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Psychophysiological Arousal in Problem and Non-Problem Video Lottery Gamblers

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Psychophysiological Arousal in Problem and Non-Problem Video Lottery Gamblers" submitted by Katherine Mary Diskin in partial fulfillment of the requirements for the degree of Master of Science.

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ABSTRACT

This study measured three indices of physiological arousal (electromyographic activity, [EMG], skin conductance [SCL], and heart rate) during gambling and gambling related tasks in a sample of problem (n=32) and non-problem (n=32) video lottery gamblers.

No difference was found between the groups at baseline or during a neutral task. A significant increase in all indices was observed for both groups from baseline to gambling task. A significant interaction was observed for heart rate, with problem gamblers experiencing a smaller increase than non-problem gamblers when gambling.

Both groups experienced increases in EMG when thinking about personally relevant wins, and increases in SCL and heart rate when thinking about losing.

Problem gamblers reported subjective feelings of excitement which were not correlated with physiological measures and more feelings of dissociation when gambling (Jacobs 1988) than the non-problem gamblers. Preference for stimulating situations was negatively correlated with baseline heart rate and EMG levels, but was not associated with problem gambling behaviour.

It appears that there were few differences between the groups in response to gambling and gambling related situations. Differences may lie in how gamblers perceive the arousal they experience.

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INTRODUCTION

Gambling and Problem Gambling

Gambling has been part of the human experience since prehistoric times. Paintings dating from 3500 BC show games played with astralagi (dice made from the anklebones of sheep and goats). Compulsive gamblers in Egypt were punished by being forced to hone stones for the pyramids. Greek mythology explained the division of the universe as the outcome of a dice game in which Zeus won the heavens, Poseidon, the seas, and Hades, the loser, became master of the underworld (Bernstein, 1996). While the practices of gambling may have evolved from literally "throwing the bones" to gambling over the Internet, the elements of risk and excitement that characterize the act of gambling are still an intrinsic part of the experience.

From being considered an outlawed, antisocial behaviour, legal gambling has become part of the social fabric. Gambling is legal in at least 90 countries (Lesieur & Rosenthal, 1991). According to Rose (1988, cited in Shaffer, Hall & VanderBilt, 1997) North America is currently experiencing the third cyclical episode ("third wave") in which legal gambling has been considered acceptable after a period of prohibition. In Canada, some forms of gambling are legal in every province. Many state and provincial governments not only license gambling establishments, but frequently rely on gambling revenues as part of their operating resources.

Gambling encompasses a range of activities, from the purchase of lottery tickets to sports betting, from the racetrack to the casino. All gambles involve the element of risk, of taking a chance. It is this element of risk that is believed to provide the

excitement of gambling. Gambling cannot be considered a rational activity, since in all forms of legal gambling the odds are with the house, yet people persist in gambling in the hope that they will beat the odds. In 1998 an extensive survey of gambling behaviour in Alberta found that 97 % of the adult population had gambled during their lifetime and that 87.4% had engaged in some form of gambling behaviour in the past year (Wynne Resources, 1998).

Gambling is an age old, widely accepted pastime, so why should gambling issues be cause for concern, and why is it necessary to investigate them? As Walker points out, there is cause for concern because "some people gamble to such an extent that the losses jeopardize other aspects of their lives that they value" (Walker 1992a, p. 247). Although for many people gambling is an occasional amusement or perhaps an opportunity to fantasize about the acquisition of wealth, for others it is a source of great distress. According to the American Psychiatric Association Diagnostic and Statistical Manual of Mental Disorders (4th ed.) "The essential feature of pathological gambling is persistent and recurrent maladaptive gambling behavior... that disrupts personal, family or vocational pursuits..."(p. 615).

Shaffer, Hall and VanderBilt (1997) published an extensive meta analysis of the prevalence of problem gambling in North America. They described a continuum of gambling behaviour consisting of three levels. Level one gambling involves few or no negative consequences and is the type of gambling behaviour typical of the majority of North Americans who gamble; level two gambling may involve a wide range of negative consequences due to gambling. Gamblers in level two may stay at that level or may

move toward either resolving their problems with gambling or developing increased gambling problems. Level 3 gambling describes gambling behaviour that satisfies the diagnostic criteria for a clinically significant gambling disorder. They estimated past year rates for level two gambling in the adult population of North America at 2.80% with a 95% confidence interval from 1.95% to 3.65% and past year rates for level three gambling at 1.14% with a 95% confidence interval from .90% to 1.38%.

The recent Adult gambling and problem gambling in Alberta 1998 report (Wynne Resources, 1998) used the South Oaks Gambling Screen (Lesieur & Blume 1987; SOGS) to estimate the prevalence of problem gambling in Alberta. The study estimated that 2.8 % of the population of Alberta (55,139 people) are current problem gamblers (similar to Shaffer et al.'s level two gambling) and 2.0% of the population (39,385 people) are probable pathological gamblers (similar to Shaffer et al.'s level three gambling). These estimates were based on a provincial population of 1.9 million in 1996.

Problem gambling behaviour does not affect the gambler alone. It has serious effects on family, friends and employers. It has been estimated that each problem gambler negatively affects at least 10 other people (Politzer, Yesalis & Hudak, 1992). If we were to employ a more conservative estimate and assume that each problem gambler has an adverse influence on the lives of five other people, approximately 475,000 Albertans are negatively affected by problem gambling.

Video Lottery Gambling

A video lottery terminal (VLT) simulates games of chance on a computer screen. The player inserts money in the VLT, purchasing credits that can be used to make

wagers. The gambler chooses the number of credits he or she wishes to bet on each play. In Alberta, the minimum wager per play is $0.25, and the maximum wager per play is $2.50. The player can change his or her bet or decide to play a different game at will. If the player chooses to repeat the same bet on the same game it is possible to make at least 14 bets in the space of one minute. VLT winnings are not paid in cash but in credits that may only be redeemed by stopping play, leaving the machine, and "cashing out".

In Alberta, VLTs are programmed to pay out at 92% over time, and do so on a variable ratio schedule. A computer chip in the terminal determines the outcome of each wager at the time it is made, and the video display conforms to the determined outcome. A machine may pay out several times in a row or may not pay out for a considerable number of plays. Nothing a player can do will influence whether or not a particular wager will be successful.

The province of Nova Scotia recently completed an extensive study of video lottery gambling behaviour entitled Nova Scotia Video Lottery Players' Study 1998 (Focal Resources). Video lottery terminals were introduced to Nova Scotia in 1991 and by 1996 revenue from VLTs constituted 54% of the total gambling revenue taken in by the province. The report estimated the net VLT revenue for the 1997/98-year for Nova Scotia at approximately 117 million dollars. The study found that 5.7% of adult Nova Scotians were involved in what was described as "regular continuous play" (playing VLTs more than once per month), and reported that 25% of the VLT players in the province accounted for 96% of the annual net VLT revenue received by the province. The study further classified 16% of video lottery players (.92% of the adult population of

Nova Scotia) as problem video lottery players, and estimated that each problem player spent almost $10,000.00 annually on VLT gambling.

The popularity of video lottery gambling in Alberta can be inferred from the change in gross provincial revenues from VLTs, which increased from 8.35 million dollars when VLTs were introduced in 1993 to 3.26 billion dollars in 1996. While participation in most gambling activities declined in Alberta between 1994 and 1998, participation in VLT gambling increased from 17% to 24%. Reported average monthly expenditure on VLTs for non-problem gamblers in Alberta is $3.14/month, while for probable pathological gamblers the reported average monthly VLT expenditure is $381.50/ month (Wynne Resources, 1998).

VLT gambling has been called the crack cocaine of gambling (Hodgins & Smoliak, 1996) due to the speed at which it has become a problem for some people. A study of problem gamblers found that among VLT players who sought help from the Alberta Alcohol and Drug Abuse Commission (AADAC), most were aware they had a problem with VLTs within 10 months of starting play. Problem gamblers in the AADAC study reported gambling on VLTs for an average of 16 days per month, averaging 6 hours per session. They reported that they preferred VLTs to other forms of gambling because of excitement, speed of play and ease of access (Smoliak, 1997). A 1994 study hypothesized that those at high risk for developing VLT gambling problems included adolescents, young adults, minorities, people with low incomes and the unemployed (Wynne, 1994). A recent South Dakota study has reported that video lottery gambling is

presently " the predominant type of gambling in pathological gamblers seeking treatment" (Morgan, Kofoed, Buchkoski & Carr, 1996, p. 451).

LITERATURE REVIEW

Models of Gambling Behaviour

Current neuropsychological explanations suggest that the "loss of control" experienced by addicts (including pathological gamblers) may be related to reward pathways in the brain, specifically to the production of excessive amounts of dopamine, which produce a "high". Bergh, Elklund, Sodersten & Norden (1997) have found that some symptoms of pathological gambling are indicative of an increased level of arousal which may reflect enhanced activity in ascending dopamine systems. Preliminary work in genetics has found that defects which produce variants of the dopamine D2 receptor gene are associated with some forms of alcoholism, drug dependency, obesity and pathological gambling (Blum et al., 1995).

A recent study (Comings et al., 1996) reported a " significant increase in the prevalence of the D1A1 allele [associated with a relative decrease in D2 receptor density] in pathological gamblers, and the even higher prevalence of the D2A1 allele in the gamblers with alcohol or drug abuse, [which] support a role for genetic defects in the dopaminergic reward pathways and the DRD2 gene in pathological gambling and in addictive behaviours in general" (p. 232).

While it appears that genetic influences may provide the predisposition for an individual to develop a gambling problem, it is necessary to consider the effects of other influences as well, since genetic predisposition alone is not sufficient to explain the

development and persistence of problem gambling. The defective alleles found in the Comings et al. (1996) study were present in both gamblers and controls and were not present in all the pathological gamblers studied.

Many explanations have been offered for problem gambling behaviour including Freudian explanations, the effects of operant conditioning, and social learning paradigms. Problem gambling has been explained as a form of self- medication, a product of erroneous cognitions or a result of the interaction of cognitive, behavioural and physiological elements.

Freudian or psychodynamic explanations of gambling consider it a sexually orgasmic activity, similar to the repetitive activity of masturbation. It has been suggested that gambling (and particularly losing) is an attempt to resolve parental conflict by self-punishment (Brown, 1986), or is "an attempt to heal a psychic wound" (Ferris, Wynne & Single, 1998, p.14). Luck is seen as a parental figure, giving rewards and extracting punishments, requiring propitiation through suffering.

To some behaviourists gambling is a learned response to irregular reinforcement, and problem gambling results from repeated exposure to powerful variable reinforcement schedules. Anderson and Brown have suggested that the effect of such a variable reinforcement schedule is to produce arousal in gamblers and that the "central phenomenon of gambling is a personal experience and an objectively verifiable state of arousal, not sexual, but probably autonomic and/or cortical" (Anderson & Brown, 1984 cited in Brown, 1986, p. 1004).

Some models of gambling behaviour are based on the premise that gambling is an attempt by the gambler to regulate his or her physiological state. McConaghy's Behaviour Completion Mechanism (cited in Brown, 1986) suggests that gambling cues produce an unpleasantly heightened state of arousal in the gambler that can only be resolved by carrying out the gambling behaviour. Indulging in gambling reduces the uncomfortable level of arousal and alleviates the gambler's feeling of discomfort. According to Brown's biological hedonism model each individual has a preferred level of physiological arousal and seeks the level of stimulation that produces the desired state, that is the level of arousal that allows them to feel and function best. Gambling is a means of stimulation used to attain the individual's preferred level of arousal, with higher sensation seekers gambling because they are more sensitive to rewards (Brown, 1986).

Jacob's General Theory of Addictions (1986) suggests that individuals who possess chronically hypo or hypertensive underlying states of physiological arousal and who have experienced deep feelings of inadequacy or rejection in childhood or adolescence are at highest risk of developing addictive behaviour. The existence of these conditions in a conducive environment may cause an individual to seek an addictive substance or activity that blurs reality testing, lowers self criticism and self consciousness and permits complimentary daydreams about the self, "in order to achieve and act out an altered state of identity"(Jacobs, 1993, p. 290). According to the theory, gamblers tend to be chronically underaroused, using gambling to relieve chronic states of boredom (Gupta & Derevensky, 1998). So far, this theory has been mainly of interest to gambling researchers, and little work has been done testing the General Theory of Addiction in

relation to other addictive behaviours.

Social learning theorists have argued that people become involved in gambling through observation and exposure within their family or social group and that gambling may serve an adaptive function by producing excitement or escape from unhappiness (Walker, 1992b). Gambling is a learned behaviour, dependent on an individual's social context, which may later come to serve as a method to deal with distress (Ferris, Wynne & Single, 1998).

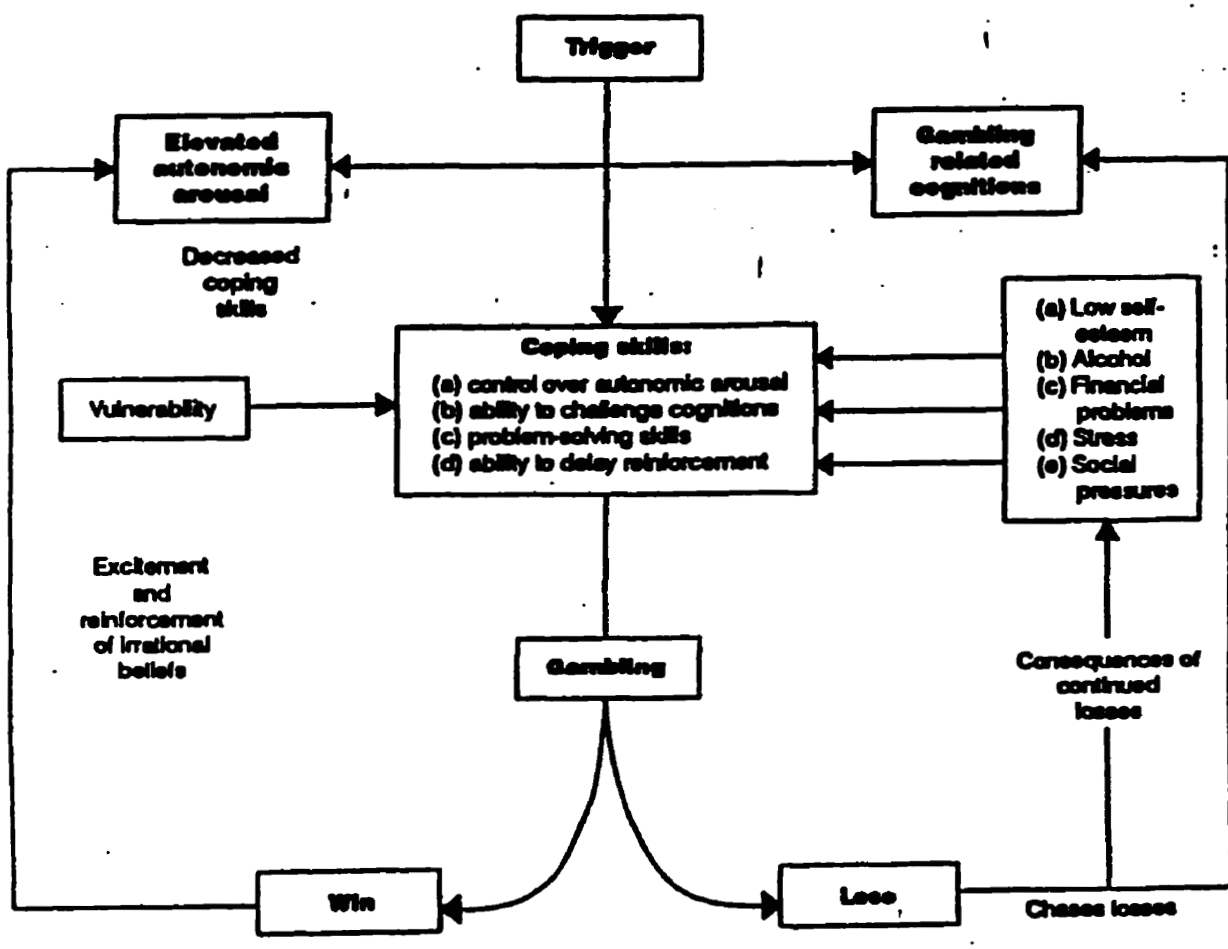
Cognitive theorists have argued that the main motivation for gambling is to win money, and that problem gamblers hold the mistaken belief that eventually they will be able to make money by gambling. It is contended that "gambling is maintained by irrational thinking and misperception of outcomes and their causes which leads the gambler to expect to win..." (Walker, 1992b, p.6). The most pervasive and influential of these irrational thoughts is considered to be the illusion of control, the belief that an individual's actions can influence the outcome of a gamble.

Sharpe and Tarrier (1993) have combined elements of the cognitive and behavioural models and have offered the most fully developed model currently advanced to explain gambling and problem gambling behaviour (see Figure 1). The model proposes a mechanism through which various factors including thoughts, environment, and physiological arousal contribute to the development of problem gambling. According to the model gambling is initially acquired through a combination of operant and classical conditioning. Gambling behaviour is reinforced by financial rewards and increased autonomic arousal (e.g. increased skin conductance, heart rate and electrodermal activity

(Sharpe & Tarrier, 1993, p. 408), which the gambler interprets as excitement. Financial rewards and the elevated arousal resulting from a win serve to reinforce the gambling behaviour. Problem gamblers are proposed to differ from high frequency social gamblers in terms of the level of arousal experienced in response to stimuli associated with gambling activities (Sharpe, Tarrier, Schotte & Spence, 1995). The physiological reactions associated with gambling are interpreted as excitement - "people experience autonomic arousal akin to excitement in response to gambling... The arousal becomes associated with monetary reward, thereby increasing the reinforcement value of this autonomic state" (Sharpe & Tarrier, 1993, p. 408). The gambling environment, the act of gambling and experiences of physiological arousal become associated with gambling related thoughts, so that any one may become a "trigger" for gambling behaviour. They propose that problem gambling behaviour may result when gamblers lack the coping skills to deal with elevated levels of autonomic arousal produced by gambling and gambling related stimuli. The lack of coping skills may result in problematic gambling behaviour since the individual is unable to resist gambling once they encounter a trigger (Ferris, Wynne & Single 1998, p.21).

Figure 1

Cognitive behavioural model of the development and maintenance of problem gambling (Sharpe & Tarrier, 1993).



Arousal and Gambling

Shaffer describes gambling as an "object of addiction" because it is one of "those things or activities that reliably and robustly shift subjective experience. The most reliable and robust 'shifters' hold the greatest potential to stimulate the development of addictive disorders"(Shaffer, 1996, p. 464). He states that "one of the great allures of gambling is its capacity to excite, entertain, and help people forget their everyday problems"(p. 468). The act of risking the stake being wagered in the hope of achieving greater gains stimulates feelings of excitement, anticipation, and disappointment or pleasure in the gambler. It serves as a means of shifting the individual's experience through the act of gambling rather than through the use of a substance such as alcohol or drugs. Brown states that "gambling is very exciting and that some form of arousal or excitement is a major and possibly the major reinforcer of gambling behaviour for the regular gambler" (1986, p. 1001). This description of gambling coincides with Shaffer's definition of gambling as an object of addiction, an activity that shifts subjective experience. Feelings of excitement and arousal are acknowledged to be major components of the gambling experience.

While the term "arousal" appears frequently in the gambling literature it is rarely defined. In the psychophysiological literature arousal is defined as "the physiological state elicited by an organism's perceptions of its environment. Arousal is not synonymous with stress since arousal can define physiological states ranging from deep sleep to quiet sitting to extreme agitation"(Johnson & Anderson 1990, p. 217). References to "arousal" in the gambling literature generally refer to changes in the

physiological state of the individual which may or may not be accompanied by expressed feelings of excitement or tension but which are produced by the act or thought of gambling.

Why is it appropriate to use physical methods to measure arousal since it is possible to simply ask gamblers about their feelings and experiences when playing? It seems that we may not always be aware of or be able to express all of our reactions to an experience. According to Cacioppo and Tassinary (1990) " the stimuli, thoughts, emotions and experiences that are apparent to or can be articulated by the individual may represent but a narrow band of influences relevant to the governance of human experience and behavior" (p. 4). The opportunity to record and measure some indices of physiological response to gambling situations may provide clearer insights into the VLT gambling experience.

When we consider the more traditional forms of gambling it is not difficult to comprehend how feelings of excitement and heightened levels of physiological response would be engendered. Horse races, card games, the spin of a roulette wheel or a game of bingo all have a particular pattern. Although they are all "continuous" forms of gambling in which the time elapsed between wager and result is brief (Dickerson, 1993), the gambling session must follow a unique course which takes place over an appreciable span of time. In these more traditional forms of gambling the rate of play is controlled externally rather than by the individual gambler. A bet is placed on the chosen horse, and the bettor must wait for the race to be run. A decision is made and the wager placed on the board, awaiting the spin of the roulette wheel. The bingo cards are laid out, waiting

for the caller, the hand of cards is dealt and the players take turns making bets. Although these activities may happen quickly certain elements of the sequence are externally instigated and controlled. A bingo player waiting for the last number to complete a full house, a card player waiting for an opponent to call or raise, a roulette player watching the wheel slow down, or a punter watching the horses head for the finish line, all have time to anticipate the outcome of their wager, to hope for the win or fear the loss - time to experience feeling of excitement. In these situations it is easy to understand the potential for changes in psychophysiological arousal during the gambling experience. However, when observing someone playing a VLT, particularly someone with a gambling problem, it is difficult to discern whether or not the player is experiencing feelings of pleasure or excitement. Often the player interacts only with the machine, diligently "working" away, bet after bet. When gambling is so repetitive and proceeds so quickly it is difficult to comprehend how the outcome of any particular play could be an anticipated event. In informal discussions, however, players claim that they are in fact aware of the results of each wager and its consequences. Some players report feeling excitement or tension throughout a VLT gambling session.

Machine gambling seems quite different from more traditional types of gambling and requires specific investigation. As Dickerson states " It has been argued that to assume the same psychological models will explain impaired control in all forms of gambling is not only naïve but runs the risk of not fully explaining the significant differences between different forms to develop a far richer and more informative vein of research" (1993, p.243).

Previous Research

Physiological arousal is an important component of many models of gambling behaviour. Although it is often assumed that changes in arousal play an important role in gambling, "studies investigating the role of arousal in problem gambling remain somewhat preliminary and the precise mechanisms which govern these relationships remain largely unknown" (Sharpe et al., 1995, p. 1530). Several studies have found some connection between the act of gambling and an increased level of psychophysiological activity. Previous studies that have measured physiological arousal during gambling activity have used either self-report or a single parameter (changes in heart rate) to determine levels of arousal; changes in skin conductance and muscle tension have not been measured during actual gambling sessions.

Several early studies found that frequent gamblers report more feelings of subjective excitement than occasional gamblers. Griffiths (1993, p.366) summarized previous self-report studies. His report included Wray & Dickerson's (1981) finding that 70% of Gamblers Anonymous members surveyed reported feeling very excited or tense during gambling; Dickerson & Adcock (1987), who found persistent videopoker players significantly more excited than low frequency players; and Dickerson, Hinchy & Fabre (1987), who found persistent off course bettors to be significantly more excited than less persistent bettors. Griffiths, (1990, 1991), found that among fruit machine players pathological gamblers reported being excited during gambling sessions.

Gupta and Derevensky (1999) found that adolescent problem and pathological gamblers responded differently compared to occasional gamblers when answering

questions related to dissociation when gambling. They were more likely to report more dissociative experiences in response to Jacob's (1986) Dissociative Scale. The Dissociative Scale includes questions about feelings of trance, memory blackouts and losing track of time when gambling. Adolescent gamblers also differed from adolescent non-gamblers in their response to Jacob's Arousal scale, which asked four questions about their preferred level of stimulation. Adolescent gamblers reported that they felt best in more stimulating situations, while non-gamblers preferred less stimulation.

Diskin & Hodgins (in press) found that some problem video lottery players were slower than occasional gamblers to respond to external stimuli when engaged in VLT play. An explanation offered was that the observed difference could be a result of narrowing of attention due to higher levels of arousal experienced by problem gamblers. A subsequent study (Diskin & Hodgins, 1999) found that problem gamblers were slower to respond to external lights when their attention was focussed on the VLT game, but were able to respond more quickly than occasional gamblers when their attention shifted to the goal of making a speedy response.

Anderson and Brown (1984) found increases in heart rate for regular blackjack players in a casino situation. Heart rates increased from baseline rates by a mean of 23 beats per minute, with some players' rates increasing by 58 beats per minute while playing.

Coventry & Norman (1997) monitored heart rate, sensation seeking and loss of control in 32 male off course horse racing bettors. Participants were divided on the basis of chasing behaviour and on the basis of high and low frequency of gambling. No

difference was found between the groups using either division, but different points in the gambling process were found to produce different levels of arousal (e.g. heart rates were highest at bet placement and during the last 30 seconds of the race). They concluded that "During gambling activity, arousal is likely to be a by-product of an interaction between a decision-making strategy (the beliefs and cognitive strategies the gambler employs) and the information from the setting itself"(p. 680).

Physical measures of arousal during machine gambling episodes have so far been limited to measures of heart rate, and findings among the various studies have not been consistent in finding differences between low and high frequency players. Until now no study had explored the psychophysiological responses of identified problem gamblers when participating in a gambling situation.

Evidence of increased heart rate during videopoker play was found by Leary & Dickerson, (1985), who reported that both regular and occasional players showed increased heart rates during play but that increases were significantly greater for regular players. Although he also found significantly greater increases in heart rate for regular videopoker players compared to occasional players while playing, Dickerson (1993) argued against arousal as a motivation for persistence in machine gambling. He contended it is the stereotypical pattern of play that accounts for persistence in the gambling session, since he did not find that heart rates changed in relation to wins during the gambling session.

Coloumbe, Ladouceur, Desharnais and Jobin (1992) found increased heart rates in both regular and occasional videopoker players when playing videopoker but did not find

differences between the groups. They employed a "thinking aloud" methodology, training gamblers to verbalize their thoughts while playing. While they found no difference in heart rates between regular and occasional players, they did find that regular players produced more irrational verbalizations as their heart rates increased during the gambling session.

Griffiths (1993) studied 30 adolescent male fruit machine players. He reported that the heart rates of regular and nonregular fruit machine players increased similarly from baseline during play, but that regular players' heart rates decreased immediately afterward, while nonregular players' heart rates did not. He argued this could indicate that regular gamblers develop tolerance to the arousal experienced when playing which may result in longer playing periods or increased wagers in order to maintain arousal levels.

Coventry and Constable (1999) measured heart rates in a group of 32 high and low frequency female fruit machine players in a natural gambling environment. They compared heart rates during fruit machine gambling to heart rates during a non-gambling neutral task. They found a significant increase in heart rate during and after gambling only for participants who won during the recorded session.

Sharpe et al. (1995) examined physiological response to gambling related cues by measuring skin conductance, heart rate and electromyographic activity in problem, low and high frequency video poker gamblers. The study was intended to test the importance of cognitive events or external cues as internal triggers for arousal. When participants watched a video tape of video poker with and without distraction no changes were found

for EMG and heart rate. There was a significant group by task interaction for SCL, with only problem gamblers experiencing significantly increased levels. Similarly, when watching a poker machine video and a horse race video no significant main effects or between group differences were found for heart rate and EMG. There was a significant group by task interaction for SCL levels, with only the problem gamblers experiencing significant increases. Measurements on the three indices of arousal were compared when participants were asked to talk about a personally relevant win or recite the alphabet. All participants experienced increased heart rates when talking about personally relevant wins, that is there was a significant main effect for heart rate, but no significant group by task interaction was observed. While SCL levels increased for all participants when talking about winning, the problem gamblers experienced a greater increase than the high and low frequency gamblers. There was no significant main effect for EMG, but a group by task interaction approached significance, with problem gamblers experiencing greater increases than high and low frequency players.

When considering the literature questions about how the findings apply to VLT gambling are raised. Are problem VLT players chronically hypoaroused, using gambling to increase their low levels of baseline arousal, as the General Theory of Addiction (1986) would suggest? Do problem gamblers experience higher levels of physiological arousal when playing compared to occasional gamblers as Sharpe & Tarrier's (1993) cognitive behavioural model would imply? Do problem and non-problem gamblers experience increased physiological arousal when thinking about gambling situations?

DESIGN

This study measured three indices of physiological arousal (skin conductance, heart rate and electromyographic activity) in several situations. Measurements were recorded when participants were resting, gambling on a video lottery terminal, thinking about personally relevant wins and losses, and while participants were doing a reaction time test and playing on the VLT.

Study Hypotheses

1) Problem and non-problem VLT players' levels of physiological arousal will differ significantly in the resting state and during the neutral physical task.
2) Physiological arousal will increase for both groups when playing on the VLT. Problem gamblers will experience higher levels of arousal than non-problem gamblers when gambling.
3) Both groups will experience changes in arousal when thinking about a personally relevant win. Problem gamblers will exhibit greater changes in arousal than non-problem gamblers when thinking about personally relevant VLT winning experiences or imagined wins.
4) Both groups will experience changes in arousal when thinking about personally relevant losses. Problem gamblers will exhibit greater changes in arousal than non-problem gamblers when thinking about personally relevant VLT losing experiences.

Research Questions

1) Do the groups report experiencing differing levels of subjective excitement or tension while participating in the various study tasks? It is expected that the problem gamblers will report more feelings of excitement than the non-problem gamblers during the gambling related tasks. Do the obtained measures of physiological arousal correspond with perceived ratings of excitement?
2) Do the groups differ in their preference for more or less stimulating activities as measured by the Arousal scale? If problem gamblers are chronically underaroused it would be expected that they would prefer more stimulating activities. Is a preference for stimulation correlated with baseline measures of physiological arousal?
3) Do the groups differ in response to questions about dissociative experiences when gambling? It is expected that the problem gamblers will report greater feelings of dissociation when gambling.

Participants

Experienced video lottery gamblers who were not currently attempting to quit gambling were recruited from the community through newspaper advertisements (see Appendix A). The advertisements stated that participants could win from 0 to 50 dollars. Since gamblers are an extremely heterogeneous population no exclusion criteria were initially specified for the study.

Sample size

Previous studies of arousal in gambling populations have found significant results using relatively small sample sizes. Leary and Dickerson (1985) used 22 high frequency

and 22 low frequency poker machine players. Sharpe et al. (1995) used a total sample of 38, of which 12 were problem gamblers and 25 were high and low frequency occasional gamblers. (Findings of the study generally differentiated between problem gamblers and others, not high and low frequency gamblers). Coloumbe et al. (1992) used a sample size of 12 regular and 12 occasional videopoker players.

The present study recruited a total of 66 experienced video lottery players, a larger number than previous studies have employed.

Instruments

The South Oaks Gambling Screen (Lesieur & Blume, 1987) is a twenty item self report questionnaire widely used to screen normal and clinical populations for pathological gambling. It is considered to be reliable and valid. A person who receives a score of 5 or greater on the SOGS (i.e. answers "yes" to 5 or more questions) is identified as a probable pathological gambler (see Appendix B).

The Brief Symptom Inventory (Derogatis & Melisaratos, 1983) is a 56 item self report instrument which addresses psychiatric symptoms which may have been experienced in the preceding seven days. As well as ratings for specific symptoms, it provides three global indices of distress, the general severity index, the positive symptom distress index, and the positive symptom total. The measures of interest for this study were the Global Severity Index (GSI), which is an indicator of an individual's general level of distress and the Anxiety subscale which measures recently experienced feelings of nervousness and tension.

Structured Clinical Interview for the DSM-IV (SCID-I/NP; First, Spitzer, Gibbon and Williams, 1997). The Psychoactive Substance Use module, the Current Major Depressive Episode and Past Major Depressive Episode modules, and the Current Manic Episode and Past Manic Episode modules from the Structured Clinical Interview for the DSM-IV were administered. The SCID-R is a structured interview that enquires about the frequency and intensity of symptoms and provides a diagnosis

Pathological Gambling Criteria Questionnaire (Stinchfield, 1997) A questionnaire developed by Stinchfield and Winters which incorporates DSM-IV diagnostic criteria for pathological gambling disorder (see Appendix C) was used. A score of 5 or more criteria indicates a diagnosis of pathological gambling disorder.

Dissociative Questionnaire, Jacobs (1986) Four questions designed to access common dissociative feelings among addicts, plus an additional question about losing track of time when gambling. For the purpose of this study the questions were modified to reflect feelings during video lottery play (see Appendix D). The questions have been used in recent studies (Brown, 1996; Wynne Resources, 1998; Gupta and Derevensky, 1999; Diskin & Hodgins, 1999). A recent study found the four dissociative questions plus the losing track of time question modified for VLT gambling had an overall reliability coefficient alpha of .71 (Diskin & Hodgins, 1999).

Arousal Scale (Gupta & Derevensky, 1999). Four forced choice questions suggested by Jacobs that require participant to state a preference for more or less stimulating activities. Answers are scored 1 for the less stimulating activity and 2 for the more stimulating activity (see Appendix E).

A brief demographic questionnaire was used to collect data on age, frequency of play, handedness and smoking (see Appendix F).

A semi-structured interview script was used to gather information about reasons for playing, game preferences and strategies, and descriptions of relevant personal wins and losses (see Appendix G).

A perception of excitement self-report checklist was used to measure subjective excitement. It consisted of a list of each of the experimental tasks with a Likert scale to indicate the level of perceived excitement or tension experienced by the participant (see Appendix H).

Physiological Measurements

Three indices of physiological arousal (heart rate, skin conductance level and electromyograhic activity) were measured in the study.

Heart rate (HR) was measured with a photoplethysmographic sensor using an LED photodetector with a light source and light sensor placed on the pad of the index finger of the non-dominant hand.

Skin conductance level (SCL) was measured using self-adhesive 1cm silver silver chloride electrodes placed on the thenar and hypothenar eminences of the palm. When the sympathetic nervous system is aroused, the skin's capacity to conduct current is enhanced and SCL increases.

Electromyographic activity (EMG) is a measure of muscle activity based on the electrical activity produced by a muscle's motor neurons. EMG was measured using 3 silver silver chloride electrodes attached to the forehead approximately 1 inch above the

eyebrows, with the ground electrode in the centre.

Physiological measurements were recorded using a Procomp+/Biograph psychophysiological data acquisition system attached to an IBM 1.66 pentium personal computer.

Apparatus

1) Video lottery terminal (model VLC) set in demonstration mode.

2) Procomp+ biofeedback system with heart rate/blood volume sensor, EMG sensors and skin conductance sensors using a Biograph software data recording and analysis program with an IBM 1.66 pentium PC.

3) Light display yoke mounted around VLT screen supporting 4 Light Emitting Diodes with a response bar mounted across the front of the terminal below the screen.

4) IBM PC containing an I/O counter timer board capable of millisecond accurate timing, controlling the LEDs via digital line outputs and recording response bar presses through digital line inputs.

5) Floor to ceiling curtain to conceal VLT when required.

Procedure

Each participant was given a verbal description of the procedure and was asked to read and sign a letter of consent (see Appendix I).The investigator showed the participant the sensors and self-adhesive electrodes used to take the physiological measurements.

The demographic questions, South Oaks Gambling Screen, DSM-IV gambling criteria questionnaire, and the drug and alcohol use and mood components of the

structured SCID interview were given in interview format. A semi-structured discussion of gambling motivations and game preferences was held. Participants were asked to complete the Brief Symptom Inventory, Dissociative questionnaire and Arousal scale questions in pencil and paper format.

After the interview component of the procedure, the physiological sensors were attached to the participant. Three sensors were placed on the forehead, two sensors were placed on the palm of the non-dominant hand, and a photoplethysmographic sensor was attached to the forefinger of the non-dominant hand. Participants were asked to keep the non-dominant hand relaxed and open during the experimental tasks.

Participants were seated in the original chair and position they had used for the interview segment of the study. The video lottery terminal was concealed from view by a curtain. After the sensors were attached the lights in the room were dimmed and the participant was asked to sit quietly. The study then proceeded in the following order:

Initial baseline (3 minutes) Participants were asked to close their eyes, sit quietly and relax. It was suggested that they visualize a scene that they found relaxing. Suggestions of a quiet beach, watching the waves on the shore, or a cozy room in front of a fireplace were offered as possible visualizations.

Play VLT in demonstration mode (10 minutes) Participants were moved over to the VLT machine. The procedure for the gambling task was reviewed. Participants were reminded that $25.00 worth of credits had been entered in the machine. They were asked to choose whatever game they preferred and to play the VLT as they normally would. Participants were told that they were expected to play the game for a minimum of 4

minutes and that after 4 minutes they could choose to stop playing or to continue. They could quit at any time (after 4 minutes had elapsed) and play would be stopped at the end of 10 minutes. Any credits in the machine at the time they stopped would be reimbursed in cash at the end of the session to a maximum value of $50.00.

Baseline 2 (3 minutes) After the gambling session participants were assisted to move back to their seat, the curtain was drawn so the VLT was not visible and they were asked to close their eyes and relax.

Visualize relevant personal win/loss (2 minutes) Participants were asked to close their eyes and visualize the relevant personal win or loss they had previously described in the semi-structured interview. The experimenter gave the participant cues taken from the earlier description (e.g. location, time of day, amount of money lost or won, whether the gambler was alone or with friends) to assist in the process of visualization. Participants who had not been able to describe a significant win or loss were asked to imagine what they would feel like in that situation.

Baseline 3 (2 minutes) Participants were asked to close their eyes and relax.

Neutral physical task (2 minutes) Participants were asked to sit on a stool the same height as a VLT stool and write the letters of the alphabet on a wall mounted erasable board within a restricted area the height and width of a video lottery terminal.

Baseline 4 (2 minutes) Participants were asked to close their eyes and relax.

Relevant personal loss/win (2 minutes) Participants were asked to close their eyes and asked to visualize a relevant personal loss if they had previously visualized a win and vice versa. They were given cues from the preceding interview to assist their

visualization. Participants who had not experienced a significant personal loss were asked to imagine how they would feel in such a situation.

Baseline 5 (2 minutes) Participants were asked to close their eyes and relax.

Reaction time test when playing VLT (5 minutes) Participants were asked to choose a game and play the VLT as they normally would while pressing the response bar as quickly as possible when they noticed an illuminated light on the display yoke surrounding the VLT screen. They were reminded that they would not be reimbursed in cash for any credits they accumulated while doing the reaction time test, but that the person with the highest total when the study terminated would receive a $50.00 restaurant gift certificate. The reaction time data are not included in the present report.

Baseline 6 (2 minutes) Participants were asked to close their eyes and relax.

Excitement questionnaire After the completion of the experimental tasks the physiological sensors were removed and participants were asked to fill out the perception of excitement questionnaire.

Debriefing Participants were given an opportunity to ask questions about the study and review their physiological data if they wished, although no interpretations of the data were offered. Participants expressing concern over their gambling behaviour were offered information on the problem gambling programs available in Calgary

Ethical Issues

Ethical approval for the research proposal was obtained from the University of Calgary Conjoint Medical Ethics Board.

Asking people who could be experiencing gambling problems to participate in a

study which involves the use of a real VLT terminal and offers the possibility of winning money raises ethical concerns, particularly if a potential participant is attempting to stop gambling. We advertised for experienced VLT gamblers who were not currently trying to stop gambling (see Appendix A). When potential participants called to find out about the study the first question asked was "Are you currently playing VLTs?" If a potential participant responded that they had quit or were trying to quit they were not enrolled in the study.

Some participants in the study were aware that they had a gambling problem although they were not attempting to quit gambling at the time. Several problem gamblers used the opportunity to ask questions about problem gambling and to get information about available services.

RESULTS

Data analysis

This was an exploratory study, investigating three indices of physiological arousal during gambling and gambling related situations. It was unknown whether the three indices would be similarly affected by the various tasks, therefore it was decided to perform separate univariate repeated measures analyses for each physiological measure when testing the hypotheses. Since each comparison in hypotheses 2,3, and 4 involved only two measures, the assumption of sphericity for repeated measures was not violated, and it was not necessary to use repeated measures MANOVA analyses when testing these hypotheses.

Because of the exploratory nature of the study the error rate for each hypothesis was set at .10 (Cohen, 1992). Since three indices of arousal (EMG, skin conductance, and heart rate) were examined for each hypothesis a Bonferroni adjustment was used so that the alpha level for the test of each physiological measure for each hypothesis was set at .10/3 = .033.

Due to the exploratory nature of the study more than one analysis was performed to test some of the hypotheses. The additional analyses were also evaluated using a .10 error rate adjusted for the three physiological measures.

Participants

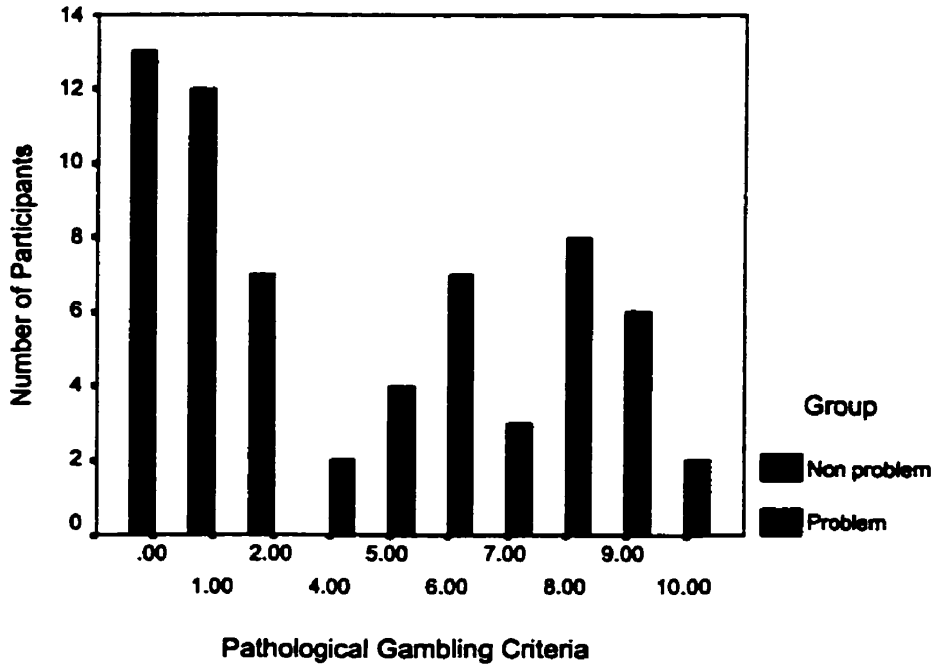
Data collection took place over 6 months, from March to September 1999. A total of 66 video lottery gamblers participated in the study. Two participants were excluded from subsequent data analysis. One male problem gambler was suffering from an untreated psychotic disorder and a female problem gambler was currently experiencing both alcohol and substance dependence disorders and had an extremely high resting heart rate.

Participants (N=64) were classified into two groups on the basis of the number of DSM-IV diagnostic criteria for pathological gambling disorder they reported experiencing. When the distribution of diagnostic criteria in the sample was examined it appeared a bimodal distribution existed (see Figure 2). Thirty-two participants endorsed from 0 to 2 criteria, while 32 participants endorsed from 4 –10 criteria. Since the division was quite clear, with no participant receiving a score of 3, participants were divided into

problem and non-problem gambling groups with a division at less than 4 DSM criteria and greater than or equal to 4 criteria. This division at 4 DSM-IV criteria did not allow the use of the designation of "pathological gambling", although some authors have suggested that 4 criteria may be an appropriate cutoff score (Lesieur & Rosenthal, 1991). Since a diagnosis of pathological gambling disorder requires 5 or more DSM-IV criteria, the two groups were designated as Problem and Non-problem gamblers.

Figure 2

DSM-IV Pathological gambling criteria for all participants (N =64)



The problem and non-problem groups did not differ significantly on age or gender. The groups differed significantly on South Oaks Gambling Screen (SOGS) score, number of DSM-IV criteria endorsed, frequency of gambling, number of cigarettes smoked, Global Severity Index (GSI) score and score on the Anxiety scale of the Brief Symptom Inventory (See Table 1).

The mean raw GSI score for the non-problem gamblers did not differ significantly from the adult non-patient norm, t (749) = 1.71, p = .087, and the mean Anxiety score for the non-problem gamblers did not differ significantly from the adult non-patient norm, t (749) = .58, p = .56.

The mean raw GSI score for the problem gamblers differed significantly from the adult non-patient norm, t (749) = 11.58, p < .001, and the mean raw Anxiety score for the problem gamblers also differed significantly from the non-patient norm, t (749) = 7.90, p <. 001, indicating that the problem gamblers in this sample were experiencing both a greater level of overall distress and a greater level of anxiety than the general population.

Several participants in both the problem and non-problem groups had current or past psychiatric or substance abuse diagnoses, including current and past major depressive episodes, alcohol abuse/dependence, and substance abuse/dependence. Several participants (6) also reported receiving treatment for psychotic disorders (See Table 2). Statistical analyses of the study data for each of the hypotheses were done with the 6 participants removed (N=58). No differences in the results were found, therefore the participants were retained in the final analyses.

Table 1

Sample Characteristics N = 64

	Non-problem		Problem		T statistic (df)	p
	Mean	**SD**	**Mean**	**SD**		
Age	40.56	14.16	41.28	10.75	(62) .229	.820
DSM	.813	.78	7.16	1.70	(62) 19.129	<.001
Anxiety	.4579	.5009	1.0252	.8479	(62) 3.259	.002
SOGS	2.41	1.66	9.69	3.33	(62) 11.182	<.001
Cigs. Daily	10.44	11.70	23.56	11.27	(62) 4.568	<.001
Play/year	46.74	34.78	118.47	65.11	(61) 5.428	<.001
GSI	.3968	.3655	.9900	.6325	(62) 4.584	<.001
Sig. Win	471.76	593.85	982.08	731.71	(61) 3.034	.004
Sig. Loss	173.00	36.40	654.35	481.66	(59) 4.799	<.001

Note. DSM = number of DSM-IVcriteria endorsed, Anxiety = score on Brief Symptom Inventory anxiety subscale, cigs.daily = number of cigarettes smoked per day, play/year = number of VLT gambling session in a year, GSI = score on Global Severity Index of the Brief Symptom Inventory, Sig. Win = dollar amount of reported recent relevant VLT win, Sig. Loss = dollar amount of reported recent relevant loss when playing VLT.

Table 2

Gender distribution of sample with psychiatric and substance abuse diagnoses

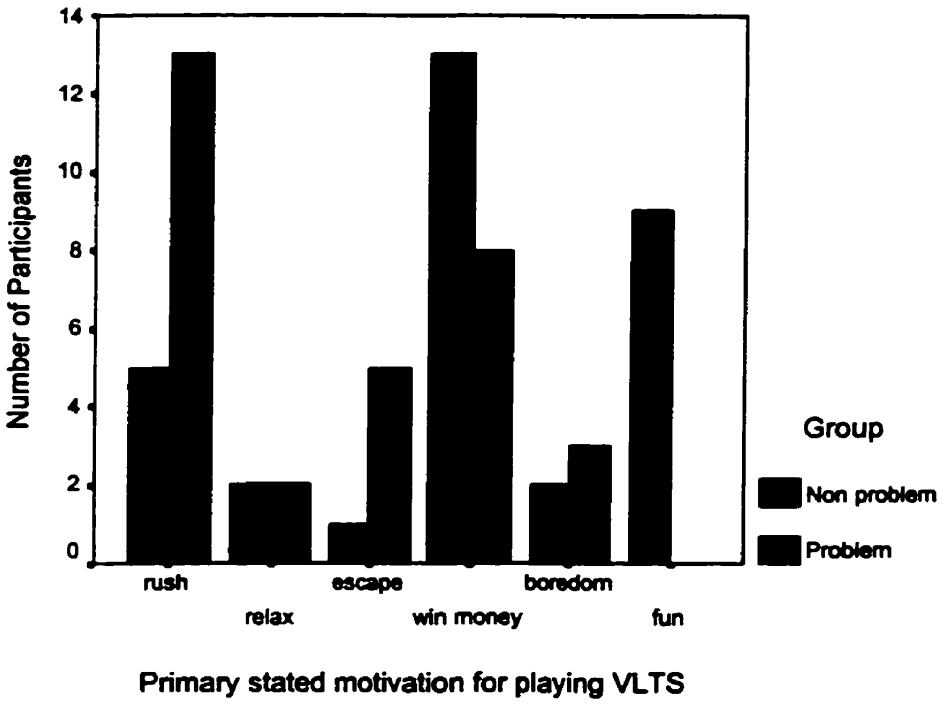
	Non-problem	Problem	X^2	2 sided sig.
Gender	18 male 14 female	18 male 14 female	.000	1.00
			Fisher's exact test	
Current MDE	3	6	1.164	.474
Past MDE	9	14	1.697	.297
Current alcohol abuse	2	4	.736	.672
Past alcohol abuse	5	12	3.925	.088
Current alcohol dep.	1	1	.000	1.00
Past alcohol dep.	4	11	4.267	.075
Current substance abuse	1	1	.000	1.00
Past substance abuse	2	5	1.444	.230
Past substance dependence	1	4	1.953	.355
Schizoaffective disorder [a]	1	1	.000	1.00
Schizophrenia [a]	2	2	.000	1.00

Note. MDE = major depressive episode
[a]Participants had been diagnosed and were receiving medication

There was a significant difference between the groups on motivation for playing VLTs, $\chi^2(5) = 16.60$, $p = .005$. Motivations to play are displayed in Figure 3. Thirteen problem gamblers reported playing for the "rush", while 13 non-problem gamblers reported playing "to win money".

Figure 3

Primary motivation for playing VLTS



Results related to Hypothesis 1

Hypothesis 1 stated that problem and non-problem VLT players' levels of physiological arousal would differ significantly in the resting state and during the neutral physical task.

Mean EMG, skin conductance, and heart rates of the problem and non-problem gamblers were compared for the first 30 seconds of the first baseline using independent t-tests. No significant differences were found between the groups (see Table 3).

Mean EMG, skin conductance, and heart rates were compared for the first 30 seconds of the neutral task, using independent t-tests. No significant differences were found between the groups (see Table 3).

In order to confirm these findings an additional analysis was performed in which the group means for each physiological measure for the first 30 seconds of baselines 1 to 6 were compared. The groups did not differ significantly (at an alpha level of .033 for each physiological parameter) at any baseline. The means for the six baselines are displayed graphically in Figure 4 a, b, and c.

Table 3

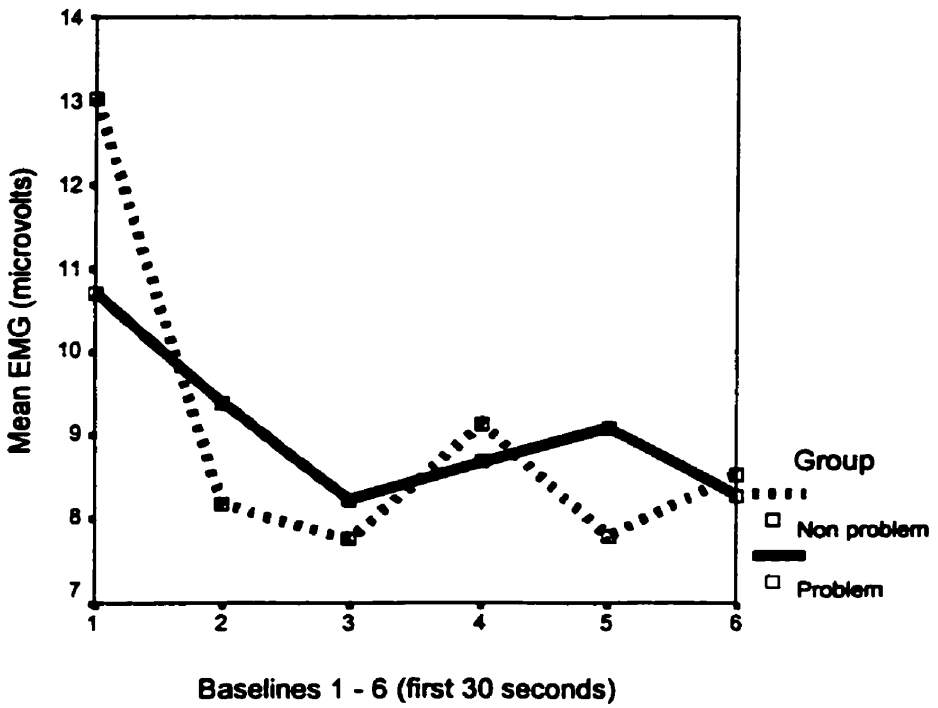
Mean values of physiological indices for first 30 seconds of Baseline 1 and first 30 seconds of Neutral Task

	Non-problem		**Problem**		**T (62)**	**2 sided sig.**
Baseline 1	Mean	S.D.	Mean	S.D.		
EMG	12.844	9.31	11.188	.680	.812	.420
SCL	11.128	7.17	10.959	.630	.100	.921
Heart Rate	71.128	11.72	75.493	10.59	1.563	.123
Neutral task						
EMG	10.289	5.28	9.302	3.82	(61).849	.399
SCL	15.078	6.68	14.698	5.48	.249	.805
Heart rate	77.307	11.68	81.404	11.28	1.427	.158

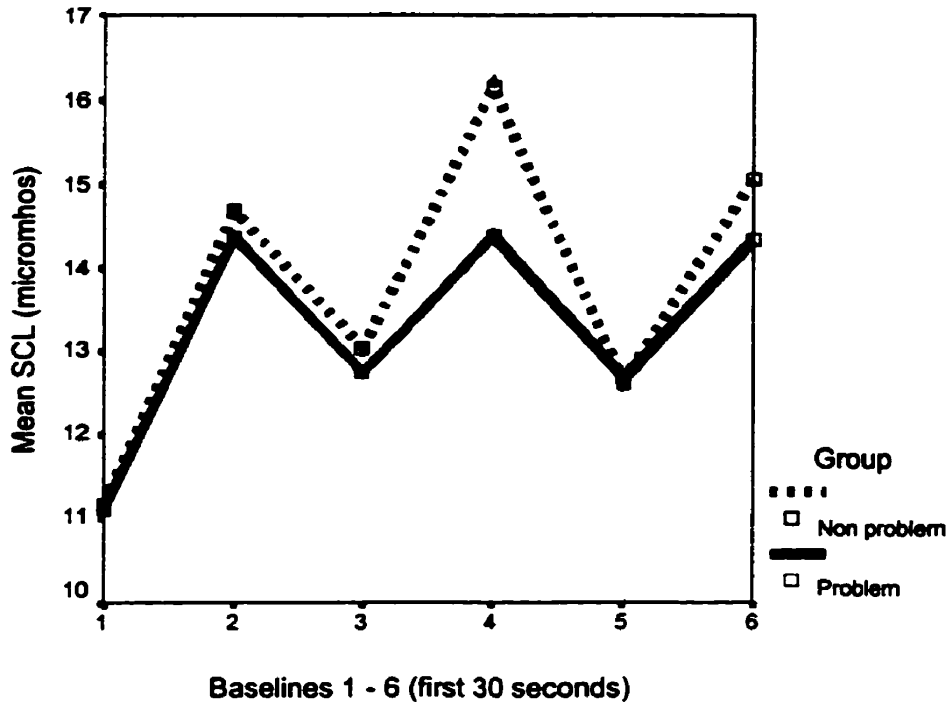
Figure 4

Individual Physiological indices at all 6 baselines

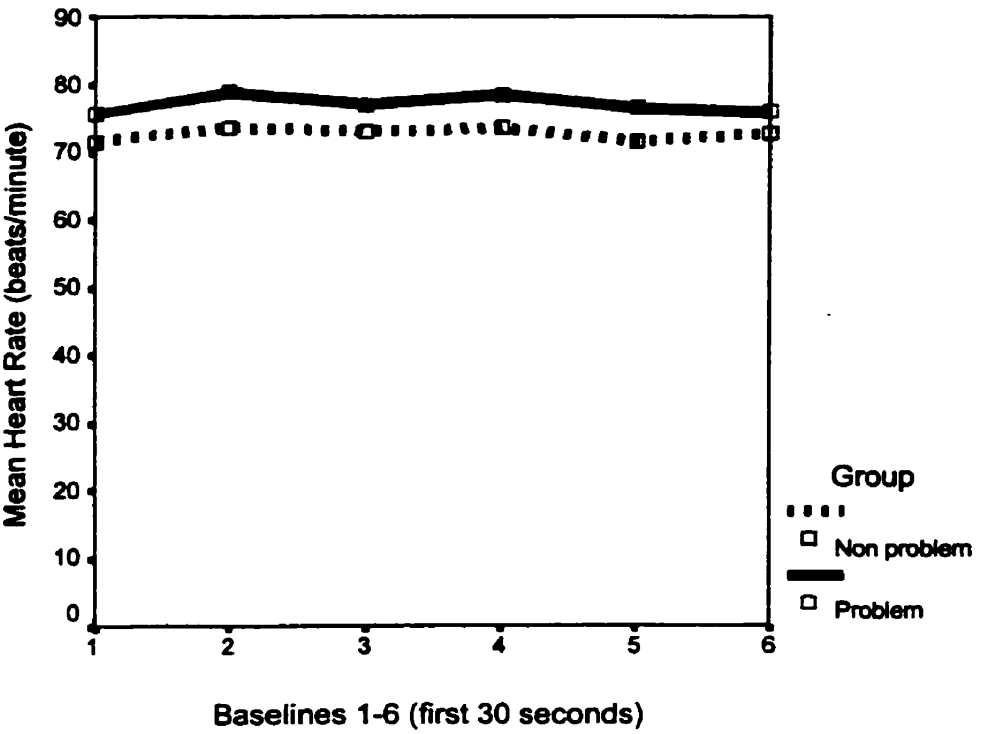
a) EMG



b) SCL


17
16
15
14
13
12
11
10
Mean SCL (micromhos)
1
2
3
4
5
6
Baselines 1 - 6 (first 30 seconds)
Group
Non problem
Problem

c) Heart Rate


90
80
70
60
50
40
30
20
10
0
Mean Heart Rate (beats/minute)
1
2
3
4
5
6
Baselines 1-6 (first 30 seconds)
Group
Non problem
Problem

Results related to Hypothesis 2

Hypothesis 2 stated that physiological arousal would increase for both groups when playing on the VLT and that problem gamblers would experience higher levels of arousal than occasional gamblers when playing on the VLT (there would be a Group by Task interaction).

Two approaches to testing this hypothesis were employed. Physiological measurements were compared between the active neutral task and the VLT gambling task (Approach 1) and measurements were compared between the resting baseline and the VLT gambling task (Approach 2).

Approach 1:

Analysis 1: Separate univariate repeated measures analyses of variance (ANOVAs) with Task (neutral task start, VLT start) as the within subjects factor and Group (problem gamblers, non-problem gamblers) as the between subjects factor were performed using each of the physiological indices as a dependent variable. Mean values of EMG, skin conductance and heart rate were analyzed from the first 30 seconds of the neutral task and the first 30 seconds of the VLT gambling session. Results of the univariate analyses are displayed in Table 4

EMG

A significant main effect was found for Task, F (1,61) =21.354, $p < .001$. Mean EMG increased from the neutral task to the gambling task for both groups, indicating that muscle activity was greater during gambling than during the neutral task. The non-problem gamblers' mean EMG increased from 10.29 microvolts for the neutral task to

13.47 microvolts when gambling, and the problem gamblers' mean EMG increased from 9.30 microvolts in the neutral task to 16.08 microvolts when gambling. There was no significant main effect of Group and no significant Group by Task interaction.

SCL

A significant main effect was found for Task, F (1,61) 6.241, p =. 015. Mean skin conductance for both the problem and non-problem groups decreased from the neutral task to the gambling task. Mean SCL for the non-problem group decreased from 15.07 micromhos during the neutral task to 14.07 micromhos when gambling. Mean SCL for the problem group decreased from 14.66 micromhos during the neutral task to 14.13 micromhos when gambling. No significant main effect was found for Group, and there was no significant Group by Task interaction.

Heart Rate

No significant main effects were found for Task or Group and there was no significant Group by Task interaction.

Table 4

ANOVAs of the first 30 seconds of the neutral task and the first 30 seconds of the gambling task

Measure	F value	Significance	Eta^2
EMG Group	.390	.535	.006
EMG Task	21.354	<.001*	.259
EMG Group by task	2.785	.100	.044
SCL Group	.013	.910	.000
SCL Task	6.241	.015*	.093
SCL Group by task	.580	.449	.009
HEART Group	1.580	.214	.025
HEART Task	.644	.425	.010
HEART Group by task	.679	.413	.011

* significant at adjusted alpha level of .033

Analysis 2: Physiological measurements were compared using the last 30 seconds of the neutral task (1.5 – 2 minutes) and the corresponding period from the gambling task (1.5 - 2 minutes). Univariate tests for each of the physiological indices are displayed in Table 5.

EMG

There was a significant main effect for Task, F (1,61) = 10.45, p = .002. Mean EMG increased from neutral task to gambling task for both groups. Mean EMG for the non-problem gamblers increased from 10.18 microvolts to 11.75 microvolts, while mean EMG for the problem gamblers increased from 9.33 microvolts to 14.48 microvolts. There was no significant main effect of Group and no significant Group by Task interaction.

SCL

There were no significant main effects for Task or Group, and no significant Group by Task interaction.

Heart Rate

There was no significant main effect for Task. The main effect for Group approached significance, F (1,61) = 4.054, p =. 046. The marginal mean of heart rate for the non-problem group was 76.295 beats per minute, while the marginal mean for the problem group was 82.04 beats per minute. There was no significant Group by Task interaction.

Table 5

ANOVAs of the neutral task and VLT gambling from 1.5 – 2 minutes

Measure	F value	Significance	Eta^2
EMG Group	.843	.362	.014
EMG Task	10.494	.002*	.147
EMG Group by task	2.967	.090	.046
SCL Group	.231	.632	.014
SCL Task	.480	.491	.008
SCL Group by task	.924	.340	.015
HEART Group	4.054	.048	.062
HEART Task	.065	.800	.001
HEART Group by task	1.027	.315	.017

* significant at an adjusted alpha level of .033

Approach 2

A second approach to determining whether VLT gambling produces physiological arousal examined changes in the physiological indices from resting baseline to gambling task.

Analysis 1: Separate univariate repeated measures analyses of variance with Task (baseline 1 finish, VLT start) as the within subjects factor and Group (problem gamblers, non-problem gamblers) as the between subjects factor were performed using each of the physiological indices as a dependent variable. Mean values of EMG, skin conductance and heart rate were analyzed from the last 30 seconds of the first baseline and the first 30 seconds of the gambling task. Results of the univariate analyses are shown in Table 6.

EMG

A significant main effect for Task was found, F (1,62) = 24.751, $p < .001$. Muscle activity increased from baseline to the gambling task for both the problem and non-problem gamblers. No significant main effect was found for Group, and there was no significant Group by Task interaction.

SCL

A significant main effect for Task was found, F (1,62) = 103.622, $p < .001$. Skin conductance increased from baseline to the gambling task for both the problem and non-problem gamblers. No significant main effect was found for Group, and there was no significant Group by Task interaction.

Heart Rate

A significant main effect was found for heart rate F (1,62) =28.318, p = < .001. No significant main effect was found for Group. A significant Group by Task interaction was found for heart rate, F (1,62) = 6.207, p =. 015. The interaction was significant using the adjusted alpha level of .033. When the group means were examined it was found that while heart rate increased for both groups when playing the VLT, the heart rate of the non-problem gamblers increased more than the heart rate of the problem gamblers. The non-problem gamblers' heart rates increased from a mean of 72.56 beats per minute at baseline to a mean of 77.32 beats per minute when gambling. The problem gamblers mean heart rate increased from a mean of 78.15 beats per minute at baseline to a mean of 79.88 beats per minute when gambling (see Figure 5).

Table 6

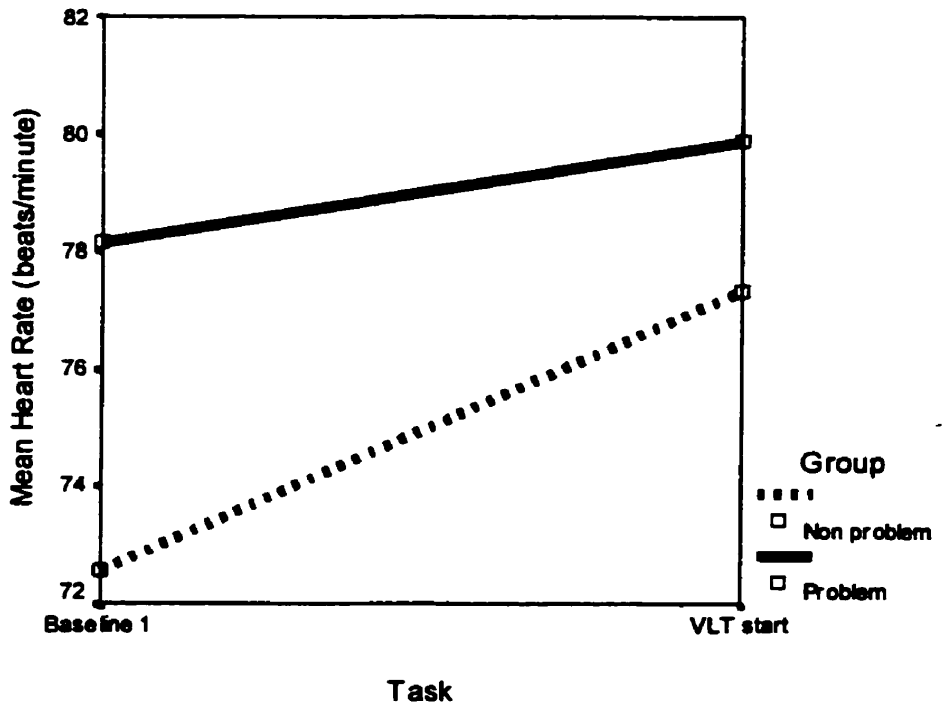
ANOVAs of last 30 seconds of baseline 1 and first 30 seconds of VLT gambling

Measure	F value (1,62)	Significance	Eta^2
EMG Group	1.985	.164	.031
EMG Task	24.751	<.001*	.285
EMG Group x Task	.097	.757	.002
SCL Group	.039	.844	.001
SCL Task	103.622	<.001*	.626
SCL Group x Task	.128	.721	.002
HEART Group	2.166	.146	.034
HEART Task	28.318	<.001*	.314
HEART Group x Task	6.207	.015*	.091

* significant at an adjusted alpha level of .033

Figure 5

Figure Caption: Group by Task interaction for Heart Rate



Analysis 2: Separate univariate analyses of variance were performed using the last 30 seconds of the first baseline and 30 seconds from 1.5 – 2 minutes of VLT gambling. Results of the univariate analyses are displayed in Table 7.

EMG

There was a significant main effect for Task, F (1,62) = 17.087, p <.001. Muscle activity increased for both problem and non-problem gamblers from baseline to 1.5 – 2 minutes of VLT gambling. There was no significant main effect of Group and no significant Group by Task interaction.

SCL

There was a significant main effect of Task, F (1,62) = 94.797, p <. 001. Skin conductance levels increased for both groups from baseline to 1.5-2 minutes of VLT gambling. There was no significant main effect of Group and no significant Group by Task interaction.

Heart Rate

There was a significant main effect of Task, F (1,62) = 37.835, p <. 001. Heart rate increased for both groups from baseline to 1.5-2 minutes of VLT gambling. There was no significant main effect of Group and no significant Group by Task interaction.

Table 7

ANOVA for last 30 seconds of baseline 1 and 1.5-2 minutes of VLT gambling

Measure	F value (1,62)	Significance	Eta^2
EMG Group	3.427	.069	.052
EMG Task	17.087	<.001*	.216
EMG Group x Task	.392	.533	.006
SCL Group	.006	.940	.000
SCL Task	94.797	<.001*	.605
SCL Group x Task	.855	.359	.014
HEART Group	3.255	.076	.050
HEART Task	37.835	<.001*	.379
HEART Group x Task	.515	.476	.008

* significant at adjusted alpha level .033

Results related to Hypothesis 3

Hypothesis 3 stated that both problem and non-problem gamblers would experience changes in arousal from baseline when thinking about personally relevant wins. It was hypothesized that problem gamblers would exhibit greater changes in arousal than occasional gamblers. (There would be a Group by Task interaction).

Means for each of the physiological indices were used from the last 30 seconds of the preceding baseline and the first 30 seconds of the thinking about a personally relevant win situation. Since some participants thought about relevant wins after the VLT session and some after the neutral task, a preliminary analysis was done using "Order" as a factor, but no significant effect was found. Similarly, because thinking about a relevant win took place after the gambling session an analysis was done using "VLT credits won" as a continuous covariate. Controlling for credits won during the preceding gambling session did not have a significant effect on the analysis for any of the physiological indices.

Results of the univariate analyses for each physiological measure are displayed in Table 8 and means are displayed in Figure 6 a, b and c.

EMG

There was a significant main effect for Task for the dependent variable EMG, $F(1,60) = 10.828$, $p = .002$. Muscle activity increased in both groups when thinking about personally relevant wins. No significant main effect of Group or significant Group by Task interaction was found.

SCL

No main effect of Task was found although the effect approached significance. No significant main effect was found for Group and there was no significant Group by Task interaction.

Heart rate

No significant main effects were found for Task or Group and no significant Group by Task interaction was found.

Table 8

ANOVAS of 30 second baseline and 30 seconds thinking about personally relevant win

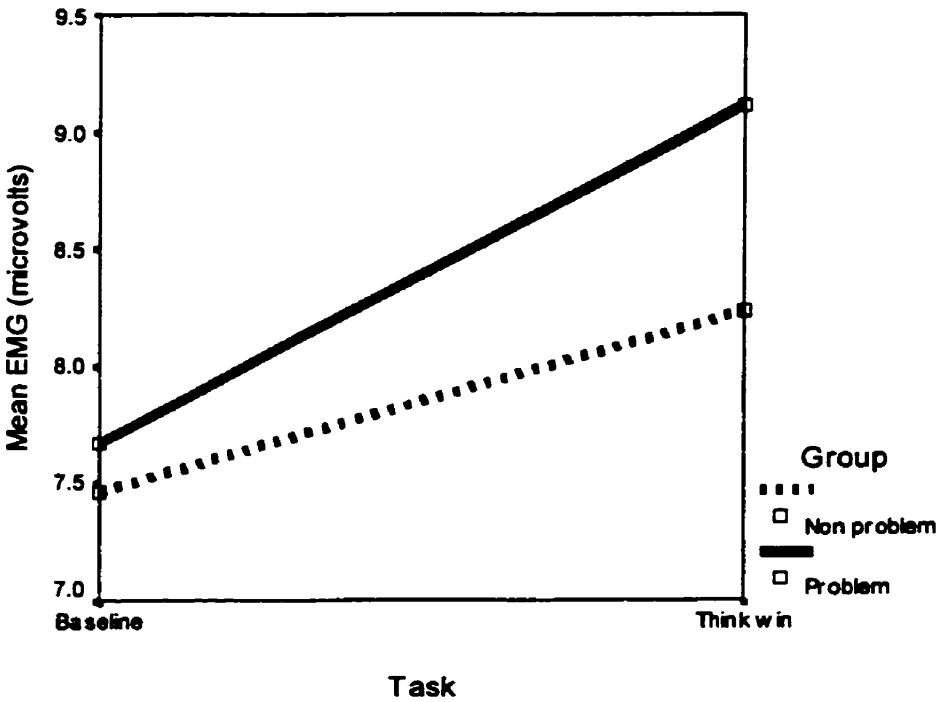
Measure	F statistic	P value	Eta^2
EMG Group	.431	.514	.007
EMG Task	10.828	.002*	.153
EMG Group x Task	1.006	.320	.016
SCL Group	.037	.847	.001
SCL Task	4.673	.035	.072
SCL Group x Task	1.351	.250	.022
Heart Group	1.382	.244	.023
Heart Task	.506	.480	.008
Heart Group x Task	2.044	.158	.033

*significant at adjusted alpha level of .033

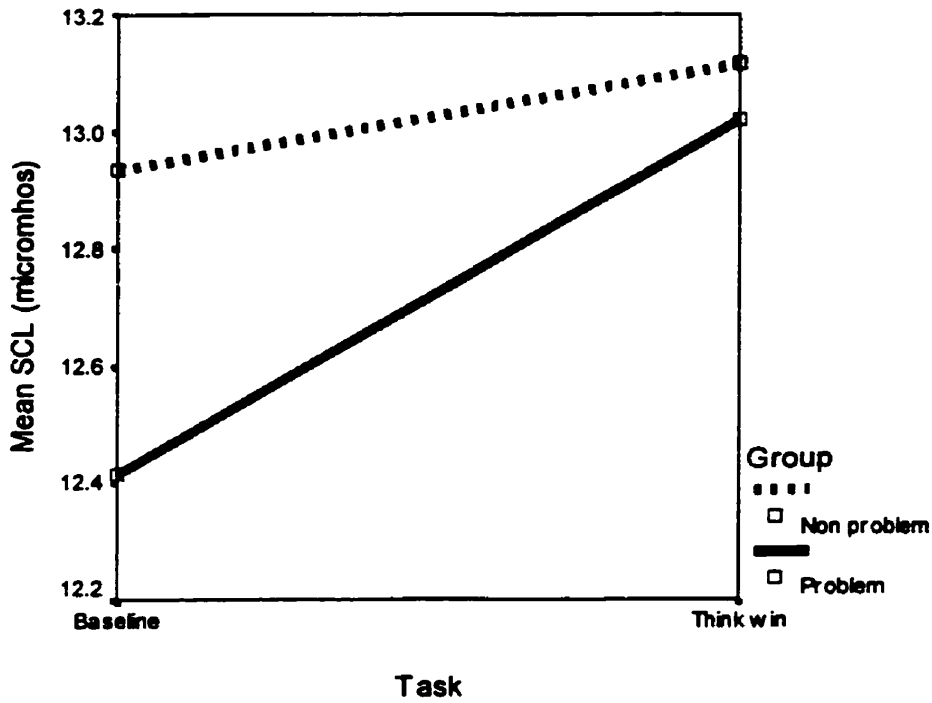
Figure 6

Physiological indices from baseline to thinking about relevant win

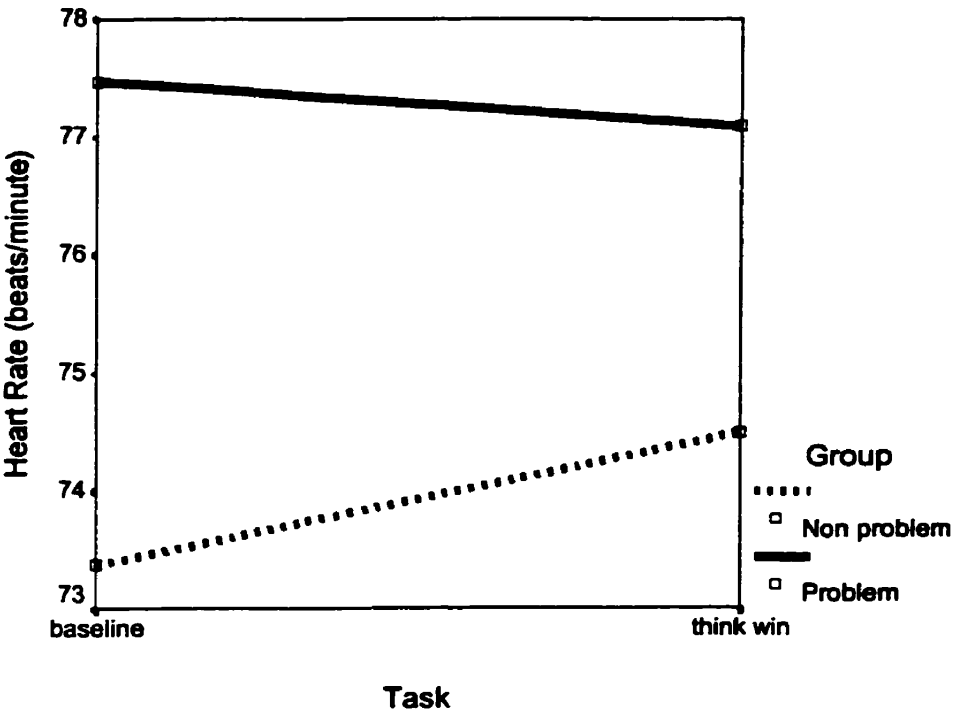
a) EMG



b) **SCL**


13.2
13.0
12.8
12.6
12.4
12.2
Mean SCL (micromhos)
Baseline
Think win
Task
Group
Non problem
Problem

c) Heart Rate


78
77
76
75
74
73
Heart Rate (beats/minute)
baseline
think win
Task
Group
Non problem
Problem

Results related to Hypothesis 4

Hypothesis 4 stated that both the problem and non-problem groups would experience changes in arousal when thinking about personally relevant losses and that problem gamblers would exhibit greater changes in arousal than occasional gamblers (there would be a Group by Task interaction).

Means were analyzed using the last 30 seconds of the preceding baseline and the first 30 seconds of the thinking of personally relevant loss task. Similarly to the analysis of Hypothesis 3, since some participants thought about relevant personal losses after the VLT session and some after the neutral task, a preliminary analysis was done using "Order" as a factor, but no significant effect of order was found. Similarly, because thinking about a relevant loss took place after the gambling session an analysis was done using "VLT credits won" as a continuous covariate. Credits won during the preceding gambling session were not found to have a significant effect on the analysis for any of the physiological indices.

Results of the univariate analyses for Hypothesis 4 are displayed in Table 9 and means are displayed in Figure 7 a, b and c.

EMG

No significant main effects were found for Task or Group and no significant Group by Task interaction was found.

SCL

A significant main effect of Task, F (1,60) 5.248, p =. 026 was found. Mean skin conductance increased for both problem and non-problem gamblers when thinking about

personally relevant losses. No significant main effect was found for Group, and there was no significant Group by Task interaction.

Heart Rate

A significant main effect of Task was found, F (1,60) = 5.974, p = .017. Heart rate increased for both problem and non-problem gamblers when thinking about personally relevant losses. No significant main effect for Group or Group by Task interaction was found.

Table 9

ANOVAs of 30 seconds baseline and 30 seconds thinking about personally relevant loss

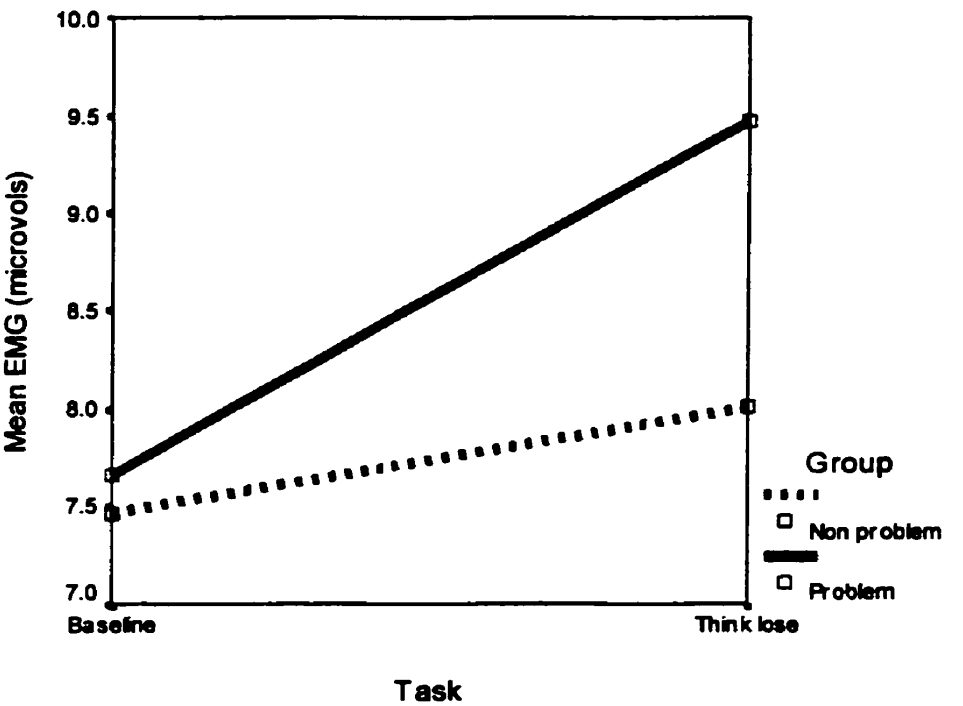
Measure	F value (1,60)	Significance	Eta^2
EMG Group	.891	.349	.015
EMG Task	4.004	.050	.063
EMG Group x Task	1.177	.282	.019
SCL Group	.000	.984	.000
SCL Task	5.248	.026*	.080
SCL Group x Task	.888	.350	.015
Heart Group	2.679	.107	.043
Heart Task	5.974	.017*	.091
Heart Group x Task	2.679	.107	.043

* significant at adjusted alpha level .033

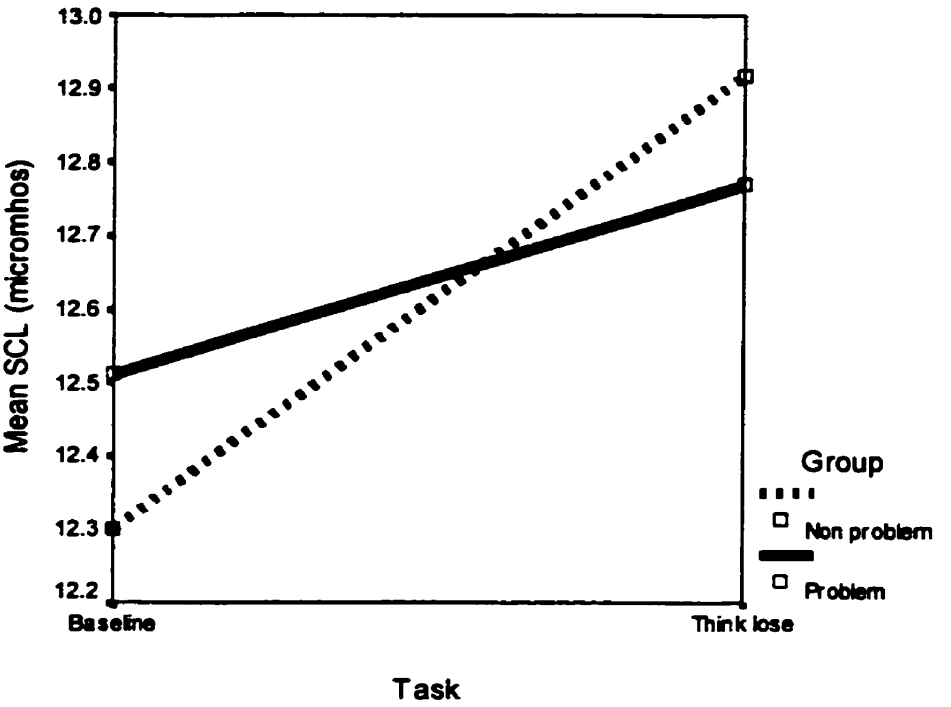
Figure 7

Physiological indices from baseline to thinking about personally relevant loss

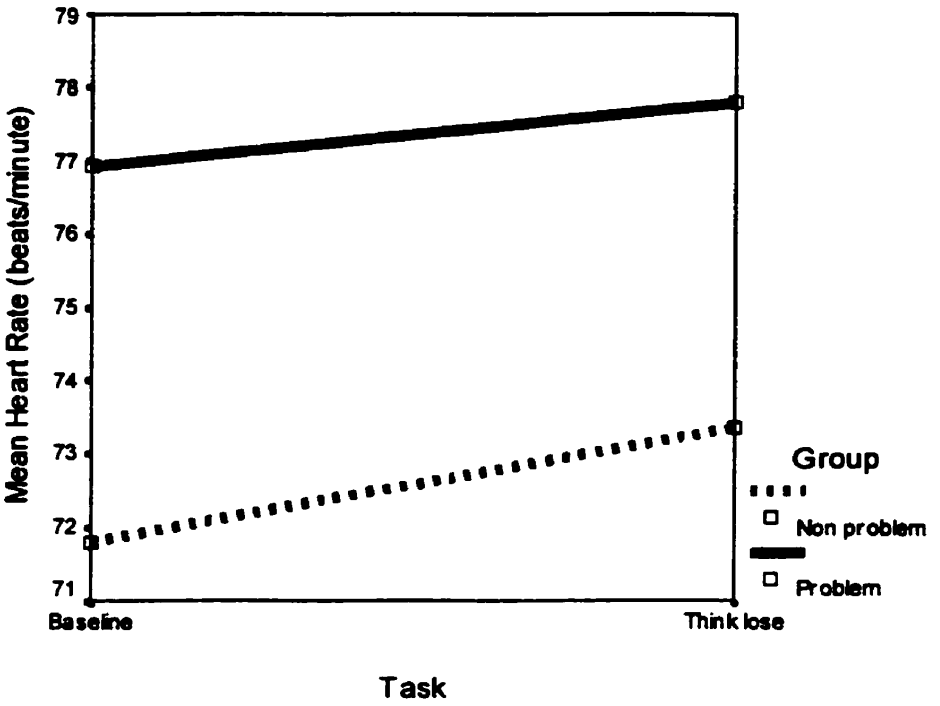
a) EMG



b) SCL


13.0
12.9
12.8
12.7
12.6
12.5
12.4
12.3
12.2
Mean SCL (micromhos)
Baseline
Think lose
Task
Group
Non problem
Problem

c) Heart rate


79
78
77
76
75
74
73
72
71
Mean Heart Rate (beats/minute)
Baseline
Think lose
Task
Group
Non problem
Problem

Research Questions

1) Do the groups report experiencing differing levels of excitement/tension while participating in the study tasks? Do the obtained physiological measures correlate with ratings of perceived excitement/tension?

There were significant differences between the groups on several items of the perceived excitement/tension questionnaire (see Table10). The problem gamblers reported feeling more excited/tense than the non-problem gamblers when resting, $t(59) = 2.578$, $p = .012$, when thinking about winning, $t(59) = 3.220$, $p = .002$, and when playing the VLT, $t(60) = 3.360$, $p = .001$.

Table 10

Mean response scores for perceived excitement/tension questionnaire

Question	Non-problem		Problem		t(df)	p
When I was ... I felt ...excited/tense	Mean	S.D.	Mean	S.D.		
Resting	2.79	1.70	4.16	2.34	(59) 2.578	.012*
Thinking about winning	6.37	2.34	7.97	1.51	(60) 3.220	.002*
Thinking about losing	4.600	2.43	5.03	2.68	(60) .662	.510
Writing alphabet	3.67	2.18	4.75	2.50	(60) 1.810	.075
Playing VLT	6.200	2.12	7.91	1.87	(60) 3.360	.001*
Doing reaction test	6.67	2.26	6.76	2.76	(57) .140	.889

*significant at an alpha level <.05

Pearson correlations between answers to the individual questionnaire items and DSM-IV criteria, self-identification as a problem gambler (SOGS question 20), Anxiety score, total Arousal Scale score, and relevant physiological measures were examined. Correlations are displayed in Table 11.

Table 11

Pearson correlations between subjective excitement score and relevant variables

Question		DSM	GSI	ANX	Self id	Arousal	EMG	SCL	Heart rate
When I was … I felt …							Base 1	Base 1	Base 1
Resting	r	.34	.38	.32	.356	-.18	.12	.002	.11
	p	.006*	.002*	.013*	.005*	.169	.358	.990	.417
	n	62	62	62	62	60	62	62	62
							Think win- base	Think win- base	Think win- base
Thinking about wins`	r	.35	.35	.26	.19	.01	.11	.03	.09
	p	.004*	.004*	.038*	.146	.939	.411	.819	.514
	n	63	63	63	63	60	61	61	61
							Think lose- base	Think lose-base	Think lose-base
Thinking about losses	r	.164	.040	.100	-.027	.079	-.043	.038	.052
	p	.198	.757	.437	.836	.549	.739	.772	.691
	n	63	63	63	63	60	61	61	61
							Neutral – base	Neutral-base	Neutral-base
Neutral task	r	.198	.178	.056	.110	.088	-.023	-.019	.002
	p	.119	.163	.662	.393	.503	.863	.884	.989
	n	63	63	63	63	60	61	62	62
							VLT start-neutral start	VLT start-neutral start	VLTstart -neutral start
Playing VLT	r	.324	.223	.155	.252	-.047	.199	.121	.226
	p	.010*	.080	.225	.046*	.723	.121	.346	.075
	n	63	63	63	63	60	62	63	63
							Reaction – base	Reaction – base	Reaction -base
Reaction test	r	.007	.053	-.028	-.155	.026	-.075	-.095	.064
	p	.959	.688	.831	.236	.850	.571	.476	.632
	n	60	60	60	60	57	59	59	59

Note. DSM = number of DSM-IV criteria endorsed, GSI = Global Severity Index Score on the BSI, Anx. = score on the Anxiety subscale of the BSI, Self id. = affirmative answer to SOGS question 20 "Do you feel you have a problem with betting money or gambling?", Arousal = total score on Arousal questions.

2) Do the groups differ in their preference for more or less stimulating activities described in the Arousal Scale? Is a preference for more stimulating activities correlated with baseline measures of arousal?

No difference was found between the problem and non-problem gamblers on mean total Arousal scores. Answers were scored 1 for the less stimulating activity and 2 for the more stimulating activity (see Appendix E). The mean for the problem gamblers was 6.61(S.D. 1.26) and the mean for the non-problem gamblers was 6.80,(S.D. 1.37), t (59) = .555, p= .581. Chi square analyses found no significant differences between the groups on answers to individual questions. Overall the 4 questions produced a reliability coefficient alpha of .69. This is slightly below the generally acceptable level for clinical significance of .70, (Cicchetti, 1994) but as there are only 4 questions in the scale further examination of the results was undertaken.

Pearson correlations were examined between total Arousal score, DSM criteria, Anxiety, GSI, self-identification as a problem gambler and physiological measures of arousal. The Arousal score was not significantly correlated with DSM criteria, Anxiety, GSI score, or self-identification as a problem gambler. The Arousal score was negatively correlated with heart rate at all baselines (baseline 1 start r (61) -. 35, p = .006, baseline 2 start r (61) -. 31, p <. 02, baseline 3 start r (60) -. 30, p =. 02, baseline 4 start r (60) =-. 28, p <. 03, baseline 5 start r (61) =-. 35, p <. 005, and baseline 6 start r =-. 305, p <. 02). Arousal Score was significantly negatively correlated with baseline EMG for baseline 3 start r (60) = -. 37, p < .005 and baseline 5 start r (61) = -. 36, p < .005. That is, a greater preference for stimulation (reflected in higher Arousal scores) was correlated with lower

baseline heart rate scores and some lower baseline EMG readings.

3) Did the groups differ in their responses to questions about dissociative experiences when gambling?

Answers to the dissociative questions were given numerical values ranging from 0 for "never" to 4 for " all the time.

The coefficient alpha for the five questions (4 dissociative questions plus the losing track of time question) was .78, which is considered to indicate a fair level of clinical significance (Cichetti, 1994). The groups differed on the total score and on each item. Means and standard deviations are displayed in Table 12.

Table 12

Responses to Dissociative questions

Question	Non prob. Mean	Non prob. SD	Problem Mean	Problem SD	t value (62)	Sig.
Total score	3.00	2.12	7.81	3.60	6.48	<.001*
1 "trance"	1.00	.80	2.18	.93	5.46	<.001*
2 "other identity"	.22	.49	1.31	1.23	4.67	<.001*
3 "outside self"	.28	.63	.875	1.12	2.59	.012*
4 "memory blackout"	.188	.47	.688	1.03	2.498	.015*
5 "lost track of time"	1.31	1.09	2.75	1.01	5.46	<.001*

* significant at alpha level <.05

DISCUSSION

Participants

The problem and non-problem groups in this study did not differ in age or gender. Problem gamblers played VLTs more often and smoked more cigarettes than non-problem gamblers. They indicated that they were experiencing greater levels of general distress and greater levels of anxiety than the non-problem gamblers. Problem gamblers reported levels of anxiety and general distress that were significantly different from the non-patient normative scores. These higher scores may be a result of the financial and social difficulties experienced by the problem gamblers due to their gambling activities. Conversely, feelings of anxiety and distress may prompt problem gamblers to engage in gambling behaviour in order to escape from unhappiness.

Both problem and non-problem gamblers reported a considerable number of past and current psychiatric and substance abuse disorders. Six of the participants in the study were being treated for schizophrenia or schizoaffective disorder. These participants were evenly divided between the problem and non-problem groups. Since these participants were all receiving social assistance and were not working, the relatively large group may be due to the availability of free time to volunteer for the study.

The most often reported motivation for playing VLTs for the non-problem gamblers was to win money, while the most often reported motivation for the problem gamblers was for the "rush". While several non-problem gamblers said they played video lottery terminals for fun, none of the problem gamblers reported playing for fun.

Hypothesis 1

It was hypothesized that problem gamblers would differ from non-problem gamblers on baseline levels of arousal. If problem gamblers were chronically underaroused, seeking to increase their levels of physiological arousal through gambling, it would be expected that they would initially demonstrate lower levels of heart rate, EMG and skin conductance than non-problem gamblers. The first analysis compared the groups on the first 30 seconds of the first baseline period. A second analysis was done after the participants had taken part in the anticipated gambling experience, using the first 30 seconds of the neutral task.

No statistically significant differences were found between the groups. This sample of problem and non-problem gamblers did not differ on baseline measures of arousal or on levels of arousal when performing a neutral physical task. A comparison of the physiological indices for the 6 baselines (Figure 2 a, b and c) indicates that the baseline levels were similar for both groups throughout the experimental session. However, significant correlations were found between baseline levels of arousal and preference for stimulating situations measured by the Arousal scale (see the discussion of research question 2 below).

A non-significant difference in heart rate was found between the groups. Mean heart rates for the problem gamblers were non-significantly higher than mean heart rates for the non-problem group. This finding was consistent throughout the various study tasks. This finding corresponds to that of Sharpe et al. (1995) who also found a similar non-significant difference in their sample. This may be a result of lifestyle – almost all of

the problem gamblers in the study were smokers.The groups differed significantly on the number of cigarettes smoked daily, with problem gamblers smoking more than non-problem gamblers.

Hypothesis 2

It was hypothesized that all participants would experience increased arousal when gambling and that the problem gamblers would display greater increases on the measured physiological indices than the non-problem gamblers. Two approaches to testing this hypothesis were used. Approach 1 compared the gambling task with comparable segments of the neutral task. Approach 2 compared the gambling task with the preceding resting baseline.

When the change in arousal from the last 30 seconds of the neutral task and the first 30 seconds of the gambling task was examined, both groups were found to have increased muscle activity (EMG) when gambling, indicating a greater level of arousal during the gambling task.

When SCL was examined an unexpected result was found. For both groups, participants' levels of skin conductance decreased from the neutral task to the gambling task. The level of physical activity employed in the neutral task may account for this unexpected result. Participants were asked to write the alphabet on an erasable board in order to provide a measurement of physiological arousal while performing a non-gambling task which would involve movements similar to those involved in playing a VLT. Unfortunately, participants tried to write the letters very quickly, covered a much

larger area than requested, and moved around more than expected. As well, many participants were not comfortable writing the alphabet and remarked that they found the task quite stressful. The neutral task became a great deal more physical and stressful than had been intended. Since SCL can be very sensitive to movement the vigorous movements and the stressful nature of the task may explain the unexpected result.

Heart rate for the two groups did not differ when measurements from the first 30 seconds of the neutral task were compared to the first 30 seconds of the gambling session. It is possible that the greater amount of movement during the neutral task affected heart rate as well as skin conductance.

When data were analyzed for a slightly later period (after the participants had been gambling or performing the neutral task for 1.5 minutes) there was a significant difference between tasks for EMG in both groups. The increased levels of EMG that were observed during the first 30 seconds of the gambling task were still present. The decrease in skin conductance level from neutral task to gambling task that was observed during the first 30 seconds was no longer observed. No difference between tasks was found for skin conductance at this later point. It may be that the participants had become accustomed to the nature of the neutral task and were not as aroused after 1.5 minutes or they may not have been moving as vigorously. No effect of task on mean heart rate was observed for the later period.

For approach 2, which compared levels of arousal from a baseline resting task to the gambling task, significant increases were found on all three physiological indices. No differences were found between the groups for EMG or SCL. There was a Group by

Task interaction for heart rate in the first 30 seconds of the gambling task – problem gamblers' heart rates did not increase as much as non-problem gamblers. There are several possible explanations for this finding. Problem gamblers in the sample played more frequently than non-problem gamblers. It may be that the problem gamblers were less aroused initially than the non-problem gamblers due to the familiarity of the task. Conversely, the greater increase in heart rate displayed by the non-problem gamblers may relate to the relative novelty of the task for them. Increased attention can be associated with slower heart rate. If the problem gamblers focus their attention on the game more intensely (as was suggested in Diskin & Hodgins, 1999) this greater attentional focus on gambling may have resulted in a somewhat slower heart rate. It also may be that the problem gamblers in this sample required a more realistic situation or a more significant accumulated wager in order to respond to the gambling situation with a similar increase in heart rate. It should be noted, however, that when the analysis was done after the participants had been gambling for 1.5 minutes, the interaction was no longer found. Main effects for task for all three indices of arousal were found, but no group by task interaction for heart rate was observed. While psychophysiological reactions are often short lived, it is necessary to be cautious in interpreting such a brief interaction.

The neutral task was more stressful and more physically active than intended. Participants employed much less movement while gambling on the VLT than they did when performing the neutral task. Even so, a significant effect of increased EMG activity during the gambling task was found for both groups. It was expected that problem gamblers would experience greater levels of arousal than non-problem gamblers when

playing.

Both groups of gamblers experienced increased EMG levels when gambling compared to levels observed during the neutral task. All participants increased on all psychophysiological indices when VLT gambling was compared to a baseline resting state, and problem gamblers were found to experience a smaller increase in heart rate than non-problem gamblers for the first 30 seconds of the VLT gambling session.

Hypothesis 3

Both problem and non-problem gamblers experienced an increase in EMG activity when thinking about personally relevant wins. Mean skin conductance for both groups also increased, although the effect did not reach significance. This finding is similar to that of Sharpe et al. (1995), who found that all the participants in the study became aroused when talking about wins. They found that problem gamblers displayed greater increases in SCL than frequent or occasional gamblers when talking about personally relevant wins. In the present study, increased EMG was found when all the participants simply thought about relevant wins. This finding would appear to support the contention that gambling related cognitions (in this case visualizing a personally relevant win) can produce physiological arousal. No differences were found for group membership. Both problem and non-problem gamblers experienced significant increases in EMG when thinking about winning.

Hypothesis 4

For all participants, the act of thinking about personally relevant losses produced increased physiological arousal as indicated by increased mean skin conductance and

heart rate. Both measures increased significantly from baseline, while EMG also increased but did not reach significance. While EMG was the only physiological measure which increased significantly when the participants were thinking about winning, both skin conductance and heart rate increased significantly when they were thinking about losing. It would appear that for gamblers in this sample, thinking about personally relevant losses resulted in a greater number of physiological reactions than thinking about personally relevant wins.

Sharpe et al. (1995) found evidence of increased heart rate and skin conductance when participants talked about personally relevant wins, with problem gamblers experiencing greater increases in SCL than high and low frequency gamblers. The present study found that both the problem and non-problem groups manifested changes in physiological arousal when simply thinking about personally relevant winning or losing situations, but did not find any differences between the groups.

Research Questions

Question 1)

The problem gambling group reported feeling higher levels of subjective excitement/tension than the non-problem gamblers when resting, when thinking about winning and when playing the VLT. However, none of the responses to the perceived excitement/tension questions were correlated with physiological measures, and higher scores of reported tension/excitement were not correlated with physiological measures of arousal at any baseline.

A significant main effect of task was found for EMG when participants were playing on the VLT compared to the neutral task, but when reported higher levels of perceived excitement when playing the VLT and physiological measures of arousal were examined, no significant correlations were found. Significant main effects were found for all three indices of arousal when the gambling task was compared to baseline levels, but no significant correlations were found between reported feelings of excitement and physiological measures from baseline to gambling.

A significant main effect of task was found for EMG activity when both groups of participants were thinking about winning. However, higher scores for subjective feelings of excitement during this task were not correlated with increased levels of physiological arousal.

While thinking about losing was associated with significantly increased levels of skin conductance and heart rate in both groups of participants, it was not reported as producing feelings of excitement/ tension in responses to the questionnaire.

The problem gamblers in this sample reported greater feelings of excitement/tension in several of the experimental situations. These findings are similar to the self-report studies summarized by Griffiths (1993). No correlations were found between the reported feelings of subjective excitement and any of the physiological measures employed in this study.

Question 2)

An interesting result was found when the total Arousal scores were examined. According to the General Theory of Addictions (1986) problem gamblers should prefer

stimulating situations in order to increase their chronically low baseline levels of arousal. Mean arousal scores did not differ between the problem and non-problem gambling groups. A preference for stimulating situations as measured by total Arousal score was not found to be correlated with variables related to problem gambling such as DSM criteria, identification as a problem gambler or higher GSI and anxiety scores. However, higher preference for stimulating situations was significantly negatively correlated with baseline heart rate for all six baseline measurements and was also negatively correlated with baseline EMG levels at two baseline measurements.

This finding provides some empirical support for the possibility that some people who have lower baseline levels of arousal (hypoaroused unipolar resting states, Jacobs, 1988) prefer stimulating situations. It does not support the contention that lower baseline levels of arousal are associated with gambling problems. It could be argued that the gamblers in this sample who had lower baseline heart rates and lower EMG levels and who preferred more stimulating situations did not have the negative childhood experiences which the General Theory of Addiction suggests are necessary for the development of gambling problems in a conducive environment. No information was gathered about the participants' early experiences or feelings of inadequacy or rejection but it should be noted that preference for stimulating situations (Arousal score) was not correlated with the GSI, which is a measure of global distress in the present.

Question 3)

Problem gambling participants reported more dissociative experiences when VLT gambling. They reported more feelings of trance, of taking on another identity when

gambling, and losing track of time when gambling. These results are similar to those found in other studies (Gupta & Derevensky, 1999; Diskin & Hodgins, 1999). It would appear from these responses that the problem gamblers in the sample perceive the VLT gambling experience differently than the non-problem gamblers. It may be this difference in perception of the gambling experience that results in differing interpretations of gambling related physiological arousal. Sharpe and Tarrier (1993) have suggested that lack of coping skills in dealing with increased arousal may lead to problem gambling (see Figure 1).

For this sample, and for the three physiological indices measured, little difference was found between the physiological responses of problem and non-problem gamblers to gambling and gambling related situations. It is possible to speculate that perhaps a relevant difference between the groups lies in how problem gamblers interpret the increased arousal produced by gambling and gambling related cues. As Orford (1985) states "the crucial importance of cognitive events and processes is now fully acknowledged even by those whose model of man is largely behavioural or physiological. This welcome trend in psychology was influenced by Schacter and Singer who demonstrated the importance, for an understanding of how emotional states are produced of the events and states to which a person attributes physiological arousal" (p.182).

Threats to Validity

Several problems became apparent during the course of the study. It was felt that

since a certain amount of movement takes place when playing VLTs it would be appropriate to incorporate a neutral task which involved similar movements. It would have been better, however, to choose a more controlled task which did not involve an element of "performance" (writing the alphabet), which was clearly stressful to some participants. The additional analysis comparing VLT gambling with the preceding baseline was therefore performed.

Due to the limited resources available, a $25.00 credit was given to each participant. Although this amount was tested when the study was being designed, and appeared to be sufficient to last for at least 4 minutes of gambling, in practice this was not always the case. Several gamblers used up their credits before 4 minutes had passed, allowing analyses to be performed for only the first 2 minutes of the gambling situation. Between group comparisons were made for this very limited time period. Video lottery gambling sessions often continue for hours at a time. The results of the present study relate only to the first two minutes of the gambling session. It may be that significant differences in physiological arousal between problem and non-problem gamblers become apparent as the session progresses. A conversation with Robert Ladouceur (personal communication, May, 1999) included the suggestion that it may be helpful to employ a reimbursement strategy to reduce the value of the credits being wagered, so that an initial stake of $25.00 could be worth 400 credits rather than 100 credits.

As well, the use of a demonstration VLT does not allow the participants to put money in the machine. Several of the participants remarked that they felt as if it wasn't their money they were playing with. As Ladouceur et al. (1991) observed when

considering issues of ecological validity in gambling studies " the crucial element is that the money won or lost during the gambling session should belong to the participant" (p.115). In future it would be better to give the participants the initial cash stake and have them turn it over to the experimenter in order to purchase credits on the machine.

Statistical Power

The observed power to detect main effects in this study was generally high, while the power to detect interactions was quite low. When the effect sizes for the univariate tests are examined it would appear that many of the interaction effects were so small that even a larger sample size would not have produced a significant effect.

Suggestions for future research

This study suggests that problem and non-problem gamblers have very similar levels of physiological arousal when they initiate a gambling session. The logical next step would be to ask gamblers to play for an extended period of time and observe their physiological responses. It would be interesting to do a small study in which several gamblers were followed while they gambled for a considerable period of time in order to examine how arousal levels may change over a lengthy gambling session. Many problem gamblers report VLT sessions lasting 6-8 hours (Smoliak, 1997). In practical terms it would not be possible to use a large number of gamblers, but it would be interesting to do a detailed study of a few extended gambling sessions, particularly in a natural environment.

In order to explore the possibility that problem gamblers perceive the gambling experience differently it would be interesting to develop a study which incorporated a

"thinking aloud" component, similar to that used by Coulombe et al. (1992). Instead of concentrating on erroneous cognitions, however, participants would be asked to express their feelings of excitement and or dissociation while they were taking place - both in gambling situations and when asked to think about relevant gambling situations.

It would be interesting to pursue the correlation between preference for stimulating situations and lower baseline heart rate and EMG in relation to the General Theory of Addictions. A study could be done using problem gamblers, occasional gamblers and non-gamblers, measuring various physiological indices of arousal and gathering information about gambling behaviour, and childhood and adolescent experiences. Since a gambling task would not be required this study could include participants who had quit or were attempting to quit gambling.

CONCLUSION

Both problem and non-problem gamblers experienced increased physiological arousal when given the opportunity to gamble on a VLT, and when thinking about personally significant wins and losses. Problem gamblers perceived themselves to be more excited than occasional gamblers, and reported more dissociative experiences when playing. They also reported their motivations for playing were for the rush, to win money, or to escape, while non-problem gamblers said they played to win money, to escape, for fun, and to avoid boredom. Few of the non-problem gamblers reported that they played for the rush, while none of the problem gamblers reported playing for fun.

The most surprising result of this study lies in what was not found. Except for the

Group by Task interaction found for heart rate from resting baseline to the first 30 seconds of gambling, no differences were found between the problem and non-problem gamblers' levels of arousal either at baseline, when gambling, or when thinking about personally relevant wins and losses.

The findings of this study offer some support for Sharpe & Tarrier's suggestion that problem gamblers lack suitable coping mechanisms to deal with the increased physiological arousal they experience when gambling. The problem gamblers in this study reported that they conceive of the gambling experience as a rush, an escape. They reported feeling more dissociated when playing and describe themselves as more excited than the non-problem gamblers while they were actually experiencing very similar physiological reactions. These findings also may offer some support for the General Theory of Addictions, since it appeared that gamblers in the study who preferred more stimulating situations had lower baseline levels of arousal. This preference for more stimulating situations was not, however, associated with problem gambling behaviour, perhaps because the other requirements of the General Theory were not met.

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APPENDIX A

NEWSPAPER ADVERTISEMENT

EXPERIENCED VIDEO LOTTERY PLAYERS: The University of Calgary is looking for volunteers to participate in a research study. Participants may win from 0 to $50.00. If you are not currently trying to quit gambling and you would like more information, please call Kate at 670-2006.

APPENDIX B

SOUTH OAKS GAMBLING SCREEN QUESTIONS

South Oaks Gambling Screen Questionnaire Items

1) When you participate in gambling activities, how often do you go back another day to win back money you lost?

   Never Sometimes (less than half the time) Most of the time All the time

2) Have you ever claimed to be winning money from gambling when in fact you lost?

3) Do you ever spend more time or money gambling than you intended?

4) Have people ever criticized your gambling?

5) Have you ever felt guilty about the way you gamble or about what happens when you gamble?

6) Have you ever felt that you would like to stop gambling, but didn't think that you could?

7) Have you ever hidden betting slips, lottery tickets, gambling money or other signs of gambling from your spouse or partner, children or other important people in your life?

8) Have you ever argued with people you live with over how you handle money? Have these arguments ever centred on your gambling?

9) Have you ever missed time from work or school due to gambling?

10) Have you ever borrowed from someone and not paid them back as a result of your gambling?

11) Have you ever borrowed from household money to finance gambling?

12) Have you ever borrowed money from your spouse or partner to finance gambling?

13) Have you ever borrowed from other relatives or in-laws to finance gambling?

14) Have you received loans from banks, loan companies, or credit unions for gambling or to pay gambling debts?

15) Have you ever made cash withdrawals on credit cards such as Visa or Mastercard to get money to gamble or to pay gambling debts? (does not include ATM or instant cash cards).

16) Have you ever received loans from loan sharks to gamble or to pay gambling debts?

17) Have you cashed in stocks, bonds, or other securities to finance gambling?

18) Have you sold personal or family property to gamble or to pay gambling debts?

19) Have you ever borrowed money from your checking account by writing cheques that bounced to get money for gambling or to pay gambling debts?

20) Do you feel that you have ever had a problem with betting money or gambling?

APPENDIX C

DSM-IV PATHOLOGICAL GAMBLING QUESTIONNAIRE

DSM-IV criteria and DSM-IV Criteria Items	
DSM-IV Criteria	DSM-IV Criteria Items
1. is preoccupied with gambling (e.g., preoccupied with reliving past gambling experiences, handicapping or planning the next venture, or thinking of ways to get money with which to gamble)	1a. Have there been periods in the past year when you spent a lot of time thinking about past gambling experiences or thinking about future gambling ventures? 1b. Have you frequently thought about ways of getting money with which to gamble?
2. needs to gamble with increasing amounts of money in order to achieve the desired excitement	2a.Have you had periods when you needed to gamble more often in order to obtain the same excitement? 2b. Have you needed to gamble with larger amounts of money or with larger bets in order to obtain the same feeling of excitement?
3. has repeated unsuccessful efforts to control, cut back, or stop gambling	3a. Have you tried to cut down or control your gambling several times in the past and found it difficult? 3b. Have you tried to stop gambling several times in the past and been unsuccessful?
4. is restless or irritable when attempting to cut down or stop gambling	4. Did you feel quite restless or irritable after you tried to cut down or stop gambling?
5. gambles as a way of escaping from problems or of relieving a dysphoric mood (e.g., feelings of hopelessness, guilt, anxiety, depression)	5a. Do you feel that you gamble as a way to escape personal problems? 5b. Does gambling seem to relieve uncomfortable emotions, such as anxiety or depression?
6. after losing money gambling, often returns another day to get even ("chasing" one's losses)	6a. When you lose money on a given day, do you often return soon another day to win back your losses? 6b. When you had a large gambling debt, did you gamble more often in the hopes of winning back your money?
7. lies to family members, therapist, or others to conceal the extent of involvement with gambling	7a. Have you often lied to family members, friends, co-workers or teachers about the extent of your gambling or of your gambling debt? 7b. Have you often hidden or tried to hide your gambling from others (e.g., family

	members)?
8. has committed illegal acts such as forgery, fraud, theft, or embezzlement to finance gambling	8a. Have you forged a check or stole something in order to finance your gambling habit? 8b. Have you committed any illegal acts, such as embezzlement or fraud, to support your gambling habit?
9. has jeopardized or lost a significant relationship, job, or educational or career opportunity because of gambling	9a. Have you had periods when your gambling caused problems in your relationships with family, friends, co-workers or teachers? 9b. Have you missed work, school or important social or family activities because of gambling?
10. relies on others to provide money to relieve a desperate financial situation caused by gambling	10a. Have you asked people to lend you money because of your financial problems due to gambling? 10b. Have you had others pay your gambling debts for you (i.e., bail you out) when you felt desperate about your financial situation?

Note. DSM-IV diagnostic criteria for pathological gambling are from APA (1994). The DSM-IV items were written in collaboration with Dr. Ken Winters. If an individual endorses either item representing a criterion, the criterion is considered endorsed.

APPENDIX D

DISSOCIATIVE QUESTIONS

1. After a session of VLT gambling have you ever felt as if you had been in a trance?

   Never Rarely Occasionally Frequently All the time

2. Did you ever feel you had taken on another identity when playing VLTs?

   Never Rarely Occasionally Frequently All the time

3. Have you ever felt that you were outside yourself watching yourself when you were playing VLTs?

   Never Rarely Occasionally Frequently All the time

4. Have you ever experienced a memory blackout for a period when you had been VLT gambling?

   Never Rarely Occasionally Frequently All the time

5. Have you ever "lost all track of time" when you have been VLT gambling?

   Never Rarely Occasionally Frequently All the time

APPENDIX E

AROUSAL SCALE

Circle the answers that best describe you

I feel BEST when

1) I am calm and relaxed vs. I am stimulated

2) I am engaged in an exciting activity vs. I am engaged in a soothing activity

3) I am around lots of people vs. I am quiet and alone

4) I am resting vs. I am active

APPENDIX F

DEMOGRAPHIC QUESTIONNAIRE

Participant Number _____

Age _____

Gender _____

How often do you play VLTs? _____/week _____/month

Which hand do you use to play VLTs? Right Left

Are you a smoker? How much do you smoke?

APPENDIX G

SEMI STRUCTURED INTERVIEW GUIDE

I'd like to talk about VLTs for a few minutes:

Why do you like to play them? What is it you enjoy?

When and where do you like to play?

Do you go alone or with friends?

Do you prefer a particular game? Why?

Do you have a strategy?

How long have you been playing?

How did you start playing VLTs?

Significant win:

Where, with whom, time of day, place details– where sitting

What had happened earlier, how much did you bet, what game were you playing, how did you feel, what did you do, other people around

Significant loss:

Where, with whom, time of day, place details-

Where were you sitting?

How much did you lose?

What game were you playing?

How did you feel?

What other people?

APPENDIX H

PERCEPTION OF EXCITEMENT/TENSION SELF REPORT QUESTIONNAIRE

Please choose a number from 1-10 that best describes how you were feeling during the tasks you have just completed.

1 = no excitement or tension 10 = very excited/tense

When I was resting I felt

1 2 3 4 5 6 7 8 9 10

When I was thinking about winning I felt

1 2 3 4 5 6 7 8 9 10

When I was thinking about losing I felt

1 2 3 4 5 6 7 8 9 10

When I was writing the alphabet I felt

1 2 3 4 5 6 7 8 9 10

When I was playing on the VLT I felt

1 2 3 4 5 6 7 8 9 10

When I was doing the reaction time test I felt

1 2 3 4 5 6 7 8 9 10

APPENDIX I

Physiological Arousal During Video Lottery Play

Investigators: Katherine Diskin, MSc. Student, Faculty of Medicine, University of Calgary, and David C. Hodgins, Associate Professor, Department of Psychiatry, Faculty of Medicine, University of Calgary.

This consent form, a copy of which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research project is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The results of this study will be useful in understanding how people react when playing VLTs and when talking about VLT wins and losses. Heart rate, skin conductance and muscle tension measurements will be taken to help us learn more about what happens when people play VLTs.

You will be asked questions about your gambling habits and your moods, and about your alcohol and substance use.

You will be shown the sensors that will be used to collect physiological data during the session. If you are willing the sensors will be attached to your hand and

forehead. Your heart rate, skin conductance and muscle tension will be measured during the following tasks: Quiet rest and relaxation; while playing on a video lottery terminal the way you normally play; while doing a short reaction time test while playing on the VLT; and while talking about your VLT experiences. Between each task there will be a short relaxation period.

You may refuse to answer specific questions and can withdraw from the study at any time. The results of the study will be completely confidential and your name will not be used on any of your responses. Information from this study will not be made public in any form in which you personally can be identified as a participant. Data from this study will be stored on computer disks that will be stored in a locked cabinet in the Addiction Centre.

You will not receive payment for your participation in this study but you will have the opportunity to win up to $50.00 by playing on the VLT. You will be given an initial "stake" of $25.00 when you begin to play on the VLT. No more credits will be added during the session. You will play the game of your choice for at least 4 minutes. You may stop after 4 minutes have elapsed or continue playing for as long as you wish or until the investigator stops the VLT session. You will receive a cash reimbursement for the credits you have accumulated on the VLT to a maximum of $50.00. Additionally, the participant who accumulates the highest number of credits during the course of the study will receive a $50.00 restaurant gift certificate when the study has concluded. Your Foothills Hospital parking expenses will be validated.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate. In no way does this waive your legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. You are free to not answer specific items or questions in interviews or questionnaires. You are free to withdraw from the study at any time without penalty. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation. If you have further questions concerning matters related to this research, please contact Kate Diskin, 670-2006.

If you have any questions concerning your participation in this project, please contact the Office of Medical Bioethics, Faculty of Medicine, University of Calgary at 220-7990.

_____	_____
Participant	Date
_____	_____
Investigator	Date
_____	_____
Witness	Date

A copy of this consent form has been given to you to keep for your records and reference.