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RESEARCH REPORT

Physiological arousal and sensation-seeking in female fruit machine gamblers

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Abstract

Aims. *To examine changes in physiological arousal, as indexed by heart rate, during fruit machine gambling while controlling for the confounding effect of movement and as a function of winning and losing, and to examine relationships between sensation-seeking, self-reported arousal during gambling, heart rate during gambling and frequency of gambling.* **Sample, design and measurements**. *Heart rate and subjective arousal were recorded in a sample of 32 female fruit machine players before, during and after the gambling process. At baseline measures were taken of sensation-seeking, self-reported arousal during gambling and frequency of gambling. A simulation of the behaviour used to operate fruit machines was used during baseline measurement.* **Findings**. *Significant increases in heart-rate over movement controlled baselines were observed within participants during gambling, but only in those who won during play. No correlations between HR levels and subjective arousal were found. However, striking negative correlations between sensation-seeking and frequency of gambling, and between subjective arousal and frequency were present.* **Conclusions**. *Gambling alone is not enough to induce increases in HR levels for female fruit machine gamblers; the experience of winning or the anticipation of that experience is necessary to increase HR levels. In addition sensation-seeking appears to be negatively associated with this kind of gambling behaviour.*

Introduction

The role of both subjective and objective arousal in the maintenance of gambling behaviour and addiction has been the subject of a number of empirical investigations employing both self-report techniques outside the gambling environment (Commission on the Review of National Policy Towards Gambling in America, 1976; Wray & Dickerson, 1981; Dickerson & Adcock, 1987; Dickerson, Hinchy & Fabre, 1987; Griffiths, 1990; Coventry & Brown, 1993) and heart-rate (HR) monitoring methods during gambling activity in the field (Anderson & Brown, 1984; Leary & Dickerson, 1985; Dickerson & Adcock, 1987; Griffiths, 1993; Coventry & Norman, 1997, 1998). While the majority of these studies have reported significant increases in HR during gambling, there are two methodological difficulties which limit generalization to all gamblers and gambling forms. First, as Coventry & Norman (1997) have noted, most of these studies do not control adequately for movement during baseline readings. Lynch, Schuri & D'Anna (1976) have reported

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significant changes in HR over non-movement controls for isometric hand and foot exercises and Fahrenberg, Foerster & Wilmers (1992) have reported similar increases for handgrips, free speech and 100-watt exercise. As most gambling forms involve movement (e.g. placing bets), baseline controls (involving heart-rate) need to involve similar levels of movement to ensure that any increases during the gambling process are due to the excitement of gambling rather than motor activity. While Coventry & Norman (1997) do provide evidence of arousal increases using a suitable movement control baseline, they measured HR during off-course horse racing alone. The gambling literature is replete with evidence that gambling activities are not homogeneous (Coventry & Brown, 1993; Dickerson, 1993; Fisher, 1993) and therefore one has to be careful in generalizing from the Coventry & Norman findings to other types of gambling.

The other main problem with studies which have measured arousal during gambling (including the Coventry & Norman study) is that the participants have been almost exclusively male. Despite the fact that women make up a significant proportion of the gambling population (around one-third of pathological gamblers are female: Sommers, 1988; Volberg & Steadman, 1988), very little research has either studied the female gambler generally or the role of arousal in female gambling. In the United Kingdom, women gamble most frequently on fruit machines and bingo (Downes *et al.*, 1976; Kallick *et al.*, 1979), making it particularly important that arousal levels should be examined during these forms in the female population. While Leary & Dickerson (1985) included a small number of female participants in their poker machine study, they did not control adequately for motor activity during the recording of baseline readings. The present study therefore focused on the measurement of heart-rate in a sample of female fruit machine players while controlling for the possible confounding effects of movement during baseline measures.

Given that women also score lower on sensation-seeking than men (Zuckerman, Eysenck & Eysenck, 1978) any relationship between sensation-seeking, arousal and levels of gambling could be more striking than is the case in the male population. Zuckerman (1979) originally predicted that gamblers should be high sensation-seekers, but the evidence in the main has failed to support this prediction (Anderson & Brown, 1984; Dickerson, Hinchy & Fabre, 1987; Kuley & Jacobs, 1987; Blaszczynski, Wilson & McConaghy, 1989; Coventry & Brown, 1993; Coventry & Norman, 1997). However, these studies have again used predominantly male participants. The study therefore also measures sensation-seeking in female participants in order to evaluate Zuckerman's hypothesis in the female gambling population.

Method

Participants

Sixty-two potential participants were approached in a bingo hall and a local leisure hall. Of these, 32 participants agreed to take part and completed the data collection. All were female, and the mean age was 37 years (SD = 8.45).

Materials

HR was recorded at 5-sec intervals before, during and after the gambling process using a small ambulatory monitor (TYPE TP-200). This monitor employed a photo-plethysmograph clipped to the participant's earlobe, and provided a beat-to-beat display. Artefactual readings were indicated by a red error signal displayed by the monitor. These were calculated as those outside the upper and lower HR limits (usually the result of sudden movement or changes in light). The baseline involved monitoring HR for a period of 30 secs while each participant pressed a button on a calculator (thus controlling for movement). This method was chosen to simulate motor activity during fruit machine play as closely as possible. Single HR readings were also taken at the end of each trial, noting when a participant won or lost.

As well as HR recordings, participants were given a questionnaire to complete consisting of:

(a) questions relating to cash involvement in gambling, frequency of gambling behaviour and the number of gambling forms participated in;
(b) questions relating to loss of control as used previously (Dickerson, 1977, 1979, 1984; Dickerson *et al.*, 1987; Kuley & Jacobs, 1987; DSM-IV, American Psychiatric Association, 1994; Coventry & Norman, 1997, 1998). These included a question on chas-

ing: "When you are behind or losing, how often do you attempt to chase your losses? In other words, how often do you start placing more bets, or larger bets once you've had a few losses? (*never*, *occasionally*, *usually* or *nearly always*);

(c) a four-item subscale from the State portion of the Speilberger State–Trait Anxiety Questionnaire (Speilberger, Gorsuch & Lushene, 1979) as used previously by Coventry & Brown (1993) and Dickerson and colleagues (Leary & Dickerson, 1985; Dickerson & Adcock, 1987; Dickerson *et al.*, 1987). This scale was used as a measure of subjective arousal, and has been found to correlate with other measures of subjective arousal during gambling (Coventry & Brown, 1993). Participants were asked to "Imagine a situation where you are waiting for the wheels of a fruit machine to stop ... Please read each statement below and indicate how you usually feel when waiting for the wheels of the fruit machine to stop." The items used were *calm*, *tense*, *at ease* and *over-excited*;

(d) the Sensation Seeking Scale (SSS) Form V (Zuckerman, 1979). This is a 40-item forced-choice questionnaire comprising of four subscales of 10 questions. These are the Thrill and Adventure-Seeking scale, the Disinhibition scale, the Experience-seeking scale and the Boredom Susceptibility scale.

Procedure

Participants were chosen at random from two betting establishments (a bingo hall and a snooker hall) in England. Both agencies were approached beforehand and the cooperation of staff was secured. Times of day and days of the week were chosen systematically to ensure that a variety of customers were sampled, and the experimenter frequented the office for a few days prior to commencing the study to further heighten unobtrusiveness. Participants were never approached during play. Each participant was asked if she would mind having her HR monitored while playing the fruit machine. If participants agreed, the session began. All participants, provided they made no objection, were asked to gamble on a fruit machine chosen by the experimenter (a machine called "Casino", which had a 72% pay-out rate). Participants were required to use their own money and were instructed to behave as they normally would during the session. They were also instructed to refrain from smoking and drinking alcohol before and during recording. In addition, the experimenter was careful to select participants as far as possible who had not been smoking, drinking or playing immediately before being asked to participate. A baseline heart-rate for each participant was obtained (out of sight of the machine). HR readings were recorded by the experimenter at 5-sec intervals during the gambling session. The experimenter stood a few feet behind the participant throughout the session, and no communication was made between experimenter and participant during the session. Single HR readings were also taken at the end of each trial, recording whether a participant won or lost. Other information such as amount of win was also noted. One minute after playing each participant's HR was recorded for a further 30 secs at 5-sec intervals. The questionnaire was then given out for completion while each participant was still in the presence of the experimenter.

Results

Overall, 56% of participants ($N = 18$) reported playing fruit machines at least once a week. Thirty-four per cent ($N = 11$) reported chasing and 6% ($N = 2$) admitted to having a problem controlling their level of gambling. Forty-seven per cent ($N = 15$) reported gambling more than intended and 6% ($N = 2$) admitted to trying to stop unsuccessfully in the past. The number of gambling forms participated in ranged from two to six forms.

All thirty-two participants completed the short form of the State portion of the State–Trait Anxiety Questionnaire. The mean score was 8.59 (SD = 2.01, range 4–12). The Zuckerman sensation-seeking scale was also completed by all participants. The mean total score was 16.22 (SD = 5.16, range 7–26). The mean subscale scores were 5.47 for TAS (SD = 2.21, range = 1–8), 4.81 for ES (SD = 2.02, range 0–7), 2.75 for Dis (SD = 1.51, range = 0–5) and 3.22 for BS (SD = 1.77, range = 0–7).

Table 1 illustrates the relationship between sensation-seeking, arousal and questions relating to loss of control. Significant negative correlations were found between the STAI scores and frequency of gambling, and between total SSS scores and frequency of gambling.

Table 1. *Pearson product–moment correlations*[a] *(two-tailed significance)*

Variable	SSS	Frequency of gambling	No. of forms participated in	Chasing	STAI	HR baseline	HR during play
Frequency of gambling	*−0.59***						
No. of forms participated In	0.19	*−0.01*					
Chasing	0.06	*0.18*	−0.15				
STAI	0.34	*−0.42***	0.11	0.32			
HR baseline	0.02	*−0.10*	0.02	0.11	−0.22		
HR during play	−0.10	*0.08*	0.17	0.10	−0.04	0.65**	
HR after play	−0.03	*−0.14*	0.08	0.24	0.08	0.73**	0.90**

*$p < 0.05$; **$p < 0.01$. HR = heart rate.
a Spearman correlations were used for the data with a non-normal distribution.

The data recorded for heart-rate allowed the calculation of average heart-rate scores before, during and after the gambling process. Fourteen participants won at least one of the trials during play, and their HRs were compared to those who did not win during the gambling process using a two-way analysis of variance. The between-subjects factor was winning/losing, and the within-subjects factor was period during the gambling process (three levels). Although no main effect of winning versus losing was found, a main effect of period was found [$F(2, 60) = 4.97$, $p < 0.05$]. Follow-up analysis using least significant difference (LSD) tests revealed that mean HR during play was significantly higher than the mean HR both during the baseline ($p < 0.01$) and after gambling ($p < 0.01$). No significant difference between HR immediately before and after gambling was found. There was also a significant interaction between winning/losing during gambling and period [$F(2, 60) = 5.12$, $p < 0.01$]. This interaction is displayed in Fig. 1. Follow-up analysis using LSD tests revealed that the mean HR for the winning group was significantly higher than that of the losing group both during gambling ($p < 0.0001$) and after the gambling process ($p < 0.05$). Additionally, significant HR increases between the baseline and during and after play were only present for the winning group, not for the losing group.

Participants were also partitioned into high- and low-frequency gamblers. High-frequency players were defined as those who played fruit machines more than once a week, and low-frequency players less than once a week. This produced 18 high-frequency and 14 low-frequency players. A two-way analysis of variance was conducted on the HR data. The between-subjects factor was frequency (two levels) and the within-subjects factor was period (three levels). There was no main effect of frequency [$F(1, 30) = 0.04$, $p > 0.05$] and no significant interaction [$F(2, 60) = 1.03$, $p > 0.05$].

While HR increases were present during gambling, there was no significant correlation between STAI scores and arousal during gambling (see Table 1). Additionally, no significant correlations were found between HR during gambling and any of the variables associated with loss of control.

Discussion

The establishment of a baseline in this study controlling for motor activity in a similar fashion to the procedure used by Coventry & Norman (1997) leads to a confirmation of the existence of HR increases during gambling, and provides evidence for significant HR increases during fruit machine gambling in women, in particular. Significantly higher HR levels during play were found compared to either a baseline or immediately after the gambling session had finished. It should be noted, however, that the levels of increase observed were much lower than those reported for (predominantly) male samples during fruit machine play (Leary & Dickerson, 1985; Griffiths, 1993), or across other gambling forms (Anderson & Brown, 1984; Dickerson & Adcock, 1987; Coventry & Norman, 1997). For example, Leary & Dickerson (1985) found a mean increase of 13.5 beats per minute for male fruit machine players during play. This difference could be linked to gender, and highlights

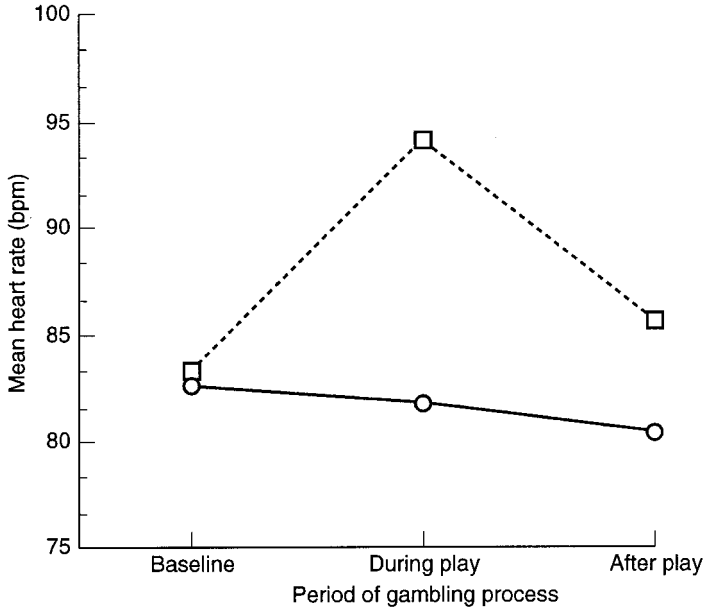

Figure 1. *Interaction between heart rate during gambling and winning/losing.* ○ *Gamblers who lost;* □ *gamblers who won.*

the need for more research to examine the behaviour and motivation of the female gambling population as a whole.

While HR increases were present during play in the sample as a whole, the comparison of the participants who won during the session with those who lost is of particular interest. The significant interaction between winning/losing and period revealed that the mean HR for the winning group was significantly higher than that of the losing group both during and after gambling. Importantly, follow-up analysis also revealed that significant increases in HR were only present in the winning group. It would appear that gambling itself is not significantly arousing, but that winning is an important ingredient which is associated with HR increases. However, this finding may be gender-specific and/or form-specific given that Coventry & Norman (1997) found no such prolongation of increased arousal in a sample of male off-course horse racing bettors after winning a horse race.

The role of sensation-seeking in the explanation of continued gambling does not appear to be supported in the present study. In fact, the significant negative correlation between the SSS total score and frequency of gambling directly contradicts Zuckerman's (1979) hypothesis. As Dickerson *et al.* (1987) and Coventry & Brown (1993) have argued, gambling forms such as off-course betting and fruit machine play may be the choice of lower sensation-seekers—high sensation-seekers may well seek out other more exciting and risky activities.

This study is also notable by the lack of significant correlations between subjective measures of arousal and HR during the gambling process. Furthermore, in this study subjective arousal correlated negatively with frequency of gambling. Following Coventry & Norman (1997), this result further indicates the need for the development and use of more sophisticated techniques to measure subjective arousal, and the need to synchronize objective and subjective measurements. In particular, such measures should be able to distinguish between positive and negative subjective arousal increases (see Thayer, 1989).

In conclusion, this study provides evidence for the importance of wins as reinforcing elements during the gambling process. Furthermore, the results indicate that, for female fruit machine players at least, gambling is not associated with increases in HR unless winning occurs. Coventry & Norman (1998) have proposed that the order in which people experience wins and losses may

be an important determinant of loss of control, and the higher HR levels associated with winning lends some support for this view. The importance of early wins as a risk factor for the development of addictive levels of gambling is widely recognized (e.g. Custer & Milt, 1985). It would therefore be particularly interesting for future studies to examine arousal during early and late losses in order to evaluate whether early wins have greater reinforcing significance.

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