 11.0 for Mac OS X (SPSS Inc., Chicago, Illinois, USA). Independent sample *t*-tests were used to test for differences between groups and Pearson's correlation analysis was used to test for associations. Multivariate and simple regression analyses were used to untangle the influence of BDI and SOGS on gambling behavior and experience. Cohen's '*d*' was used as a measure of effect size in the analyses of differences between groups, and Cohen's '*f*²' in the regression analyses. In the analyses of differences between groups on BDI items, the Bonferroni correction was used subsequent to the independent samples *t*-test.

Results

Descriptive

In the pathological gambling group, the mean score on SOGS was 11.6 (SD ± 3.3), which indicates a substantial level of difficulties. The mean score for this group on BDI was 19.8 (± 12.9), which is above the agreed cut-off score for probable clinical depression, but scores varied considerably. The mean score on SSS was 19.7 (± 5.7).

Twelve pathological gamblers (nine males, three females) were classified as having high levels of comorbid depressive symptoms (BDI ≥ 16). In this group, the mean score on the BDI was 27.8 (± 9.8), the mean score on the SOGS was 13.1 (± 3.1), the mean score on the SSS was 20.2 (± 6.7), and the mean age was 42.1 years (± 9.4). Eight pathological gamblers (four females, four males) were classified as having low levels of comorbid depressive symptoms (BDI ≤ 15). In this group, the mean score on the BDI was 7.6 (± 4.6), the mean score on the SOGS was 9.5 (± 2.3), the mean score on the SSS was 19.0 (± 4.2), and the mean age was 43.1 years (± 12.2). The difference in BDI scores between groups was significant, $t(18) = -6.17$, $P < 0.001$.

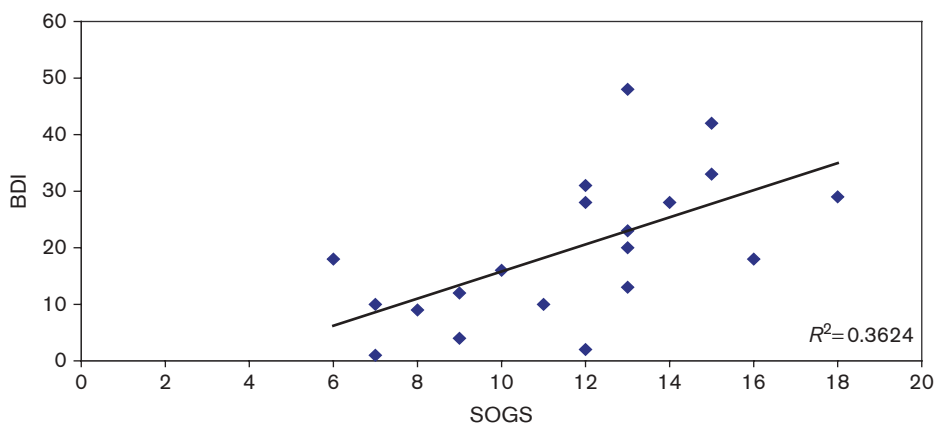
In the control group, the mean score on the SOGS was 0, the mean score on the BDI was 3.9 (± 4.8), and the mean score on SSS was 22.1 (± 6.5).

Relationship between South Oaks Gambling Screen and Beck Depression Inventory

Gamblers with high levels of depressive symptoms exhibited significantly more pathological gambling symptoms compared with gamblers with low levels of depressive symptoms [$t(18) = 3.00$, $P < 0.01$]. Furthermore, we found a strong and highly significant correlation between BDI and SOGS [$r(18) = 0.60$, $P < 0.01$], and no interaction with SSS and age, thereby lending further support to the hypothesis that severity of depressive symptoms is associated with severity of pathological gambling symptoms (Fig. 1).

In terms of SSS, we found no significant difference between pathological gamblers and controls, nor between gamblers with high and low levels of depressive symptoms [$t(37) = -1.26$, NS, $t(17) = -0.44$, NS].

Fig. 1



Correlation analysis of Beck Depression Inventory (BDI) and South Oaks Gambling Screen (SOGS) in pathological gamblers showing a significant positive correlation between depressive and pathological gambling symptoms.

Differences between groups with high and low levels of depressive symptoms

Results from the 2-s version (intergame duration: 2 s per game) showed that pathological gamblers with high levels of depressive symptoms played longer, $t(18) = -3.07$, $P < 0.05$, and related to this, played significantly more games, $t(18) = -3.54$, $P < 0.01$, compared with their low-level counterparts. The average duration of gambling in pathological gamblers with high levels of depressive symptoms was 58.3 min (± 4.1), which is very close to the 60-min time limit, thereby reflecting a possible ceiling effect. Pathological gamblers with high levels of depressive symptoms also reported significantly higher levels of excitement from gambling, $t(18) = -2.42$, $P < 0.05$, as well as higher levels of gambling urge after gambling, $t(18) = -3.52$, $P < 0.01$ on the 2-s version, compared with gamblers with low levels of depressive symptoms. In the 3-s version (intergame duration: 3 s per game), the only significant finding was that gamblers with high levels of depressive symptoms played more games than their low-level counterparts, $t(18) = -2.30$, $P < 0.05$. As there was no difference between groups in reward return on either of the slot machines [2-s: $t(38) = -0.52$, NS, 3-s: $t(38) = 1.00$, NS], differences between groups on behavioral and subjective measures cannot be accounted for by differences in how much they won. Likewise, as there was no difference in reward return between the 3-s and the 2-s version, $t(39) = 0.30$, NS, differences between versions cannot be explained in terms of differences in reward return. All effect sizes were large (Cohen's $d > 0.8$).

Regression: influence of pathological gambling and depressive symptoms on gambling behavior

In an attempt to untangle the relative contribution of SOGS and BDI on measures of observable and self-reported gambling behavior, simple and multiple regression analyses were conducted. Results showed that SOGS, but not BDI, scores contributed significantly to the prediction of rate of games played in the 2-s version ($F = 23.92$, $\beta = 0.76$, $P < 0.001$). Furthermore, BDI, but not SOGS, scores contributed significantly to the prediction of gambling urge ($F = 8.89$, $\beta = 0.58$, $P < 0.01$), duration of gambling ($F = 4.50$, $\beta = 0.45$, $P < 0.05$), and related to this, total number of games played ($F = 6.58$, $\beta = 0.52$, $P < 0.05$) in the 2-s version. Neither SOGS nor BDI predicted observable or self-reported gambling behavior in the 3-s version. Results from the multiple regression analyses showed that no additional information was gained by adding BDI to the analysis of rate of games played, and vice versa by adding SOGS to the analysis of duration of gambling, gambling urge, and total number of games played.

Although none of our hypotheses involved the control group, we found it interesting to test whether depressive symptoms could predict gambling behavior in this group.

Results showed that BDI (min: 0, max: 14) significantly predicted the total gambling urge (2-s and 3-s version added together) ($F = 4.73$, $\beta = -0.46$, $P < 0.05$). However, BDI did not significantly predict gambling urge in this group when we looked at the versions separately. All effect sizes, other than BDI (independent variable) and duration of gambling (dependent variable), were large ($f^2 > 0.35$).

Differences in BDI items between groups with high and low levels of BDI symptoms

Using the Bonferroni correction, results showed a significant difference between groups with high and low levels of BDI symptoms on BDI items: 'sadness', 'loss of pleasure', 'loss of interest in other people', 'self-hatred', 'self-dislike', and 'loss of interest in sex' ($P < 0.05$). This suggests that gamblers with high and low levels of depressive (and pathological gambling) symptoms primarily differed on BDI items that reflect anhedonia (main findings are summarized in Table 1).

Discussion

The objective of this study was to look at the relationship between depressive symptoms and gambling severity in pathological gamblers in terms of gambling symptoms and observable and self-reported gambling behavior during slot machine gambling.

Table 1 Gambling behavior and experience during slot machine gambling in pathological gamblers with different levels of comorbid depressive symptoms

	BDI ≥ 16 (mean \pm SD)	BDI ≤ 15 (mean \pm SD)	
a. Differences in gambling symptoms and behavior between pathological gamblers with high and low levels of co-morbid depressive symptoms			
BDI	27.8 \pm 9.8	7.6 \pm 4.6	$t(18) = -6.17$, $P < 0.001$
SOGS	13.1 \pm 3.1	9.5 \pm 2.3	$t(18) = -3.00$, $P < 0.01$
Gambling duration	58.3 \pm 4.1	43.4 \pm 13.4	$t(18) = -3.07$, $P < 0.05$
Games played	1321.2 \pm 121.3	945.1 \pm 283.5	$t(18) = -3.54$, $P < 0.01$
Excitement from gambling	7.3 \pm 2.1	4.8 \pm 2.7	$t(18) = -2.42$, $P < 0.05$
Gambling urge	7.8 \pm 2.5	3.6 \pm 2.8	$t(18) = -3.52$, $P < 0.01$
BDI item: loss of pleasure	1.3 \pm 0.8	0.3 \pm 0.5	$t(18) = -3.67$, $P < 0.05$
BDI item: loss of interest in other people	1.3 \pm 0.9	0.3 \pm 0.5	$t(18) = -3.56$, $P < 0.05$
BDI item: loss of interest in sex	1.4 \pm 0.9	0.0 \pm 0.0	$t(18) = -4.93$, $P < 0.05$
b. Influence of SOGS and BDI on gambling behavior			
SOGS predicted	Rate of games played		$F = 23.92$, $P < 0.001$
BDI predicted	Gambling urge		$F = 8.89$, $P < 0.01$
	Gambling duration		$F = 4.50$, $P < 0.05$
	Games played		$F = 6.58$, $P < 0.05$

All results are using intergame duration set at 2 s per game. Gambling urge and excitement from gambling are self-report measures (1–10). Rate of games played is measured as number of games played/duration of gambling in minutes. BDI, Beck Depression Inventory; SOGS, South Oaks Gambling Screen.

Main findings

We found support for our hypothesis of exacerbated self-reported and observable gambling behavior in gamblers with high levels of depressive symptoms compared with gamblers with low levels of depressive symptoms, in terms of self-reported gambling urge, self-reported excitement from gambling, duration of gambling, and related to this, total number of games played. Interestingly, we found a strong correlation between level of pathological gambling symptoms and level of comorbid depressive symptoms, posing the question of which symptoms contribute to the exacerbated gambling behavior. Regression analyses showed that gambling and depressive symptoms accounted for different aspects of the gambling behavior. Although gambling symptoms predicted rate of games played (i.e. games played per minute), depressive symptoms predicted gambling urge, duration of gambling, and total number of games played. The association between gambling symptoms and rate of games played emphasizes the impulsive nature of pathological gambling behavior. It is interesting that important measures of gambling behavior, such as gambling urge and duration of gambling, are predicted by depressive symptoms and not by gambling symptoms. The fact that this pattern was seen in both a self-report measure of gambling urge and a behavioral measure of gambling behavior (duration of gambling) strengthens the finding, and is in line with previous studies showing an association between induced depressed mood and increased craving for sweet rewards such as chocolate (Willner *et al.*, 1998a) and alcohol (Willner *et al.*, 1998b) in healthy participants.

Furthermore, we found a significant difference between the two groups on BDI items reflecting anhedonia: 'loss of pleasure', 'loss of interest in other people', and 'loss of interest in sex'. It is possible that an underlying anhedonic state can help explain why depressive symptoms, and not gambling symptoms, predicted gambling urge, duration of gambling, and number of games played in this population, although only speculative. If the group with high levels of depressive symptoms is suffering from an underlying anhedonic state, excessive gambling activity (which might have offered an escape or a feeling of reward in the beginning, and may or may not still do) could be pursued in an endless attempt to compensate for a general lack of pleasure. We will discuss this hypothesis in detail.

The strong correlation between pathological gambling symptoms and depressive symptoms is of high clinical interest, and raises the possibility that former reporting of exacerbated conditions in pathological gamblers with comorbid depressive symptoms is also related to concurrent, increased levels of pathological gambling symptoms. Coupled with the finding that depressive and

gambling symptoms explain different aspects of the gambling behavior, this highlights the need to look more closely at the role of depressive mood in gambling in future studies.

Related findings

Most of our findings of significant differences between gamblers with high and low levels of depressive symptoms, as well as findings from the regression analyses, were only evident in the 2-s version. Lack of significant difference between gamblers with different levels of severity on the 3-s version, as well as in the regression analyses, supports our finding of reduced gambling behavior among pathological gamblers in general in the 3-s version, thereby stressing the importance of intergame duration in gambling behavior (Linnet *et al.*, in preparation).

In the control group, we found a different relationship between depressive symptoms and gambling behavior. In this group, in which gambling symptoms (as measured with SOGS) were absent, depressive symptoms significantly predicted total gambling urge (2-s and 3-s version added together) with less symptoms being associated with more gambling urge. Hence, although depressive symptoms were associated with increased gambling urge in pathological gamblers, they were associated with decreased gambling urge in controls. It is interesting that depressive symptoms are only positively associated with gambling urge in the presence of pathological gambling symptoms. However, it must be noted that the level of depressive symptoms in the control group was low, with a mean score on BDI of only 3.9 and with notable variation (± 4.8).

Other studies have found support for increased levels of sensation seeking in pathological gamblers (McDaniel and Zuckerman, 2003), thereby stressing the impulsive nature of pathological gambling. We found no association between level of sensation seeking and severity of gambling or depressive symptoms. Furthermore, we found no difference in level of sensation seeking between pathological gamblers and controls (19.7 ± 5.7 vs. 22.1 ± 6.5) or between gamblers with high and low levels of depressive symptoms (20.2 ± 6.7 vs. 19.0 ± 4.2). Generally, SSS scores in this sample reflect a moderate level of SSS (max score on SSS is 40).

A heterogeneous disorder or comorbid symptoms?

The strong association between gambling severity and severity of depressive symptoms, conceptualized through analyses of self-reported symptoms and observable gambling behavior, could have important consequences for theoretical understandings and clinical interventions, if replicated in future studies. As mentioned, pathological gambling can be considered a heterogeneous disorder, and because of high rates of comorbidity with MDD, we have argued for the importance of looking at this

type of gamblers separately. Another possibility is to view pathological gambling symptoms as comorbid symptoms (simply) co-occurring with other disorders. Prevalence studies provide some support for this idea. According to recent studies, the prevalence of lifetime pathological gambling in the general population is in the interval of 0.4–0.7% (Petry *et al.*, 2005; Kessler *et al.*, 2008), which is relatively low. In the study by Kessler *et al.* (2008), prevalence of lifetime pathological gambling was 0.6%, and nearly all individuals (93.3%) with lifetime pathological gambling also had another lifetime DSM-IV disorder. Hence, pathological gambling is a relatively rare disorder with markedly few individuals being diagnosed with lifetime pathological gambling as a single disorder. These findings emphasize the need to investigate how pathological gambling is related to other DSM-IV disorders, including MDD, and stresses the importance of looking at symptom patterns outside the DSM-based classifications.

Self-medication or anhedonia: a possible link?

Inherently linked to the above reasoning, is the discussion of causality: do pathological gamblers get depressed because they ruin their life through gambling? Or do they gamble to self-medicate a depressive mood and/or lack of pleasure (anhedonia)? Although theories of self-medication tend to focus on efforts to relieve a negative mood (Khantzian, 1974, 1977, 1993), it is equally possible that excessive gambling activity or drug use is pursued to compensate for an underlying anhedonic state. As gambling because of anhedonia is not a part of the current DSM criteria for pathological gambling (American Psychiatric Association, 1994), this hypothesis has received very limited attention in research.

According to the epidemiological study by Kessler *et al.* (2008), other DSM-IV disorders typically predated pathological gambling and predicted the subsequent onset and persistence of pathological gambling (based on retrospective accounts). These associations were particularly strong for mood and anxiety disorders. To date, no longitudinal studies have looked at the relationship between pathological gambling and comorbid mood disorders. Studies of pathological gamblers' self-reported reasons for gambling also seem to favor a self-medication hypothesis, by showing that a large group of pathological gamblers report using gambling as a way of escaping problems or temporarily relieving depressive symptoms (Blaszczynski and McConaghy, 1989; Dickerson *et al.*, 1996; Gupta and Derevensky, 1998; Beaudoin and Cox, 1999; Wood and Griffiths, 2007). However, the mentioned studies of mood 'before', 'during', and 'after' gambling provide sparse support for a self-medication effect on depressed mood (Blaszczynski and McConaghy, 1989; Corless and Dickerson, 1989; Dickerson *et al.*, 1991; Griffiths, 1993; Griffiths, 1995; Hills *et al.*, 2001; Stewart *et al.*, 2002; Brown *et al.*, 2004; Hodgins and el-Guebaly,

2004; Gee *et al.*, 2005). The distinction between wanting and liking, which was proposed by Robinson and Berridge (1993, 2003, 2008) to explain the phenomenon that drug addicts crave for the next shot without necessarily deriving pleasure from it, might help explain these seemingly contradictory findings. 'Wanting' is defined as the motivation for, or incentive salience of a reward, whereas liking is the actual pleasure or hedonic impact of a reward, both of which may or may not be available for conscious introspection and reporting. Hence, it is possible to want something, without liking it. The idea that wanting and liking are separate components of reward, and do not necessarily operate together, is supported by extensive research showing that these two psychological components are mediated by partly dissociable brain structures. Overall, the component of wanting has primarily been related to activity in the dopaminergic mesolimbic pathway, (Berridge and Robinson, 1998; Berridge, 2007; Berridge and Kringelbach, 2008). Furthermore, recent findings have shown that mesolimbic dopamine has not lived up to its former label as a pleasure neurotransmitter (Berridge and Kringelbach, 2008). Hence, it is plausible to speculate that although pathological gamblers want to gamble, and cannot inhibit this incentive salience wanting, the gambling activity in itself does not necessarily provide the expected pleasure or liking. This could help explain the above-mentioned dilemma, in the sense that pathological gamblers might want to gamble and report using gambling as a way to self-medicate a depressed mood, although the gambling activity does not elicit the expected pleasure, or liking. Although several studies have tested the self-medication hypothesis in terms of a mood improvement from gambling, no studies, to our knowledge, have tested whether pathological gamblers use gambling as a way to self-medicate an underlying anhedonic state. Our finding from this study that gamblers with high and low levels of depressive symptoms primarily differed on BDI items that reflect anhedonia, coupled with the finding that depressive symptoms predicted gambling urge and duration of gambling, supports the need to address this hypothesis in future studies. Although only speculative, it is possible that anhedonia can explain the connection between depressive symptoms and increased gambling urge and prolonged gambling behavior seen in this population of gamblers, in the sense that the excessive gambling activity might be pursued and maintained in an endless attempt to experience pleasure. Our finding of increased levels of excitement from gambling in the group of gamblers with high levels of depressive symptoms might seem in contradiction to this hypothesis. However, it is important to remember that self-reported excitement from gambling is not necessarily expressive of pleasure or liking. Furthermore, the group of gamblers with high levels of depressive symptoms exhibited concurrent high levels of pathological gambling symptoms, and in the regression analysis, depressive symptoms alone did not predict increased levels of excitement from gambling.

The hypothesis of a relationship between depressive symptoms, including anhedonia, and gambling behavior was made *post hoc* after we saw high levels of depressive symptoms in the population (in which MDD or antidepressant medication was an exclusion criteria). The hypothesis of anhedonia as an underlying state behind pathological gambling activity in gamblers with comorbid MDD should be tested in studies using measurements of anhedonia on different levels such as self-report, behavioral, physiological, and functional neuroanatomical. Related to this, measures of gambling behavior that separate wanting and liking are needed to properly test the hypothesis that pathological gambling behavior is expressive of wanting and not necessarily accompanied by liking.

DSM-IV classification and symptom patterns beyond

Regardless of whether pathological gambling is better understood as a heterogeneous disorder or as comorbid symptoms, reporting of high rates of comorbidity stresses the importance of looking at symptom patterns beyond the DSM-based categories. In line with this reasoning, Grant and Kim (2006) have argued for the importance of looking at different types of pathological gamblers in relation to pharmacological treatment of gambling symptoms. On the basis of a review of pharmacotherapy trials for pathological gambling, they suggest a diagnostic and treatment approach that takes into account differences in symptom patterns and comorbid symptoms. For example, opioid antagonists are recommended for pathological gamblers reporting urges or cravings to gamble, as well as gamblers with co-occurring substance use disorders, whereas selective serotonin reuptake inhibitor trials are suggested for pathological gamblers who gamble because of depression or anxiety, or have co-occurring depressive or anxiety symptoms (Grant and Kim, 2006).

Within the DSM classification, overlap between pathological gambling and other DSM-IV disorders has also led to controversy regarding how pathological gambling is best understood and categorized. Instead of the DSM-IV classification of pathological gambling as an impulse control disorder, it has been suggested that it should be characterized as a substance use disorder, an obsessive-compulsive spectrum disorder, or an affective spectrum disorder (Grant and Kim, 2006). In addition to the resemblances in symptoms in pathological gamblers and substance addicts (e.g. craving, tolerance and withdrawal, and repeated, unsuccessful attempts to cut back or stop), findings from recent neuroimaging studies support the similarity, by showing similar changes in brain activity underlying gambling urges and cocaine cravings (Potenza, 2008). In line with this reasoning, Shaffer *et al.* (2004) have suggested that different types of addiction, chemical and behavioral (e.g. pathological gambling), are better understood as manifestations of a shared, underlying addiction syndrome. Further support for the association between pathological gambling and substance use

disorders is found in epidemiological studies. In the study by Kessler *et al.* (2008), the lifetime comorbidity of substance use disorders was 76.3% among pathological gamblers, which was significantly higher compared with the rest of the sample.

Findings from the present study emphasize the close relationship between pathological gambling and depressive symptoms – an association which has also been systematically reported in substance use disorders (Compton *et al.*, 2000, 2007; Kessler *et al.*, 2003; Grant *et al.*, 2004; Conway *et al.*, 2006). On account of the risky and self-destructive nature of pathological gambling behavior, it has also been suggested that pathological gambling reflects subclinical mania or cyclothymia, which is part of the affective spectrum disorders (Grant and Kim, 2006). As we did not screen for manic symptoms in the present study, we are unable to rule out the possibility that some of the pathological gamblers with high levels of depressive symptoms also exhibited manic symptoms.

Conclusion

Overall, findings from this study showed a strong and highly significant positive correlation between pathological gambling and depressive symptoms. Furthermore, we showed that not only gambling, but also depressive symptoms significantly influenced important measures of pathological gambling behavior. Although gambling symptoms predicted rate of games played, depressive symptoms predicted gambling urge, duration of gambling, and total number of games played. Lastly, we found that gamblers with high and low levels of depressive (and pathological gambling) symptoms primarily differed on BDI items reflecting anhedonia, suggesting that an anhedonic state might underlie the excessive gambling activity. Together, these findings highlight the importance of looking further into the role of depressive mood in pathological gambling, and into the relationship in general between depressive and pathological gambling symptoms. In future, this may be accomplished by integrating knowledge from other cross-disciplinary fields of research including neuroimaging studies of possible, underlying imbalances in specific areas of the brain. Particularly, studies of dopamine could provide important information on the links between addictive and affective disorders. In addition to the well-established influence of dopamine in substance use disorders, recent findings support a similar dopaminergic involvement in pathological gambling (Laruelle *et al.*, 1995; Volkow *et al.*, 1999, 2005; Betz *et al.*, 2000; Drevets *et al.*, 2001; Fiorillo *et al.*, 2003; Shaffer *et al.*, 2004; Kalivas and Volkow, 2005; Schultz, 2006; Potenza, 2008). Similarly, a growing body of literature supports the involvement of dopamine in affective disorders, both in animal models of depression and in human studies (Willner, 1983, 2002; Willner and Papp, 1997; Markou *et al.*, 1998; Naranjo *et al.*, 2001; Tremblay *et al.*, 2002, 2005; Willner *et al.*, 2005; Slattery

et al., 2007; Dayan and Huys, 2009), thereby departing from a longstanding sole focus on serotonin in favor of an increasing focus on the interplay between different neurotransmitters such as dopamine and serotonin. For example, Willner *et al.* (2005) showed involvement of dopamine in the action of selective serotonin uptake inhibitors in a group of depressed patients, thereby replicating an effect which has been found consistently in animal models of depression (Willner and Papp, 1997; Willner, 2002). The present findings of a strong correlation between the levels of pathological gambling symptoms and comorbid depressive symptoms should be seen in the light of these previous findings. Taken together, this body of evidence points to the importance of future investigations of the relative roles of neurotransmitters such as dopamine and serotonin in addiction and depression.

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