

Running Head: PHYSIOLOGICAL AROUSAL DIFFERENCES

Physiological Arousal Differences Among Frequent and Infrequent Gamblers: A Review

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Abstract

Literature on the differences between frequent and infrequent gamblers is reviewed in two areas: physiological arousal differences during regular gambling sessions and the effect of winning. There are significant heart rate arousal differences among frequent and infrequent gamblers. Winning while gambling is associated with an increase in heart rate among frequent gamblers but it is not associated with an increase in heart rate among infrequent gamblers. It is concluded that there are differences in patterns of arousal among frequent and infrequent gamblers, but further research is needed to determine whether the results should be generalized outside the laboratory.

Gambling in Canada has undergone significant growth in the past thirty years. The explosion of gambling venues has brought with it both benefits and costs (Frish, Fraser & Govoni, 2003; Korn, 2000). As Frish et al. (2003) state, gambling can provide increased government revenues and economic benefits as well as a new range of recreational opportunities; however, problem gambling can negatively impact an individual financially, socially, occupationally, emotionally and physically. For this reason, there has been a growth in interest in investigating what the consequences of gambling are and why some people develop a gambling disorder.

There might be a problem of ecological validity when research is conducted in the laboratory. Anderson and Brown (1984) examined the differences, if any, that might arise from laboratory versus field studies. They attempted to determine what aspects of blackjack are arousing, and to what extent, in a real casino. They compared two conditions in this study, a laboratory and a real condition, using two samples, a student sample and a gambler sample. Heart rate increases, gambling behavior and events such as 'stake decision time' were recorded as subjects played blackjack. The game was split into three periods to get a valid measure of heart rate increases. The three time periods were: (a) between the dealer's request to place their stakes and the first card dealt, (b) between first card dealt out and the subject receiving two cards, and (c) between two cards dealt and when the subjects' fate was decided. Anderson and Brown hypothesized that the level of non-specific arousal in regular gamblers would differ from the laboratory to the real gambling situation. A significant difference in mean heart rate increases was found between real and artificial casinos. This study casts doubt on laboratory gambling as a valid generalization of the real gambling situation because the researchers found that

participants react differently in the artificial casino than in the real casino. Therefore, this research suggests that any findings based on laboratory research will ultimately need to be validated in actual gambling situations.

Over the past two decades, researchers have examined how frequent and infrequent gamblers respond to winning and losing. This is usually measured using heart rate as an indicator of physiological arousal. Ladouceur, Sévigny, Blaszczynski, O'Connor and Lavoie (2003) argue that a person's level of arousal may be the reason behind why people continue to gamble and it may affect the length of each gambling session. This could mean that it is simply the excitement of the game that keeps people gambling.

The results from studies of arousal are inconclusive. Some studies have found a difference in physiological arousal between frequent and infrequent gamblers during and after play (Blanchard, Wulfert, Freidenberg & Malta, 2000; Leary & Dickerson, 1985; Sharpe, Tarrier, Schotte & Spence, 1995) while others have not found a difference (Coulombe, Ladouceur, Desharnais, & Jobin, 1992; Coventry & Norman, 1998). Some studies (Anderson & Brown, 1984; Coventry & Constable, 1999; Coventry & Hudson, 2001; Coventry & Norman, 1998; Dickerson & Adcock, 1987, Leary & Dickerson, 1985; Moodie & Finnigan, 2005) have examined the effect of winning and losing on arousal among frequent and infrequent gamblers and have found a significant correlation between arousal, the frequency of gambling, and the amount won. However, Coventry and Norman (1997) did not find a relationship between winning or losing and arousal. The goal of this review therefore is to examine progress to date in understanding the effect of physiological arousal and the role of winning versus losing among frequent and

infrequent gamblers.

Arousal Differences among Frequent and Infrequent Gamblers

A common finding is that most frequent gamblers experience a higher increase in heart rate during gambling than infrequent gamblers (Blanchard, Wulfert, Freidenberg & Malta, 2000; Coulombe, Ladouceur, Desharnais, & Jobin, 1992; Coventry & Norman, 1998; Leary & Dickerson, 1985; Sharpe, Tarrier, Schotte, & Spence, 1995). To demonstrate this effect, Leary and Dickerson (1985) recruited 44 high and low frequency players for a two-factor (frequency of poker machine playing and provocation) mixed design with repeated measures of arousal. The subjects participated in one of two provocation conditions: (a) they listened to traffic noise on tape and were requested to count the number of car horn sounds they heard, or (b) subjects were asked to listen to a tape of poker machines and count the number of machine win noises they heard. After the provocation condition, subjects then played on poker machines. Heart rate arousal was measured during baseline, provocation, and play conditions. The purpose was to examine differences between frequent and infrequent gamblers' physiological arousal and subjective arousal. There was increased physiological arousal but no increase in subjective arousal found for infrequent players, yet subjective arousal accompanied the increase in physiological arousal among frequent players. Playing was associated with increases in physiological arousal in both groups, but significantly greater arousal was shown by frequent players as opposed to infrequent players.

Two studies took a different approach from the previous study to measure cue-specific arousal in gamblers. Sharpe, Tarrier, Schotte and Spence (1995) included 21 male and 17 female participants in their study; 13 were problem gamblers, 12 were high-

frequency gamblers, and 13 were low-frequency gamblers. Following a twelve-minute adaptation period, five experimental situations were presented in random order. The five experimental situations were: (a) a neutral task, (b) a videotape of a horse-race, (c) a videotape of a poker-machine being played, (d) a poker machine videotape with instructions to count the number of occurrences of a payout observed on the tape, and (e) an image of a personally relevant previous experience of poker machine playing. Each task took two minutes with a two minute baseline period both before and after the task, during which Sharpe et al. observed physiological and subjective reactions to each trial. They hypothesized that problem gamblers would demonstrate a higher increase in physiological arousal to gambling cues compared to high frequency social gamblers, but these high frequency social gamblers would show higher increases in physiological arousal to the gambling cues compared to matched controls of low frequency social gamblers. Gambling-related stimuli were associated with increases in arousal in the absence of the behavior of gambling for all of the groups. Increases in arousal were generally found to be greater among problem gamblers than the control groups, especially for the videotaped stimuli. Problem gamblers specifically showed higher arousal increases to both the poker machine video stimuli and the personally relevant image of previous poker machine playing. However, the high and low frequency social gamblers only became aroused in the personally-relevant situation. This demonstrates that visual cues and personal relevance to a specific gambling situation may be an important determinant of the arousal experienced.

Blanchard, Wulfert, Freidenberg and Malta (2000), examined seven men with gambling problems and a control group of seven men matched on age, but who denied

engaging in regular gambling. The participants were exposed to experimental manipulations that consisted of performing mental arithmetic, observing two gambling scenes, and observing a fear scene, with a baseline between each manipulation. For the experimental group, the gambling scenes and the fear scene were individualized audiotapes based on the members' preferred form of gambling, and on a situation each described as fearful during the interview process. For each of the control subjects, one of the gamblers' tapes was randomly selected for the assessment. The arousal assessment measurement was heart rate. Blanchard et al. found that gamblers showed a significantly greater heart rate increase to descriptions of their preferred gambling activity than did age and gender matched non-gamblers. No difference in heart rate was found between frequent and non-gamblers during the mental arithmetic condition or the fear scene. This lends further support to the notion that personally relevant gambling situations might contribute to the level of arousal experienced in gamblers.

These studies clearly support the suggestion that frequent gamblers experience greater increases in arousal than infrequent gamblers. However, some research has not found this. In a 2 x 5 design, Coulombe, Ladouceur, Desharnais and Jobin (1992) studied twelve male regular gamblers and twelve occasional gamblers. Heart rate arousal and verbalizations made from each participant about their playing strategy during real and simulated video poker games was measured. After each poker game, the participants of this study completed a four item sub-test of the State Anxiety Scale to evaluate the relationship between physiological arousal and subjective arousal by determining whether participants felt calm, tense, quiet or overexcited. Coulombe et al. hypothesized that regular gamblers would show greater heart rate increases than occasional gamblers,

and that there would be a positive relationship between heart rate and the number of verbalizations made by the subjects. They did find that the more a gambler denied the role of chance as the determinant of game outcome, and therefore made more verbalizations, the more aroused the gambler became. However, what they failed to confirm was that regular gamblers demonstrate a higher level of arousal than occasional gamblers. It is possible that the simulated video poker games were not the participants preferred form of gambling and therefore might explain why a significant effect was not found.

Coventry and Norman (1998) examined the arousal differences among frequent and infrequent gamblers by means of a computer-based task and were also unable to find a significant difference between the gambling groups. Fifty-four male and female participants were presented with the computer based gambling task in order to examine the relationship between arousal, erroneous verbalizations and the illusion of control. This was a between-subjects design consisting of ascending, random and descending conditions, in which participants won either mainly towards the end of the task, randomly throughout the task, or mainly at the start of a task. The heart rate of each participant was monitored before and during the computer-based gambling task, and at the end all participants were asked to complete the Sensation-Seeking Scale. Coventry and Norman had hypothesized that arousal would be greater among frequent gamblers as opposed to infrequent gamblers, but their findings were inconclusive. They found no significant difference between the types of verbalizations made and arousal. No relationship between illusion of control and arousal and the types of verbalizations made was found, and no difference on any measure was found between frequent and infrequent gamblers.

These studies present contradictory evidence. The research by Leary and Dickerson (1985), Blanchard et al. (2000) and Sharpe et al. (1995) clearly demonstrate that a greater increase in heart rate arousal is present among frequent gamblers as opposed to infrequent gamblers. However, research by Coulombe et al. (1992) and Coventry and Norman (1998) could not conclude that such a difference exists between frequent and infrequent gamblers. The difference in findings could simply have occurred because Coulombe et al. and Coventry and Norman failed to have a non-gambling control group in their designs, whereas most of the other studies did use a non-gambling control group. Or it could be that personally relevant gambling situations are what are required for frequent gamblers to experience a greater increase in heart rate arousal as opposed to infrequent gamblers.

Effects of Winning versus Losing on Arousal Differences among Frequent and Infrequent Gamblers

Past research demonstrates that, in general, when people win a gamble their heart rate increases (Anderson & Brown, 1984; Coventry & Constable, 1999; Coventry & Hudson, 2001; Coventry & Norman, 1998; Dickerson & Adcock, 1987, Leary & Dickerson, 1985; Moodie & Finnigan, 2005). Dickerson and Adcock (1987) examined two previous studies, one by Langer (1975) and the other by Anderson and Brown (1984), in order to compare the effects of winning and losing on arousal in frequent and infrequent gamblers. Langer conducted his study in a laboratory setting; participants had an opportunity to win or lose on a commercially available machine. Heart rate was measured by a two-channel polygraph and subjective measures of arousal were recorded by means of a questionnaire. Anderson and Brown had participants play under direct

observation in a real club setting and subjective arousal, the illusion of control and subject's persistence to continue playing were recorded. Dickerson and Adcock hypothesized that subjective and physiological arousal plays an important role in gambling persistence. Based on these two studies, they concluded that frequent players become more aroused than infrequent players when gambling on poker machines and that the decision to continue playing, even to the point of spending more time and money than planned, may have been determined by the continued experience of increased arousal.

Coventry and Constable (1999) examined changes in physiological arousal as a function of winning and losing by observing participants play fruit-machines. In this study, heart rate was recorded in a sample of 32 female fruit machine players at five-second intervals before, during and after the game. Single heart rate readings were also taken at the end of each trial, with the researcher specifically noting when a participant won or lost. Participants were required to use their own money, and were given a questionnaire to complete in order to determine subjective arousal at the end of the gambling task. In this study, the mean heart rate for the winning group was significantly higher than that of the losing group both during and after gambling. However, no correlations were found between heart rate levels and subjective arousal. The interesting finding is that the heart rate of women increased during play over the baseline trials only when a win occurred in the game, suggesting that women play to win more than for the enjoyment of the game.

To extend the previous study and to include men into the results, Coventry and Hudson (2001) examined gender differences in heart rate in relation to winning versus losing. A total of 42 participants, 22 males and 20 females, had their heart rate and

subjective arousal measured before, during, and after the gambling process. The experimenter recorded heart rate readings at five second intervals during the three minute gambling session on the fruit machines. Heart rate levels were much higher for winners than losers, but there were no gender differences. As in the study by Coventry and Constable (1999), female gamblers who won experienced arousal increases.

Moodie and Finnigan (2005) employed a between-subjects design, with a total of three experimental groups: (a) frequent gamblers, (b) infrequent gamblers, and (c) non-gamblers, giving a final sample of fifty four males and nine females. This study also took place in an actual gambling setting, and in order to obtain a measure of arousal associated with both the anticipation and outcome of each shot on the fruit machine, heart rate was recorded before, during and after each of the twenty shots. Moodie and Finnigan expected that wins would be associated with increased arousal. Frequent gamblers showed significantly greater arousal compared with infrequent gamblers, and winning increased arousal for frequent gamblers during play more than for infrequent gamblers'. Also, the amount won influenced arousal levels for both frequent and infrequent gamblers, with those winning the greatest amounts having the greatest increases in arousal.

The previous studies have all examined whether or not winning versus losing affects physiological arousal among frequent and infrequent gamblers differentially. All of the researchers concluded that, in general, when people win a gamble their heart rate increases; however more of an arousal increase is present among frequent than infrequent gamblers. Rather than just looking at the arousal differences between winning versus losing, some studies also investigated whether there was an effect of having an incentive

while gambling on the arousal experienced between frequent and infrequent gamblers.

In an investigation of poker machine players, Dickerson, Hinchy, England, Fabre and Cunningham (1992) recorded heart rate, play rate, winnings, subjective arousal and expectations of winning for five male and five female high frequency players. The sessions in this study began with a pre-play interview and assessment while the heart rate electrodes were fitted. During poker machine play, the observer recorded the number of plays per minute, the number of small and big wins per minute, heart rate, and breaks taken by each participant. Persistent gambling was studied as a function of the reinforcement of arousal during normal poker machine playing sessions. During the gambling session, experienced players showed a slight increase in physiological arousal as compared to infrequent gamblers who did not experience any physiological arousal. Frequent gamblers' also did not report high levels of subjective arousal. The participants did experience moments when they felt the poker machine was about to pay out (expectation of winning), but these feelings were not associated with play rates or the termination of a gambling session. Rather, wins affected play rate for up to three minutes, with small wins elevating play rate and larger wins interrupting play rate.

Ladouceur et al. (2003) selected 34 occasional and regular male and female video lottery players who were randomly assigned to one of two conditions: high winning expectancy and low winning expectancy. Problem and pathological gamblers were identified for exclusion by asking each participant to complete the *South Oaks Gambling Screen (SOGS)* before participants were assigned to each condition, with the cut-off *SOGS* score being four or more. The *SOGS* is a 20-item self-report scale in which each item scores one point. The scale has adequate reliability and validity and is used in

clinical studies to classify problem gamblers (Cox, Enns, & Michaud, 2004; Oliveira, Silva, & daSilveira, 2002). A total of one hundred games were played by each participant with eight periods used for measuring heart rate levels. Two phases, consisting of fifty games each, were used for both conditions. The first phase (familiarization) measured heart rate at three different points. The second phase (expectancy modulation) measured heart rate at five points. The participants in the high expectancy condition were told that they could win forty dollars. Participants in the low expectancy condition could not win or lose any actual money. Ladouceur et al. proposed that winning expectancy is a significant factor influencing arousal. They found that even though the low expectancy group did experience an increase in heart rate while playing the game, it was only modest when compared to the increased heart rate experienced by the high expectancy group after being informed that they could win money.

The results show that with all other variables held constant, the presence of an incentive does increase the arousal experienced in gamblers. This supports the hypothesis that having an incentive for gambling (such as money) could be a factor in the development of a gambling problem.

Discussion

Over the past two decades, researchers have examined the physiological arousal differences that might be found between frequent and infrequent gamblers. One suggestion has been that what keeps a person gambling is the level of arousal experienced just before, during and after play (Ladouceur et al., 2003). Many of the studies presented here have found a significant difference between frequent and infrequent gamblers on measures of physiological arousal, mainly heart rate arousal. These studies support the

proposal that a greater increase in heart rate is present among frequent gamblers than among infrequent gamblers (Blanchard et al., 2000; Dickerson et al., 1992; Leary & Dickerson, 1985; Sharpe et al., 1995).

The studies examining the effects of winning versus losing on physiological arousal, that compare frequent and infrequent gamblers, consistently demonstrate that for frequent gamblers, winning is associated with an increase in heart rate. Ladouceur et al. (2003) suggest that monetary gain might be responsible for the continued gambling practices of people because that is when heart rate arousal is at its peak. Other studies have provided support for Ladouceur et al.'s suggestion (Coventry & Constable, 1999; Coventry & Hudson, 2001; Moodie & Finnigan, 2005).

There is a limitation to the studies on physiological arousal differences between frequent and infrequent gamblers' and the role of winning versus losing: most research presented here were experiments of short duration. The recording times were also short, usually ranging from three to five minutes per gambling session.

There is evidence that there are differences in the physiological arousal (specifically heart rate arousal) of frequent and infrequent gamblers. It is also evident that winning while gambling is associated with an increase in heart rate, especially among frequent gamblers. Research also shows that the presence of an incentive affects the arousal experienced in gamblers; however, further research is needed to determine what the specific cues or reasons behind this arousal might actually be. It would also be interesting to see whether or not there is an interaction between an incentive being present in a gambling situation and the frequency of gambling.

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Running Head: EFFECT OF OUTCOME

Effect of Outcome on Arousal: Relation to Gambling Frequency and Incentive

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Abstract

Previous research has shown that frequent gamblers experience greater heart rate increases when winning than infrequent gamblers do. Male and female undergraduate students played a computer game of chance, with or without an incentive. Heart rate was measured to determine whether having an incentive affected arousal. The *South Oaks Gambling Screen* (SOGS) was administered to identify frequent gamblers. It was hypothesized that there would be an interaction between the effect of the incentive and whether the person was a frequent or infrequent gambler. Results were in the predicted direction but no significant differences between conditions were detected. This failure to replicate previous findings will be discussed.

Effect of Outcome on Arousal: Relation to Gambling Frequency and Incentive

In Canada gambling has undergone significant growth in the past thirty years. The explosion of gambling venues has brought with it both benefits and costs (Frish, Fraser & Govoni, 2003; Korn, 2000). As Frish et al. (2003) state: on the positive side, gambling can provide increased government revenues and economic benefits, as well as a new range of recreational opportunities which are used by many people. However, problem gambling can negatively impact an individual financially, socially, occupationally, emotionally and physically. For this reason, a growth in interest has been sparked among researchers to investigate what exactly the consequences of gambling are and what might be behind why some people develop a gambling disorder.

Past research clearly demonstrates that, in general, when people win a gamble, their heart rate increases (Anderson & Brown, 1984; Coventry & Constable, 1999; Coventry & Hudson, 2001; Coventry & Norman, 1998; Dickerson & Adcock, 1987, Leary & Dickerson, 1985; Moodie & Finnigan, 2005).

Over the past two decades, researchers have used physiological arousal, usually measured by heart rate, not only to examine the differences between winning and losing a game, but also to see whether the presence of an incentive affects the experience of gambling among frequent and infrequent gamblers. These are important considerations in the field of gambling research because they could demonstrate that people who do experience a heart rate increase during a gambling activity might be more likely to gamble more frequently and be willing to spend more time and money on gambling. This could lead to an explanation of why some people become problem gamblers while others do not (Ladouceur, Sévigny, Blaszczynski, O'Connor & Lavoie, 2003). In other words,

having a high degree of reactivity to arousal in a gambling situation might predispose some people to problem gambling.

Coventry and Constable (1999) examined changes in physiological arousal as a function of winning and losing by observing participants play fruit machines. In their study, heart rate was recorded in a sample of 32 female fruit-machine players at five second intervals before, during and after the game. At the end of each trial single heart-rate readings were taken and it was noted whether a participant won or lost. Participants were required to use their own money, and were given a questionnaire to complete in order to determine subjective arousal at the end of the gambling task. The winning group had a significantly higher mean heart rate than the losing group, both during and after gambling. However, no correlations were found between heart rate levels and subjective arousal, indicating that some people can be unaware of their own heart rate increase. Perhaps the findings of this study demonstrate that heart rate is a more sensitive measure of arousal than subjective reports. Those who win experience what will be called a “win rush effect”, that is, an increase in heart rate that occurs with winning.

With all other variables held constant, the presence of an incentive affects the arousal experienced in gamblers (Ladouceur et al., 2003). Ladouceur et al. proposed that winning expectancy is a significant factor influencing arousal. Potential participants completed the *South Oaks Gambling Screen (SOGS)*. Problem and pathological gamblers were excluded from this study. The cut-off *SOGS* score was four or more. The *SOGS* is a 20-item self-report scale in which each item scores one point. The scale has adequate reliability and validity and is used in clinical studies to identify problem gamblers (Cox, Enns, & Michaud, 2004; Oliveira, Silva, & deSilveira, 2002). Thirty-four male and

female occasional and regular players of a video lottery were randomly assigned to one of two conditions: high winning expectancy and low winning expectancy. A total of one hundred games were played by each participant with eight periods used for measuring heart rate levels. Two phases, each consisting of fifty games, were used for both conditions. In the first phase (familiarization), heart rate was measured at three different points. In the second phase (expectancy modulation), heart rate was measured at five points. The participants from the high expectancy condition were told that they could win forty dollars. Participants in the low expectancy condition could not win or lose any actual money. Ladouceur et al. found that even though the low expectancy group did experience an increase in heart rate arousal while playing the game, it was only modest when compared to the heart rate arousal the high expectancy group experienced after being informed that they could win money. These results support the notion that having an incentive for gambling (such as money) could be a factor in becoming a problem gambler. Perhaps the bigger an incentive is for a gambler, the bigger the win rush (heart rate increase) experienced will be, an effect that will be called the “incentive effect”.

A finding is that most frequent gamblers experience a higher increase in heart rate while gambling than do infrequent gamblers (Blanchard, Wulfert, Freidenberg, & Malta, 2000; Coulombe, Ladouceur, Desharnais, & Jobin, 1992; Dickerson et al., 1992; Leary & Dickerson, 1985; Moodie & Finnigan, 2005; Sharpe, TARRIER, Schotte, & Spence, 1995). To demonstrate this effect, Leary and Dickerson (1985) recruited 44 high and low frequency players for a two factor (frequency of poker machine playing and provocation) mixed design with repeated measures of arousal. The subjects participated in one of two provocation conditions: (a) they listened to traffic noise by tape and were requested to

count the number of car horn sounds they heard; (i.e., low gambling provocation) or (b) subjects were asked to listen to a poker machine being played and count the number of “win” noises they heard (i.e., high gambling provocation). After the provocation condition, subjects played on poker machines. Heart rate arousal was measured during baseline, provocation and play conditions. The purpose was to examine differences between frequent gamblers’ and infrequent gamblers’ physiological arousal and subjective arousal. Playing was associated with increases in physiological arousal in both groups, but significantly greater arousal was shown by frequent players as opposed to infrequent players. This study, among others, demonstrates that frequent gamblers show a larger heart rate increase than infrequent gamblers while gambling, which will be called the “frequency effect”. Another difference was also found because although infrequent players had no increase in subjective arousal, subjective arousal paralleled the increase in physiological arousal for frequent gamblers.

It is clear that in general, when people win a gamble, their heart rate goes up (a win rush effect). It is also evident that with other things being equal, the bigger the incentive, the bigger the win rush will be (the incentive effect). Furthermore, research demonstrates that most frequent gamblers show a larger win rush than infrequent gamblers (a frequency effect). What is being proposed here is that frequent gamblers will show a bigger incentive effect than infrequent gamblers. That is, there will be an interaction between the incentive effect and the frequency effect. This would suggest the possibility that a high degree of reactivity to arousal in a gambling situation might contribute to an individual’s disposition to gamble. Therefore, the heart rate levels of each participant were examined while they played a computer game (looking specifically

at their heart rate when they won and lost). The presence or absence of an incentive was manipulated by the computer game instructions. The heart rate findings were correlated with each participants score on the *SOGS* to examine possible related variables.

Method

Participants

Participants were male and female undergraduate students at Algoma University College. The students were volunteers; however some participated for class credit. After signing up for a session time, participants were instructed to meet individually in an office at Algoma University College.

Apparatus

The game screen showed three boxes: the three boxes were all initially black, and on each trial one box would turn red. Subjects had to click on the box that they thought would turn red on the next draw. The sequence of winning and losing trials was pre-programmed so that no matter what choice participants made, they won half the time and lost half the time.

A heart rate monitor made by the *Polar Company*, model number FS1, measures accurate electrocardiogram (EKG) heart rate in beats per minute.

The *South Oaks Gambling Screen* (SOGS) is a twenty-item screening measure that asks participants to rate their gambling habits (see Appendix A). This measure determines the degree to which an individual is disposed to participate in gambling. A score of five or greater places a person at the problem gambling level, whereas a score of one to four indicates a person could have some problems with gambling and a score of zero means there is no problems with gambling at all.

The subjective arousal questionnaire determined what participants felt subjectively while playing the game, and how frequently they gamble in a one month period.

Procedure

Each participant was randomly assigned to either the incentive condition or the no incentive condition. The dependent variable was the heart rate ratio experienced, which was defined as the participant's average heart rate on winning trials divided by the average heart rate on losing trials.

At the beginning of each session participants were asked to fill out a consent form and the heart rate monitor was attached to each participant's chest. The game's instructions appeared on the computer screen informing participants that "this is a guessing game where we will see how well you can do at predicting the pattern that will be followed. You will be shown three black boxes. One of the three boxes will turn red; your job is to predict which box it will be". Once a guess was made, feedback was made by either the noise of "kids cheering" for a win or "a buzzer" noise for a loss. All participants were told that it was important to get as many guesses correct as possible. Those participants in the high incentive condition were also told that "one of the top 5 scorers will receive a great prize". During the game, a baseline procedure was given which consists of 10 trials on the computer task. After the baseline procedure, the play condition was administered whereby participants were given 20 data trials of the computer game. Heart rate was measured and recorded for each trial (win or lose), along with the outcome, and whether an incentive was present.

At the end of the game, each participant was asked to fill out the *South Oaks Gambling Screen (SOGS)*, so the score on the SOGS could be correlated with the difference between winning and losing trials to measure outcome. After each participant completed the *SOGS*, they were administered a second questionnaire that asked them what they felt subjectively while playing the game. This was done in order to determine if participants self-reported arousal correlated with their physiological arousal. After this, each participant was informed that they would receive an e-mail further debriefing the study.

Results

Although a slight increase in the mean heart rate arousal is present for frequent gamblers in the incentive condition compared to infrequent gamblers in the incentive condition, the heart rate change is so small that the results did not achieve statistical significance (see Table 1 and Figure 1).

A two-sample t-test was done to further investigate whether heart rate arousal was higher for frequent gamblers than for infrequent gamblers. Contrary to previous findings, the results do not indicate a significant effect [$t = 0.631$, $p = 0.05$], and as can be seen in Figure 2.

To determine if heart rate arousal was higher for participants in the incentive condition, a two-sample t-test was done. As Figure 3 illustrates, there was no significant difference between the heart rate experienced in the incentive condition and the heart rate experienced in the no incentive condition [$t = 0.746$, $p = 0.05$].

An analysis of variance indicated no main effect of the incentive condition [$F = 1.504$, $p = 0.228$], or the frequent and infrequent subject group [$F = 0.424$, $p = 0.519$].

and therefore the differences between groups were not statistically significant [$F = 0.995$, $p = 0.325$]. As can be seen in Figure 4, where there is an incentive, heart rate showed an increase on winning trials for frequent gamblers and no change for infrequent gamblers. Where there is no incentive, both groups experienced a slight drop in heart rate on winning trials; however the results are not statistically significant.

A Pearson's Correlation was done to examine the relationship between the *SOGS* scores and each participants self-reported gambling frequency. As Figure 5 illustrates, a correlation is present [$r = .535$, $p = 0.01$], however the frequency histogram in Figure 6 shows that most participants in this study do not have a problem with gambling because most participants scored a zero or one on the *SOGS*.

Also, a subjective measure of arousal was taken, however a preliminary view of the data does not seem to show that participants were very aroused by the game. This could be because the environment of the study itself needed to be more stimulating.

Discussion

It was predicted that the presence of an incentive would increase heart rate arousal more in frequent gamblers than in infrequent gamblers, and it was expected that all participants would show a greater heart rate increase to a win than to a loss, with participants in the incentive condition experiencing a greater heart rate increase overall than those in the no incentive condition. It was also anticipated that frequent gamblers would show a much larger increase in heart rate than infrequent gamblers in the incentive condition.

Although it seems like a plausible hypothesis to say that a high degree of reactivity to arousal in a gambling situation contributes to a person's disposition to

gamble, this was not statistically confirmed. Heart rate arousal did increase slightly for frequent gamblers in the incentive condition compared to infrequent gamblers in the incentive condition, but the heart rate change was so small that it does not appear that heart rate is greater for frequent gamblers than for infrequent gamblers when given an incentive.

It could be that this study had a problem with ecological validity. In other words, participants did not experience enough emotional arousal towards the game itself, because the computer game and the room it was played in might not have been stimulating enough. Perhaps had the study been conducted in a real gambling environment, with loud sounds and other people gambling, the results might be significant. The fact that participants did not play the game with their own money at stake could also explain the results found in this study. Conceivably, if participants used their own money to play the game there would be more of an incentive present for them to win that money back.

Or possibly, as illustrated by the low *SOGS* scores, it is only problem gamblers who truly experience a high heart rate increase while gambling, and therefore the participants used in this study might not have been the proper population to examine.

Previous research findings (Anderson & Brown, 1984; Coventry & Constable, 1999; Coventry & Hudson, 2001; Coventry & Norman, 1998; Dickerson & Adcock, 1987, Leary & Dickerson, 1985; Moodie & Finnigan, 2005) have indicated that winning while gambling is associated with an increase in heart rate, and that the larger an incentive is during a game, the larger the heart rate increase is (Ladouceur et al., 2003). This study provides contradictory findings. Overall, the current study suggests that research in the

future should control for the frequency of gambling among the participants, and should also provide a stronger incentive while attempting to make the gambling environment more emotionally stimulating.

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Appendix A

**SOUTH OAKS GAMBLING SCREEN
[SOGS]**

Name: _____

Date: _____

5 Please indicate which of the following types of gambling you have done in your lifetime.

For each type, mark one answer: “Not at All,” “Less than Once a Week,” or “Once a Week or More.”

PLEASE “✓” ONE ANSWER FOR EACH STATEMENT:	NOT AT ALL	LESS THAN ONCE A WEEK	ONCE A WEEK OR MORE
---	------------	-----------------------	---------------------

- a. Played cards for money
- b. Bet on horses, dogs, or other animals (at OTB, the track or with a bookie)
- c. Bet on sport (parlay cards, with bookie at Jai Alai)
- d. Played dice games, including craps, over and under or other dice games
- e. Went to casinos (legal or otherwise)
- f. Played the numbers or bet on lotteries
- g. Played bingo
- h. Played the stock and/or commodities market
- i. Played slot machines, poker machines, or other gambling machines
- j. Bowled, shot pool, played golf, or some other game of skill for money
- k. Played pull tabs or “paper” games other than lotteries
- l. Some form of gambling not listed above (please specify: _____)

2. What is the largest amount of money you have ever gambled with on any one-day?

_____ Never gambled _____ More than \$100.00 up to \$1,000.00

_____ \$1.00 or less _____ More than \$1,000.00 up to \$10,000.00

_____ More than \$1.00 up to \$10.00 _____ More than \$10,000.00

_____ More than \$10.00 up to \$100.00

3. Check which of the following people in your life has (or had) a gambling problem.SM

_____ Father _____ Mother

_____ Brother/Sister _____ My Spouse/Partner

_____ My Child(ren) _____ Another Relative

_____ A Friend or Someone Important in My Life

4. When you gamble, how often do you go back another day to win back money you have lost?

_____ Never _____ Most of the Times I Lose

_____ Some of the Time _____ Every Time I Lose

(less than half the time I lose)

5. Have you ever claimed to be winning money gambling, but weren't really? In fact, you lost?

_____ Never

_____ Yes, less than half the time I lost

_____ Yes, most of the time

6. Do you feel you have ever had a problem with betting or money gambling?

_____ No _____ Yes _____ Yes, in the past, but not now

7. Did you ever gamble more than you intended to? _____ Yes _____ No

8. Have people criticized your betting or told you that you had a

problem, regardless of whether or not you thought it was true? _____ Yes _____ No

9. Have you ever felt guilty about the way you gamble, or what

happens when you gamble? _____ Yes _____ No

10. Have you ever felt like you would like to stop betting money

on gambling, but didn't think you could? _____ Yes _____ No

11. Have you ever hidden betting slips, lottery tickets, gambling money, IOUs, or other signs of betting or gambling from your spouse, children or other important people in your life? _____ Yes _____ No
12. Have you ever argued with people you live with over how you handle money? _____ Yes _____ No
13. (If you answered "Yes" to question 12) Have money arguments ever centered on your gambling? _____ Yes _____ No
14. Have you ever borrowed from someone and not paid them back as a result of your gambling? _____ Yes _____ No
15. Have you ever lost time from work (or school) due to betting money or gambling? _____ Yes _____ No
16. If you borrowed money to gamble or to pay gambling debts, who or where did you borrow from (check "Yes" or "No" for each):
- a. From household money _____ Yes _____ No
 - b. From your spouse _____ Yes _____ No
 - c. From other relatives or in-laws _____ Yes _____ No
 - d. From banks, loan companies, or credit unions _____ Yes _____ No
 - e. From credit cards _____ Yes _____ No
 - f. From loan sharks _____ Yes _____ No
 - g. You cashed in stocks, bonds or other securities _____ Yes _____ No
 - h. You sold personal or family property _____ Yes _____ No
 - i. You borrowed on your checking accounts (passed bad checks) _____ Yes _____ No
 - j. You have (had) a credit line with a bookie _____ Yes _____ No

k. You have (had) a credit line with a casino _____ Yes _____ No

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and the scored items are not revised without permission of the author.

SOUTH OAKS GAMBLING SCREEN – SCORE SHEET
[SOGS]

Scores on the SOGS are determined by scoring one point for each question that shows the
“at risk” response indicated and adding the total points.

Question 1 X Not counted

Question 2 X Not counted

Question 3 X Not counted

Question 4 _____ Most of the time I lose or Yes, most of the time

Question 5 _____ Yes, less than half the time I lose or Yes, most of the time

Question 6 _____ Yes, in the past but not now or Yes

Question 7 _____ Yes

Question 8 _____ Yes

Question 9 _____ Yes

Question 10 _____ Yes

Question 11 _____ Yes

Question 12 X Not counted

Question 13 _____ Yes

Question 14 _____ Yes

Question 15 _____ Yes

Question 16 a _____ Yes

Question 16 b _____ Yes

Question 16 c _____ Yes

Question 16 d _____ Yes

Question 16 e _____ Yes

Question 16 f _____ Yes

Question 16 g _____ Yes

Question 16 h _____ Yes

Question 16 I _____ Yes

Question 16 j X Not counted

Question 16 k X Not counted

TOTAL POINTS:

(Maximum score = 20)

INTERPRETING THE SCORE:

- | | |
|-----------|------------------------------|
| 0 | No problem with gambling |
| 1-4 | Some problems with gambling |
| 5 or more | Probable pathological gamble |

Table and Figure Captions

Table 1. Mean total heart rate ratios.

Figure 1. Mean total heart rate ratios.

Figure 2. Mean heart rate ratios for the frequent and infrequent gambler condition.

Figure 3. Mean heart rate ratios for the incentive and no incentive condition.

Figure 4. Failure of an interaction between gambling frequency and incentive.

Figure 5. Correlation for the *SOGS* scores and the self-reported gambling frequency.

Figure 6. Frequency histogram for *SOGS* scores.

Table 1

	Incentive	No Incentive
Frequent	1.0144	0.9955
Infrequent	1.0004	0.9985

Figure 1

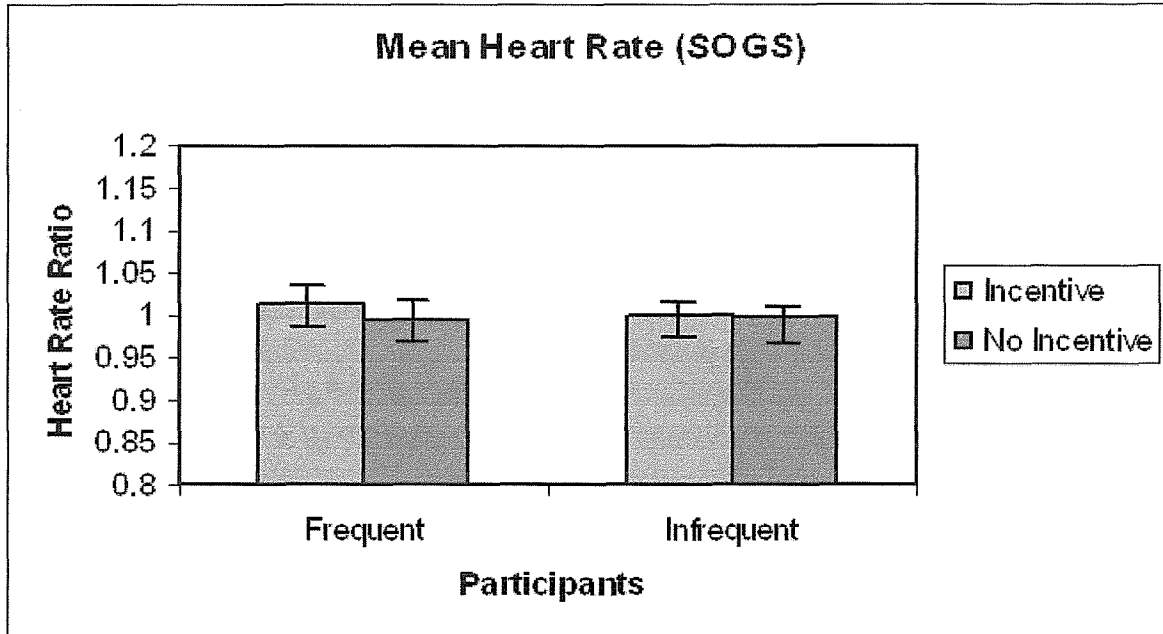


Figure 2

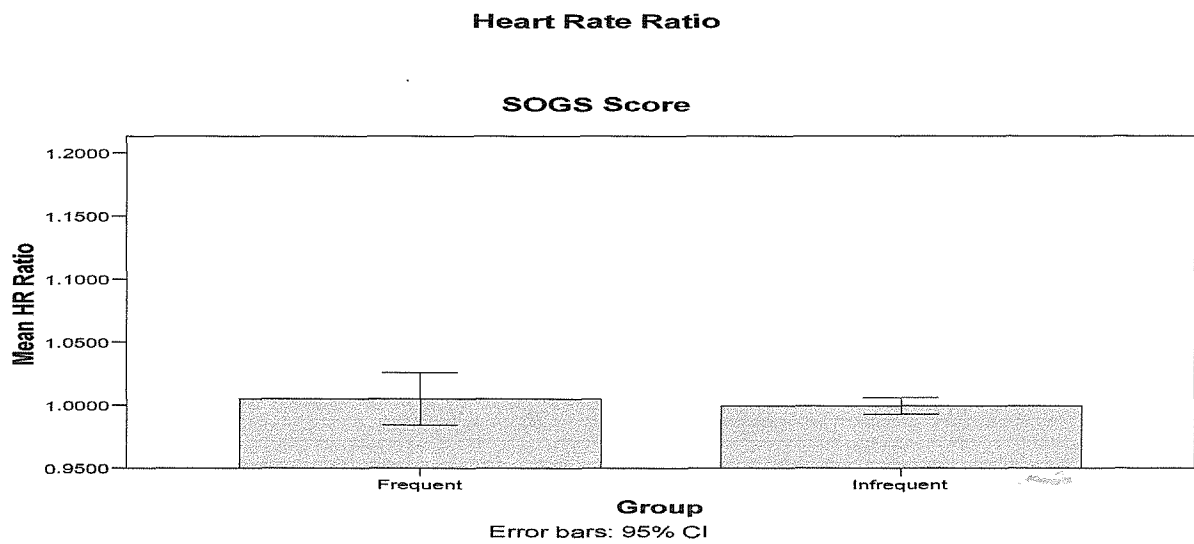


Figure 3

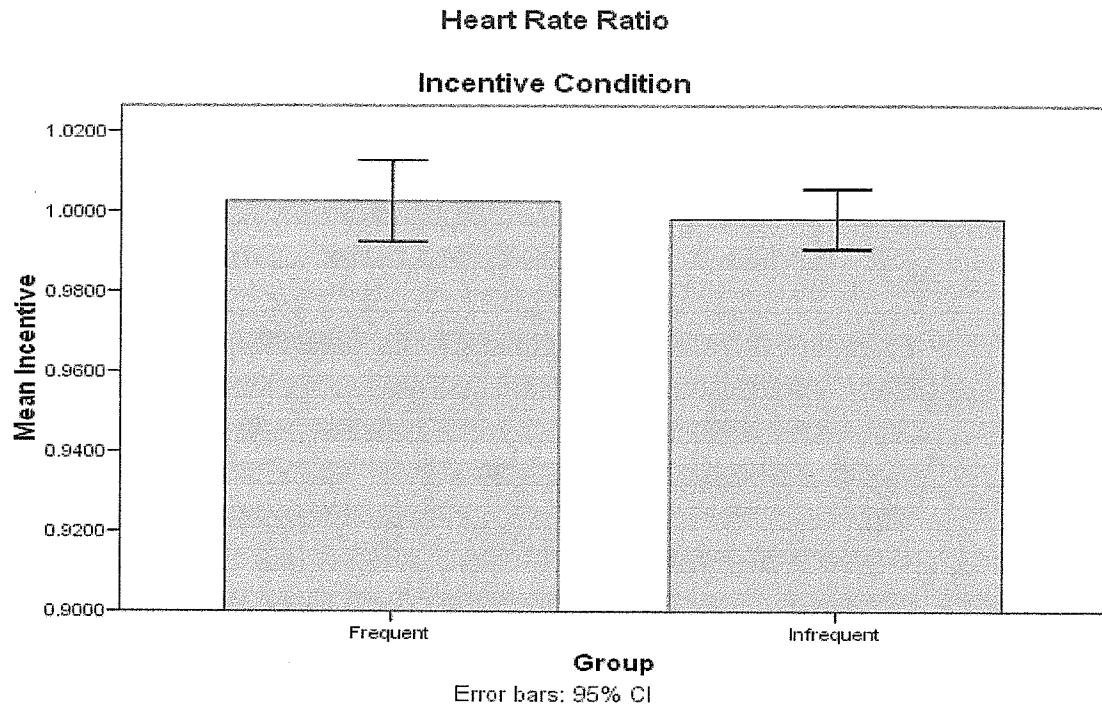


Figure 4

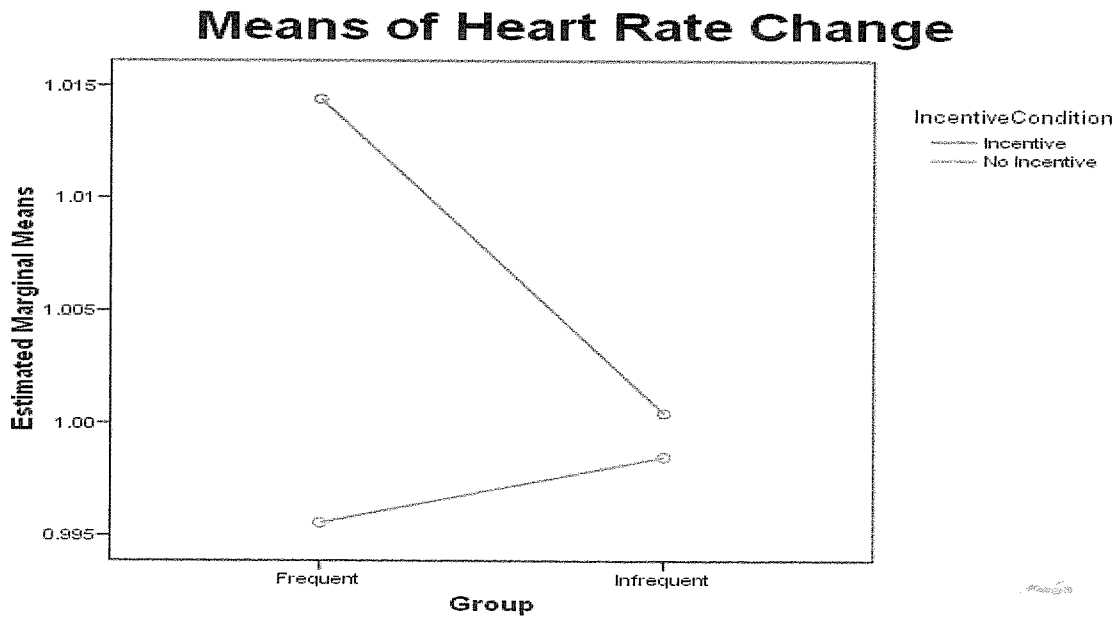


Figure 5

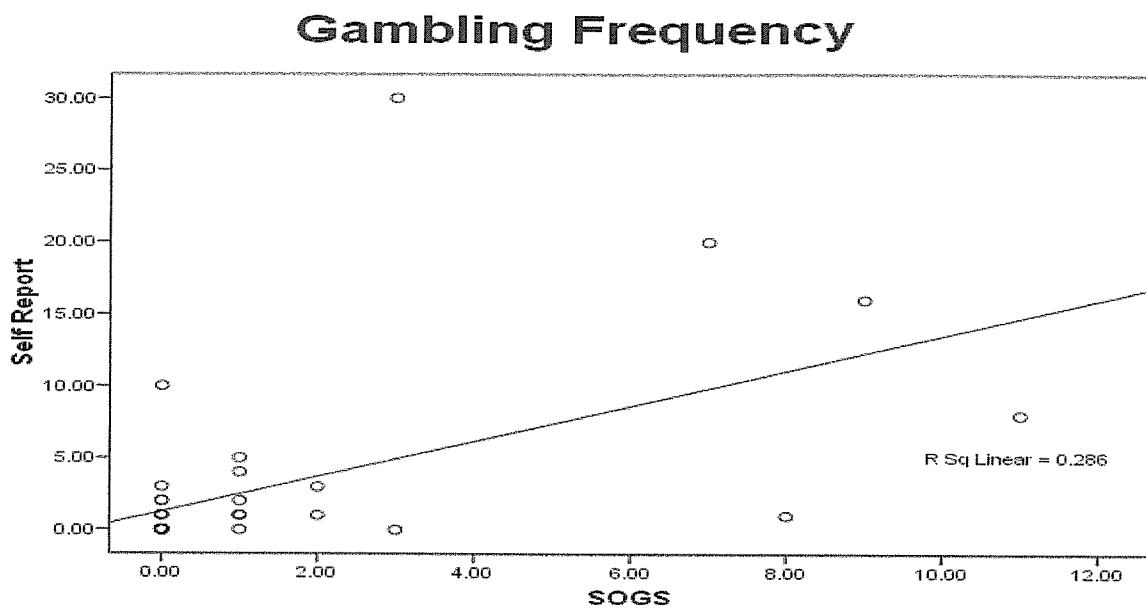


Figure 6

