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ORIGINAL PAPER

Cue-Reactive Altered State of Consciousness Mediates the Relationship Between Problem-Gambling Severity and Cue-Reactive Urge in Poker-Machine Gamblers

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Abstract In order to enhance our understanding of the nature of poker-machine problem-gambling, a community sample of 37 poker-machine gamblers ($M_{age} = 32$ years, $M_{PGSI} = 5$; PGSI = Problem Gambling Severity Index) were assessed for urge to gamble (responses on a visual analogue scale) and altered state of consciousness (assessed by the Altered State of Awareness dimension of the Phenomenology of Consciousness Inventory) at baseline, after a neutral cue, and after a gambling cue. It was found that (a) problem-gambling severity (PGSI score) predicted increase in urge (from neutral cue to gambling cue, controlling for baseline; $sr^2 = .19$, $p = .006$) and increase in altered state of consciousness (from neutral cue to gambling cue, controlling for baseline; $sr^2 = .57$, $p < .001$), and (b) increase in altered state of consciousness (from neutral cue to gambling cue) mediated the relationship between problem-gambling severity and increase in urge (from neutral cue to gambling cue; $\kappa^2 = .40$, 99 % CI [.08, .71]). These findings suggest that cue-reactive altered state of consciousness is an important component of cue-reactive urge in poker-machine problem-gamblers.

Keywords Poker-machines · Gambling cue-reactivity · Altered state of consciousness

Introduction

Poker machines (a type of electronic gaming machine) are a ubiquitous feature of the Australian hotel, club, and casino landscape. They bring in more revenue than all other forms of gambling combined (62 %), and account for as much as 80 % of all gambling by problem gamblers (Productivity Commission 2010). These prevalence statistics, along with

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the some times catastrophic financial and emotional difficulties suffered by poker-machine problem-gamblers, has led the Productivity Commission (2010) to identify poker machines as being the most harmful of all forms of gambling. That said, only 15 % of Australian poker-machine gamblers gamble in a way that is problematic enough to be labelled problem gambling (Productivity Commission; problem gambling was defined as a score of 8 or above on the Problem Gambling Severity Index; PGSI; Ferris and Wynne 2001). The fact that only a minority of people who play poker machines do so problematically raises the question: why do poker-machine problem-gamblers play poker machines despite harmful consequences?

Problem Gambling and Cue-Reactive Urge

One approach to this question has been to theorise that gambling cues trigger a particularly strong urge to gamble in problem gamblers (Baudinet and Blaszczynski 2013; Blaszczynski and Nower 2002). There is extensive discussion in the literature about how to best conceptualise urge to gamble, and the extent to which cognitions, physiological arousal, affect, volition, and other phenomenological dimensions are relevant for defining the construct (Ashrafioun and Rosenberg 2012). A straightforward approach is to conceptualise urge simply as the degree to which a person wants to do something, and to relate other constructs and dimensions (e.g., cognitions, physiological arousal) to this uni-dimensional construct, where appropriate. Studies that have operationalised urge by asking participants "How strong is your urge to gamble right now?" and to rate their answer on a scale of, for example, 1 (*no urge*) to 10 (*extreme urge*), have implicitly adopted this uni-dimensional conceptualisation of urge. Notably, research that has explored relationships between different measures of physiological arousal (e.g., heart rate, skin conductance response) and subjective arousal (e.g., urge, excitement) has produced complex and mixed findings (see Baudinet and Blaszczynski 2013 for a review). For example, although some studies have found a positive relationship between measures of physiological arousal and subjective arousal (e.g., Leary and Dickerson 1985), many studies have not (e.g., Wilkes et al. 2010). The theorised relationship between gambling cues and urge derives from behavioural psychology approaches, and is as follows: In terms of operant conditioning, when poker-machine play is rewarded with wins (the *reinforcement schedule*), the poker-machine-play behaviour is strengthened. Subjectively, the gambler experiences an increased urge to play poker machines. The reinforcement schedule implemented by poker machines is a variable ratio; that is, a ratio that is known to produce behaviours that are highly resilient to extinction (Productivity Commission 2010). Concurrently, and in terms of classical conditioning, the gambler learns to associate the wins (the *unconditioned stimulus*) with stimuli that *accompany* the wins (*conditioned stimuli*; e.g., poker-machine imagery, poker-machine sounds). After this association has been learnt, not only do wins (the unconditioned stimulus) trigger urge (the *unconditioned response*), but the associated stimuli (the conditioned stimuli, or *cues*) *in themselves* trigger urge (the *conditioned response,* or *cue reactive* response) (Blaszczynski and Nower 2002).

Based on this theoretical understanding, psychological interventions involving exposure to gambling cues have been incorporated into behavioural and cognitive-behavioural interventions for problem gamblers (e.g. McConaghy et al. 1991; Oakes et al. 2008; Tavares et al. 2003). Exposure therapy, which aims to directly address the cue-response association, involves presenting the gambler with a specific cue (e.g., a picture of a poker machine; this is referred to as *cue exposure*) and supporting the gambler to refrain from responding to the cue (i.e., to refrain from gambling and to instead practice a self-soothing technique; this is

referred to as *response prevention*; Oakes et al. 2008). The theory is that over time, with repeated cue exposure paired with response prevention, cue-reactive urge will decrease in strength (will be *extinguished*) and gambling behaviour will decrease in frequency (will be extinguished).

Remarkably, very little experimental research has been conducted to test whether problem gamblers do, in fact, experience greater cue-reactive urge than non-problem gamblers (or whether gamblers with higher levels of problem-gambling severity do, in fact, experience greater cue-reactive urge than gamblers with no, or lower levels of, problem-gambling severity). Only three studies (Ashrafioun et al. 2012; Sodano and Wulfert 2010; Wulfert et al. 2009) have done so, and none of those studies looked specifically at poker-machine gamblers. As Baudinet and Blaszczynski (2013) have noted in their literature review of gambling cue-reactivity studies, gambling cue-reactivity research is in its infancy. Given the potential role of cue-reactive urge in the maintenance of problem-gambling behaviour, the need to undertake further research is apparent.

In the Wulfert et al. (2009) study, the participants were either horse-race ($N = 47$) or scratch-off-lottery gamblers ($N = 47$). Forty-two percent of the sample were problem gamblers (defined as scoring 5 or above on the South Oaks Gambling Scale; SOGS; Lesieur and Blume 1987). Each participant was presented with a series of four cues: a counting task (intended to create stress); a 2-min video of their preferred mode of gambling; a 2-min video of a non-preferred mode of gambling; and a 2-min video of a car chase (intended to arouse excitement). Urge (rated from 1 to 100) was assessed after each cue. Problem gamblers reported higher overall-urge (the mean urge across all four conditions) than non-problem gamblers. Also, urge for all participants combined was higher in the preferred-gambling-mode condition compared to the other conditions. Sodano and Wulfert (2010) used a similar experimental design and found comparable results. A limitation of these two studies is that because problem gamblers and non-problem gamblers were only compared on overall urge, and because the preferred-gambling-mode cue was compared to the other cues for all participants combined, the findings do not specifically tell us whether the preferred-gambling-mode cue triggered higher urge in the problem gamblers than in the non-problem gamblers. Furthermore, because neither study included baseline assessments or a control condition (i.e., a neutral cue), post-test scores may be an artefact of baseline urge scores and the authors are precluded from isolating the effects of the treatment.

The research design and statistical testing conducted by Ashrafioun et al. (2012) allow for more precise conclusions to be drawn. The participants were university students ($M_{age} = 21$ years) who gambled at least once a month (predominately scratch-off-lottery and card games). Each participant was presented with either an imagery script or a series of gambling-related photographs, which depicted a variety of gambling modes. Urge (quantified by the Gambling Urge Scale; Raylu and Oei 2004) was assessed at baseline and post cue. Post-cue urge was greater than baseline urge in both conditions. However, effects sizes were not reported, and cannot be calculated from the statistics that were reported. Additionally, post-cue urge for both conditions combined was positively associated with problem-gambling severity (scores on the SOGS-Revised Adolescent; Winters et al. 1993; $r = .6$, a large effect). A limitation, however, of the experimental design was that there was no control condition (neutral cue) and, thus, the effects of the treatment cannot be isolated. A further limitation was that preferred gambling-mode was not controlled for. In their literature review of gambling cue-reactivity studies, Baudinet and Blaszczynski (2013) have cited research that has found that problem gamblers are not a homogenous group; that is, gamblers have preferred modes of gambling, and their cue reactivity is tied

to their preferred mode. Consequently, to determine accurate effect sizes researchers need to identify and control for preferred gambling-mode.

Urge-Related Altered State of Consciousness

A construct that might improve our understanding of urge to gamble is *altered state of consciousness*. When describing their experience of during-play urge, poker-machine problem-gamblers have reported experiencing a drug-like "high" (Griffiths 1996; Oakes et al. 2012); that is, a strongly desired trance-like or dissociative state known by gamblers as the "zone" (Schull 2005). Due to lack of research in this area, the exact nature of what constitutes an altered state of consciousness requires further conceptual clarification, especially in regards to whether altered state of consciousness is a uni-dimensional or a multi-dimensional construct. Jacobs (1986) conceptualised the gambler's altered state of consciousness as a *dissociative* state, and his four dissociation questions (Jacobs 1988) assess this state in terms of a person's subjective experience of trance, altered identity, depersonalisation, and loss of time. An alternative tool for assessing altered state of consciousness is the Phenomenology of Consciousness Inventory (PCI; Pekala 1991). The Altered State of Awareness (ASA) dimension of the PCI assesses altered state of consciousness as a uni-dimensional construct (i.e., it simply asks respondents whether they experienced an altered state of consciousness or awareness). At the same time, other dimensions of the PCI quantify more specific subjective phenomena such as time sense, absorption, self-awareness, and volitional control.

As yet, the association between cue-reactive altered state of consciousness and urge in poker-machine problem-gamblers has not been experimentally studied. Only one study (McCormick and Delfabbro 2011) has experimentally investigated altered state of consciousness in the context of gambling. That study explored whether there was a relationship between altered state of consciousness (quantified by the PCI-ASA) and problem-gambling severity (according to PGSI criteria) during poker-machine play. The study also tested for dissociation (quantified by Jacobs' dissociation questions; Jacobs 1988). However, due to the sample size ($N = 14$), the authors did not engage in null-hypothesis significance testing.

It is noteworthy that a paucity of experimental studies have examined altered states of consciousness in the context of alcohol cue-reactivity. For example, in a sample of university students, Rock and Kambouropoulos (2012) found that altered state of consciousness (quantified by the PCI-ASA) was statistically significantly higher in the alcohol-cue condition than the neutral-cue condition. In two other studies (Kambouropoulos and Rock 2010; Rock and Kambouropoulos 2009), altered state of consciousness (quantified by the PCI-ASA) during the alcohol-cue was positively associated with post alcohol-cue urge (assessed by a visual analogue scale; rs $= .41$ and .32 for each study respectively, which represent medium-to-large effect sizes). However, neither study tested whether altered state of consciousness was higher in the alcohol-cue condition than in the neutral-cue condition, controlling for baseline. As such, neither study allows us to conclude that there was a positive association between *cue-reactive* altered state of consciousness and cue-reactive urge.

Rock and Kambouropoulos (2009) explored the possibility that altered state of consciousness might play a *mediating* role with regards to urge to drink alcohol. Noting that altered state of consciousness would *precede* urge (i.e., the participants' state of consciousness would be assessed for the period *during* cue exposure, whereas current urge would be assessed immediately *after* cue exposure), they reasoned that the alcohol cue

might cause participants to *re-experience,* rather than merely remember, the altered state associated with previous drinking, and that this might, in turn, facilitate urge. The specific hypothesis tested was that altered state of consciousness would mediate the relationship between the *unusual experience* factor of a personality trait referred to as *mental boundaries* (Hartmann 1991) and urge. The hypothesis was supported (i.e., a statistically significant indirect effect was found).

Rock and Kambouropoulos' (2009) mediation model may be modified and tested in the context of poker-machine gambling cue-reactivity. For example, perhaps poker-machine cues trigger poker-machine problem-gamblers to re-experience the altered state associated with poker-machine play, which in turn facilitates urge. That is, it might be argued that altered state of consciousness will mediate the relationship between problem-gambling severity and increase in urge to gamble.

Aim of The Present Study

The present study aimed to test if the relationship between problem-gambling severity and urge was mediated by an altered state of consciousness. To the best of our knowledge, this is the first study to investigate this aim.

As previously stated, the experimental evidence supporting a relationship between problem-gambling severity and cue-reactive urge (Ashrafioun et al. 2012; Sodano and Wulfert 2010; Wulfert et al. 2009) is limited. No studies have tested if this relationship exists for poker-machine gamblers, and no studies have adopted the research protocol of assessing cue-reactive urge by testing for an increase in urge from neutral cue to gambling cue, controlling for baseline. Thus, the first hypothesis was:

H1 Problem-gambling severity will predict cue-reactive urge to gamble (from neutral cue to gambling cue, controlling for baseline).

One study (Rock and Kambouropoulos 2012) found evidence of cue-reactive altered state of consciousness in people who drink alcohol. However, no studies have tested if poker-machine cues trigger an altered state of consciousness in poker-machine gamblers, and whether that effect, if it exists, may be predicted by problem-gambling severity. Thus, the second hypothesis was:

H2 Problem-gambling severity will predict cue-reactive altered state of consciousness (from neutral cue to gambling cue, controlling for baseline).

Finally, there is some evidence that alcohol-cue altered state of consciousness positively correlates with post-alcohol-cue urge to drink (Kambouropoulos and Rock 2010; Rock and Kambouropoulos 2009). In addition, one study found that altered state of consciousness mediated this relationship (Rock and Kambouropoulos 2009). However, the studies that tested for these relationships did not test for relationships between *change* scores (i.e., an increase from neutral cue to active cue), and no such studies have been conducted in regards to poker-machine problem-gambling. Thus, the third hypothesis was:

H3 Cue-reactive altered state of consciousness (from neutral cue to gambling cue) will mediate the relationship between problem-gambling severity and cue-reactive urge to gamble (from neutral cue to gambling cue).

We note that in the present study, baseline would have ideally been controlled for in *H3*. However, the current computer programs that perform mediation analysis (e.g., Hayes's (2013) PROCESS macro, version 2.13) do not allow for baseline measures to be entered as

covariates *and* for a κ^2 statistic to be obtained. The κ^2 statistic is a standardised value that measures the proportion of the maximum possible indirect effect that could have been found, and is recommended by Preacher and Kelley (2011) as being the most informative measure of indirect effect (i.e., mediation). Owing to the utility of the κ^2 statistic, and given that baseline was controlled for in *H1* and *H2*, we decided that it was less important to control for baseline in *H3*, and more important to obtain a κ^2 statistic.

Method

Participants

The participants were 37 poker-machine gamblers recruited from the general community. Following the precedent of McCormick et al. (2012), and MacLaren et al. (2012), the selection criteria were: (a) having played poker machines at least twice a month for the past 12 months; and (b) poker machines were the person's preferred mode of gambling. Other characteristics of the sample are presented in Table 1. Individuals participated in this online study by responding to either a notice in a local newspaper (northern New South Wales) or a notice on Facebook. The Facebook notice was posted on the first author's personal Facebook page along with a request for the notice to be passed on through the Facebook network of contacts.

Fifty-nine people commenced the online study. Twenty-one cases were discarded because a manipulation check (a page timer) indicated that the video cues had not been watched in their entirety (each video cue ran for 3 min; cases were discarded if the time spent on a video-cue page was <3 min). Although participants were instructed to watch the videos in their entirety, we were not surprised that 21 of the 59 people who commenced the study did not comply with this instruction. We reasoned that this was a natural circumstance of an unsupervised online study; that is, many people may have merely been "checking out" the study, whereas others may have been too impatient to sit through the full 3 min of each video. Of the remaining 38 cases, one case was discarded because of missing data on an assessment measure (two of the nine Problem Gambling Severity Index items had not been completed).

Table 1 Characteristics of the sample

Variable	*M* (*SD*)	Range	*N*	%
Age (in years)	32.4 (9.5)	18–48		
Sex				
Male			24	65
Female			13	35
Residence				
Australia			35	95
Other			2	5
Problem gambling				
PGSI scores	4.6 (3.9)	0–15		
PGSI score of 8+[a]			8	22
PGSI score of 4+[b]			20	54

PGSI problem gambling severity index

[a] *Problem gambling,* according to the PGSI

[b] *Problem gambling,* according to the cut-off criteria recommended by Walker and Blaszczynski (2010)

Materials and Measures

The study was conducted on an online platform using Qualtrics™ software (version 58,208 of the Qualtrics Research Suite, copyright 2014; Qualtrics, Provo, Utah, USA). The platform was set up to consist of a welcome page, an information page, a consent page, a demographics questionnaire, the assessment measures (described below), two 3-min videos (the cues), and a debriefing page. The neutral cue was a 3-min video, with audio, of two women making a cup of tea. The audio content was the two women chatting quietly about the process of making the tea. The gambling cue was a 3-min video, with audio, of the same two women playing poker machines in a hotel (pub) environment. The audio content included poker-machine sounds and the two women chatting about their poker-machine play, including a couple of moments of excited talk about wins. We note that there is no precedent regarding what to use as a neutral video-cue in the context of a poker machine gambling study. The 3-min presentation time followed the precedent of Kambouropoulos and Rock (2010) and Rock and Kambouropoulos (2009, 2012). As manipulation checks, the time that participants spent on the video-cue pages was timed, and participants were asked whether they had the sound on when watching the videos.

Altered State of Consciousness

Altered state of consciousness was assessed using the Altered State of Awareness (ASA) dimension of the *Phenomenology of Consciousness Inventory* (PCI; Pekala 1991). The PCI assesses 12 dimensions of phenomenological experience (e.g., Time Sense, Imagery, Volitional Control, Arousal, Altered State of Awareness). The ASA dimension consists of three pairs of questions rated on a 7-point dipole scale (0–6). The three pairs of questions are: (1) "My state of consciousness was not any different or unusual from what it ordinarily is" versus "I felt that I was in an extremely different and unusual state of consciousness"; (2) "My state of awareness was very different from what I usually experience" versus "My state of awareness was no different than usual"; and (3) "My state of awareness was not unusual or different from what it ordinarily is" versus "I felt that I was in an extraordinarily unusual and nonordinary state of awareness". The questions can be phrased either in the present tense (to assess a person's current state of consciousness) or in the past tense (to assess a person's state of consciousness during, say, the previous 3 min—e.g., during a period of cue exposure). A PCI-ASA-dimension score is calculated by averaging the three item-scores. The PCI has been found to have good criterion validity and internal consistency (Cronbach alphas have ranged from .70 to .90; Pekala et al. 1986). The PCI includes instructions for calculating a reliability-index score for responses on the PCI-ASA dimension. A score of 2 or less indicates that the participant responded consistently across the three PCI-ASA items (Pekala 1991). All participants in the present study had reliability-index scores of 2 or less.

Problem-Gambling Severity

Problem-gambling severity was assessed using the *Problem Gambling Severity Index* (PGSI; Ferris and Wynne 2001). This measure has been used in all recent studies in Australia (Delfabbro 2012). It consists of nine items rated on a 4-point Likert scale (0 = *never*; 1 = *sometimes*; 2 = *most of the time*; 3 = *almost always*), designed to assess symptoms of problem gambling in nonclinical populations. Questions pertain to the

previous 12 months and assess problem-gambling *behaviour* (e.g., "how often have you bet more than you could afford to lose?") and negative *consequences* (e.g., "how often have you felt that you might have a problem with gambling?"). A PGSI score is calculated by totalling the item scores. The PGSI classifies total scores as follows: 0 = no problems; 1–2 = low level of problems; 3–7 = moderate level of problems; and 8–27 = problem gambling. However, Walker and Blaszczynski (2010) have recommended that researchers use a cut-off score of *4* + to designate problem gambling. The PGSI has been found to have good criterion validity and internal consistency (e.g., Cronbach alphas have ranged from .84 to .97; Walker and Blaszczynski). The Cronbach alpha for the present sample was .84.

Urge

Urge was assessed using a visual analogue scale (VAS). The VAS ran horizontally across the width of the online page; its length was thus relative to the size of the screen on which it was viewed. Participants were asked, "In the present moment, how strong is your urge to play poker machines?" The VAS anchors were *no urge* (scored as 0) and *extreme urge* (scored as 10). Participants responded by clicking on the horizontal line (i.e., the *sliding bar* function in Qualtrics). VASs have been used often in alcohol cue-reactivity studies, and are considered to be a highly sensitive measure of urge (Rock and Kambouropoulos 2007).

Design

The present study consisted of a repeat-measures design with three phases: (1) baseline assessment; (2) presentation of the neutral cue; and (3) presentation of the gambling cue (see Rock and Kambouropoulos 2007). We note that not counterbalancing cue presentation is a standard aspect of cue-reactivity protocols (Monti et al. 1987; Rock and Kambouropoulos 2007); that is, it is argued that if the gambling cue was presented first, then any cue-reactivity could carry-over to the neutral cue (Rohsenow and Niaura 1999).

Procedure

After ethics approval was granted for the present study, notices were placed in a local newspaper and on Facebook. The notices briefly described the study and provided a link to the online platform. The online platform presented participants with the welcome page, the information page, the consent page, the demographics questionnaire, and the PGSI. Participants were then presented with the VAS (to assess baseline urge) and the PCI-ASA items (to assess baseline altered state of consciousness). Subsequently, the neutral-cue video was presented, followed by the VAS (to assess current urge) and the PCI-ASA items (to assess altered state of consciousness during the video). The gambling-cue video was presented next, followed by the VAS (to assess current urge) and the PCI-ASA items (to assess altered state of consciousness during the video). Next, participants were asked if they had the sound on during the videos. Finally, participants were presented with the debriefing page.

Results

Hypothesis 1

To determine if problem-gambling severity predicted cue-reactive urge to gamble (from neutral cue to gambling cue, controlling for baseline), a hierarchical multiple regression analysis was conducted. The criterion variable was urge change-score (gambling-cue VAS response minus neutral-cue VAS response). Baseline urge (baseline VAS response) was entered as a predictor in step 1. Problem-gambling severity (PGSI score) was entered as a predictor in step 2.

The hypothesis was supported: After controlling for baseline urge, problem-gambling severity predicted a statistically significant increase in urge from neutral cue to gambling cue ($b = 0.16$, 95 % CI [0.05, 0.27], $sr^2 = .19$, $\Delta R^2 = .19$, $p = .006$). For each unit-increase in PGSI score there was an average increase of 0.16 units on the VAS ($b = 0.16$), which accounted for 19 % of the unique variance in the increase of urge from neutral cue to gambling cue ($sr^2 = .19$).

Hypothesis 2

To determine if problem-gambling severity predicted cue-reactive altered state of consciousness (from neutral cue to gambling cue, controlling for baseline), a hierarchical multiple regression analysis was conducted. The criterion variable was altered state of consciousness change-score (gambling-cue PCI-ASA rating minus neutral-cue PCI-ASA rating). Baseline altered state of consciousness (baseline PCI-ASA rating) was entered as a

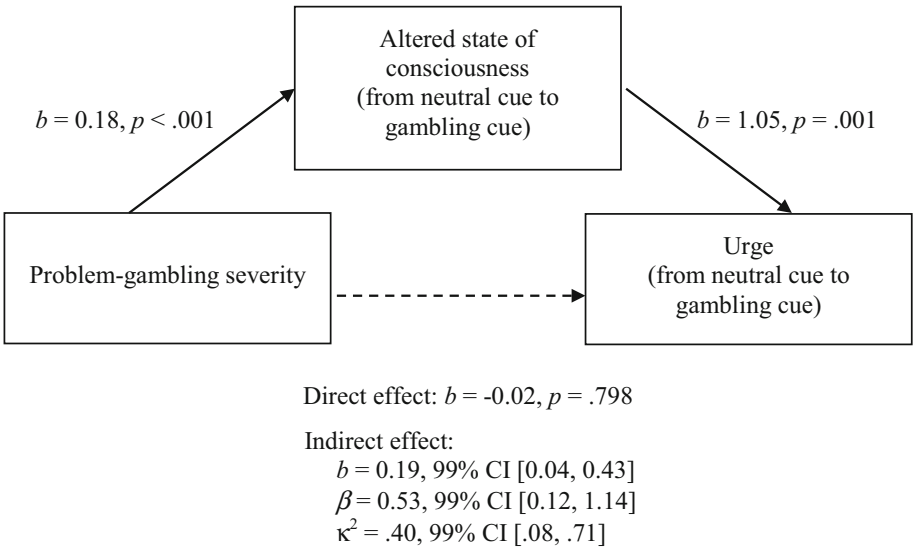

Fig. 1 Model of altered state of consciousness mediating the relationship between problem-gambling severity and urge. *Solid arrow-lines* represent statistically significant pathways, *dotted arrow-lines* represent statistically nonsignificant pathways, b = unstandardised regression coefficient, β = the completely standardised regression coefficient of the indirect effect (the index of mediation), CI = bias-corrected and accelerated bootstrapped confidence-intervals based on 5000 samples

predictor in step 1. Problem-gambling severity (PGSI score) was entered as a predictor in step 2.

The hypothesis was supported: After controlling for baseline altered state of consciousness, problem-gambling severity predicted a statistically significant increase in altered state of consciousness from neutral cue to gambling cue ($b = 0.18$, 95 % CI [0.13, 0.24], $sr^2 = .57$, $\Delta R^2 = .57$, $p < .001$). For each unit-increase in PGSI score there was an average increase of 0.18 units on the PCI-ASA dimension ($b = 0.18$), which uniquely accounted for 57 % of the unique variance in altered state of consciousness scores from neutral cue to gambling cue ($sr^2 = .57$).

Hypothesis 3

To determine if cue-reactive altered state of consciousness (from neutral cue to gambling cue) mediated the relationship between problem-gambling severity and cue-reactive urge (from neutral cue to gambling cue), an indirect effect analysis was conducted using model 4 in Hayes's (2013) PROCESS macro (version 2.13) in SPSS. The results of the analysis are presented in Fig. 1.

As shown in Fig. 1, the hypothesis was supported: Problem-gambling severity did not act directly on urge (the direct effect was nonsignificant, $p = .798$), but indirectly through altered state of consciousness (the indirect effect, $b = 0.19$, was significant, 99 % CI [0.04, 0.43]). Acting through altered state of consciousness, for each unit-increase in PGSI score there was an average increase of 0.19 units on the VAS ($b = 0.19$). The $\kappa^2 = .40$ statistic tells us that this indirect effect was 40 % of the maximum possible indirect effect that could have been found (Preacher and Kelley 2011).

Discussion

Although exposure therapies for poker-machine problem-gamblers (e.g., Oakes et al. 2008) are based on the theory that problem gamblers experience greater cue-reactive urge than non-problem gamblers (Baudinet and Blaszczynski 2013), the present study is the first to experimentally test this theory using a sample of poker-machine gamblers (*H1*). The hypothesis was supported; that is, in the present sample of poker-machine gamblers, problem-gambling severity statistically significantly predicted cue-reactive urge. This finding is important on the grounds that it is the first experimental evidence supporting the theoretical rationale underpinning exposure therapies for poker-machine problem-gamblers.

In addition, although qualitative studies have reported that poker-machine problem-gamblers experience a drug-like "high" (e.g., Oakes et al. 2012), the present study is the first quantitative study to experimentally test the hypothesis that poker-machine problem-gambling severity predicts cue-reactive altered state of consciousness (*H2*). The hypothesis was supported.

We note, of course, that statistical significance is not practical significance. Problem-gambling severity accounted for 19 % of the variance in cue-reactive urge, and 57 % of the variance in cue-reactive altered state of consciousness. These are medium and large effect-sizes, respectively, according to Cohen's (1988) guidelines. However, Cohen emphasises that effect sizes must be interpreted in context. In the present study, each one-unit increase in problem-gambling severity (PGSI score) was associated with an increase (from the

neutral cue to the gambling cue, controlling for baseline) of 0.16 units of urge (VAS response, bounded by 0 and 10) and 0.18 units of altered state of consciousness (PCI-ASA rating, bounded by 0 and 6). Or put another way: compared to participants with a PGSI score of 0, participants with a PGSI score of 8 (the threshold score for being a problem gambler, according to PGSI criteria) were likely to experience only 1.28 more units of cue-reactive urge, and 1.44 more units of cue-reactive altered state of consciousness. One might wonder whether increases and differences (i.e., effect sizes) of these magnitudes are of any clinical significance. Given that these results were obtained in the artificial context of an online study, they may well be. However, there are presently no guidelines that might be used to draw a conclusion either way.

The third hypothesis, that cue-reactive altered state of consciousness would mediate the relationship between problem-gambling severity and cue-reactive urge, was also supported. Indeed, the *direct* effect of problem-gambling severity on cue-reactive urge was nonsignificant by a rather large margin, and the magnitude of the mediation effect (i.e., the indirect effect) was 40 % of what it might possibly have been (κ^2)—a large effect, according to Preacher and Kelley's (2011) guidelines. Importantly, the experimental design was structured to assess altered state of consciousness for the period *during* cue exposure, and to assess urge immediately *after* cue exposure. Thus, the findings suggest that cue-reactive altered state of consciousness might be a major precursor to cue-reactive urge in poker-machine problem-gamblers. Similarly, Kambouropoulos and Rock (2010) argued that alcohol cues might cause some drinkers to re-experience the altered state associated with previous drinking, which might, in turn, facilitate urge to drink. The present findings lend support to the possibility that this causal pathway might occur in poker-machine gamblers in regards to poker-machine cues. Specifically, it may be that poker-machine cues trigger poker-machine problem-gamblers to re-experience something of the altered state that they previously experienced when gambling, and that this cue-reactive altered state of consciousness might play a significant role in causing them to experience cue-reactive urge to play poker-machines. Furthermore, it could be hypothesised that such re-experiencing of previous gambling events could lead to the activation of cognitive biases and cognitive distortions associated with these gambling events stored in long-term memory (Corney and Cummings 1985). Given that the operation of such cognitive biases has been implicated in the persistence of gambling behaviour (Corney and Cummings 1985; Tavares et al. 2003), the activation of such cognitive biases (e.g. illusory correlations, confirmation bias; Griffiths 1994) may lead to engaging in behaviour consistent with such heuristics. If so, this might suggest that interventions for problem gambling that fail to incorporate an exposure-based component may not be accessing such a cue-reactive altered state of consciousness. Given that the processes involved in such cue-reactivity may be central in the maintenance of gambling behaviour, the findings of this study highlight the need for research into psychological interventions to focus attention on understanding and addressing such cue-reactive altered states of consciousness.

Strengths, Limitations, and Suggestions for Future Research

A particular strength of the present study was that it included a neutral-cue control, and controlled for baseline. This has been the standard protocol in alcohol cue-reactivity studies (Rock and Kambouropoulos 2007), but is a more rigorous protocol than has been adopted in gambling cue-reactivity studies to date (e.g., Ashrafioun et al. 2012; Sodano and Wulfert 2010; Wulfert et al. 2009).

Given the characteristics of the sample, the results might reasonably be said to generalise to the following population: Men and women aged between 18 and 48, currently residing in Australia, whose preferred mode of gambling is poker-machines, and who play poker-machines at least twice a month. The spread of gambling severity in the sample was comparable to the spread that has been found among Australian poker-machine gamblers who gamble weekly (Productivity Commission 2010). However, one should bear in mind that the participants were a small number of self-selected volunteers who responded to a notice in a northern NSW newspaper and to a Facebook campaign initiated on the first author's personal Facebook page. This raises issues of potential sampling bias. In particular, it is possible that these self-selected volunteers differed from all the poker-machine gamblers who did not read the notices section of the northern NSW newspaper, or did not come across the Facebook campaign, or did not have access to the internet, or were not motivated to participate in an online study.

To determine whether the magnitudes of the observed effect sizes are of clinical significance, more studies need to be conducted, especially in situ. Studies that compared participants' cue-reactivity in analogue environments and in situ would be particularly informative towards developing a data base of what effect sizes are typical under a given condition.

The present study tested for the *presence* of altered state of consciousness, but did not assess what the phenomenological *content* of the altered state was (e.g., shifts in volitional control, rationality, negative affect). Future research could assess phenomenological content by administering the entire PCI, or by conducting semi-structured interviews designed to assess, for example, whether the cue-reactive altered state is similar to a during-play altered state. The administration of the PCI would allow for the evaluation of variables including mental imagery, recollection of memories, attention, positive and negative affect and arousal in response to gambling cues. Measuring such variables in response to gambling cues may further the understanding of the avenue through which poker-machine related cues increase the urge to gamble. Relatedly, cognitive distortions regarding the perceived randomness and independence of events have been implicated in the maintenance of gambling behaviours (e.g. Toneatto 1999). Future research may therefore seek to understand whether such cognitive distortions and biases in processing are influenced (i.e., fluctuate) according to the presence of poker-machine related gambling cues and cue-reactive altered state of consciousness. If this was the case, this could have significant implications for the manner in which psychological interventions (e.g., cognitive restructuring to address maladaptive gambling-related beliefs; Ladouceur et al. 2001) address such cognitive distortions.

Finally, future research might also explore whether cue-reactive altered state and urge are greater for poker-machine gamblers (in response to poker-machine cues) than for gamblers of other modalities (in response to cues associated with those modalities). One reason for thinking that this might be so is that poker machines may be programmed to issue rewards according to precisely calculated variable ratios and, as noted above, conditioned responses to such variable ratios are extremely resilient to extinction. If it were found that poker-machines have a unique power to trigger an urge-related altered state of consciousness, such a finding could have broad implications in the contemporary political debate over poker-machine regulation (see Productivity Commission 2010).

Conclusion

The findings in the present study support the view that as a poker-machine gambler's gambling problems become more severe, poker-machine cues are likely to trigger an increasingly intense, urge-related altered state of consciousness. If future, well-designed studies were to replicate and expand on the present findings, there is no telling how beneficial such research might be for improving exposure therapies and for providing political leverage to bring about more rigorous poker-machine regulation.

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