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**The identification of near misses in
electronic gaming machines and its
effect on gambling behaviour**

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Background

The gambling industry in Australia has grown substantially over the last twenty years, resulting in a significant rise in gambling expenditure. A number of factors are likely to have contributed to this rise, particularly as a result of the increasing number of casino establishments that have been introduced and the legalization of gaming machines in most states and territories (Tasmanian Gaming Commission, 2003). The Tasmanian Gambling Commission reports that Australians lost approximately \$15 billion on gambling in 2002 and around 80% of people were estimated to have engaged in some form of gambling activity over the last year (Productivity Commission, 1999). The largest proportion of total gambling expenditure amongst Australians was on electronic gaming machines each year, which account for approximately 59.4% of expenditure per year (Tasmanian Gaming Commission, 2003).

Although the majority of Australians do not experience a gambling problem, recent studies indicate that negative consequences associated with gambling have become a significant public health issue (Korn, 2000). Prevalence estimates of problem or excessive gambling, found that around 2.3% of the adult population exhibiting severe gambling-related

problems (Productivity Commission, 1999). Indeed, while electronic gaming machines account for slightly over half of all gambling-related expenditure, it is estimated that approximately 80-90% of all gamblers presenting for treatment have difficulties predominantly with electronic gaming machines (Walker, personal communication). Research indicates a significant increase in the associated personal, financial and social consequences of excessive gambling behavior (Productivity Commission, 1999). The Australian Productivity Commission (1999) and the American National Research Council (1999) has collated national data from a number of studies concluding that the costs of problem gambling include depression and anxiety, suicide, job loss relationship breakdown, debt, criminal offences and social dysfunction.

The prevalence of problem gambling has been found to be directly related to the degree of accessibility of gambling, especially in relation to poker machines (Productivity Commission, 1999, Ladouceur et al, 1999). In addition, as electronic gaming machines become more and more frequently located where alcohol is available, it is more likely that subcultures that drink regularly will also gamble more frequently (Sharpe, 2002). Estimations of the rates of problem gamblers are higher amongst people who gamble regularly, reaching 12.5% and

20.7%, among patrons playing poker machines in registered clubs and hotels, respectively (Blaszczynski, Sharpe and Walker, 2001).

Moreover, rates of gambling are thought to be higher amongst those individuals not included in traditional prevalence studies, such as the homeless, prisoners and amongst youth.

Hence, it is likely, particularly amongst those who regularly play electronic gaming machines, that the proportion who develop problems is underestimated by traditional prevalence rates.

The original gaming machines were known as fruit machines or slot machines and are still the most commonly available machines in some countries, such as the USA and UK. Playing a slot machine generally consists of three reels on one line which is spun. If all reels display matching symbols after spinning, it will result in a win (monetary or credit payout). Early machines in Australia were similar, however, in recent years as well as becoming more accessible, electronic gaming machines have also become considerably more complex. In NSW and some other Australian jurisdictions, the electronic gaming machines (EGMs) are characterised by five simulated reels over a series of lines (up to 25) that appear on a video screen. These more recent structures of the game allow the game manufacturers a greater degree of freedom in the structure of the game and offer a greater variety of feature and choices to the gambler, such as the opportunity

to vary wagers, and inclusion of bonus features. However, the degree to which these changing characteristics of EGMs affect the way in which players respond to gambling is unknown. To date, there has been relatively little research that has investigated the issues widely discussed in the literature as contributing to the development of problem levels of gambling with reference to the structural characteristics of these particular machines. It is likely that the degree to which important concepts, such as cognitions about gambling and/or arousal in response to gambling will differ depending upon the nature of the gambling task. Hence, it is important to consider the specific nature of the gambling task, if one is to understand the factors that contribute to problem levels of gambling in our community in 2004.

Theories of problem gambling

In the past decade, cognitive-behavioural models of gambling have gained wide acceptance in the area of problem gambling, since the first such model was espoused in 1993 (Sharpe & Tarrier, 1993). According to a cognitive-behavioural model of problem gambling, all forms of gambling are reinforced by a variable and intermittent pattern of reinforcement. That is, players do not win on every trial, but rather experience wins unpredictably on some wagers and not on

others. This schedule of learning is known to result in the fast acquisition of behaviour that is resistant to extinction even when a large number of trials fail to provide any reinforcement. This schedule of reinforcement is exemplified by EGMs, whereby small, intermittent wins are relatively frequent and occur immediately following the wager.

In addition to the direct learning effects, players experience arousal in response to winning outcomes. As such, a process of classical conditioning occurs. That is, players experience arousal in response to winning outcome and learn to associate play with this arousal, which encourages future play. Moreover, the schedule of reinforcement also encourages players to develop irrational beliefs that promote further play. The most well documented of these is the gambler's fallacy, where players assume that when a series of losses has occurred, players erroneously believe that a win is more likely, and hence change their gambling behaviour accordingly by chasing their losses. As such, win or lose, gamblers continue to play creating a vicious cycle that perpetuates gambling (Sharpe & Tarrier, 1993).

A revision of the earlier cognitive-behavioural model of pathological gambling was developed in order to incorporate the growing body of empirical literature that was conducted during the ensuing decade (Sharpe, 2002). This

reformulated model emphasised the importance of a range of social, biological, environmental and psychological factors in the etiology and development of problem gambling. Clearly, the availability of gambling opportunities within a particular community and the social acceptability of gambling will determine the base rate of gambling in society. In those jurisdictions where gambling opportunities are easily available, it is likely that individuals will become exposed to gambling at some stage of their lives. While the majority of individuals will not develop problems with gambling, some individuals are believed to be more at risk of developing gambling problems than others.

Research indicates that both aspects of the individual and their early gambling experiences might contribute to subsequent problems with gambling. For example, there is evidence that suggests that those individuals who experience large early wins are more likely to develop gambling problems. This is likely to be partly due to developing positive expectancies about the outcome of gambling, but may also be due to a stronger conditioning experience. That is, big wins are known to be associated with higher levels of arousal and hence the gaming environment is likely to become associated, not only with more positive attitudes, but also with increased arousal that may promote play (Sharpe, 2002). There is also evidence to

suggest that those with high trait levels of impulsivity are also more at risk of developing gambling problems (Vitaro, Arseneault & Tremblay, 1999).

Specifically, it is likely that there is an interaction between the gaming environment and individual characteristics that contribute to the development of problem gambling in vulnerable individuals. For example, it is known that people with high trait levels of impulsivity are more impervious to punishment and at the same time more insensitive to positive reinforcement. Hence, not only might impulsive people be less able to control their behaviour in general, but they may also be more sensitive to the exact schedules of reinforcement that characterise gambling, and are exemplified by EGMs (Sharpe, 2002).

The reformulated biopsychosocial model takes a diathesis-stress framework. That is, in those individuals where there is heightened vulnerability, coupled with accessibility, unhelpful beliefs and arousal, gambling problems are more likely to develop. Hence, when the player wins, they believe that they are on a lucky streak and continue to play. Alternately, when they lose, they believe that the win is just around the corner and continue to play. Hence, win or lose the player will continue to gamble. The deterioration into problematic levels of gambling is argued to be

mediated by coping strategies. That is, those who are more able to control their behaviour will be less likely to continue to gamble at all costs. However, those with poor coping strategies, or whose coping strategies are compromised by stress, alcohol use or other factors, are more likely to continue to gamble (Sharpe, 2002).

Once gambling behaviour has become problematic, the consequences of gambling compound the existing problem, creating a vicious cycle. That is, gamblers incur debt, which encourages further gambling in the hope of recouping their losses. As this process continues, gamblers become more stressed and then turn to gambling as an escape from the stressors of their life. As such, the gambling problem becomes more serious affecting all aspects of the gambler's life in the most severe manifestations of pathological gambling.

The pathways model of problem gambling (Blaszczynski & Nower, 2002) shares many characteristics with the biopsychosocial model of problem gambling, but was developed in response to an increasing body of evidence suggesting that problem gamblers are not in fact a homogenous group. Hence, the pathways model attempts to identify subtypes of problem gamblers based on the relative contribution of a variety of social, biological and psychological factors in the development of

pathological gambling. The pathways model specifies three distinct pathways through which problem gambling can develop.

The first sub-group of gamblers that Blaszczynski and Nower (2002) identified as behaviourally conditioned problem gamblers. This sub-group are thought to develop gambling problems simply as a consequence of becoming involved with gambling either through peer groups or by chance and become conditioned via the principles of operant and classical conditioning. The mechanisms through which the problematic level of gambling develops are those described above drawn from early cognitive-behavioural models of problem gambling. As the name suggests, for the behaviourally-conditioned gamblers, social and behavioural factors are viewed as the dominant cause of the development of their problem gambling. The negative mood states commonly associated with problem gambling (e.g. anxiety and depression) are seen as secondary to the gambling and typically resolve once gambling is resolved.

The second subtype have been described by Blaszczynski and Nower (2002) as having more serious psychopathology than the behaviourally conditioned group and are labelled as emotionally vulnerable problem gamblers. For this group, psychological difficulties are pre-existing and precede any

difficulties with gambling. Hence, amongst this group, psychological factors are the primary etiological factor with gambling seen as a symptom of the underlying pathology. The emotionally vulnerable group of gamblers is thought to gamble largely in order to alleviate negative mood states and typically have elevated levels of anxiety and depression. The final sub-group identified by Blaszczynski and Nower (2002) are labelled the 'anti-social impulsivists' and represent the most severe end of the gambling spectrum. This group is characterised by heightened levels of impulsivity, which predispose individuals to problems not only with gambling, but with a range of impulsive and anti-social behaviours. Indeed, at the extreme, pathological gamblers in this group can meet the criteria for antisocial personality disorder. This group of problem gamblers are most likely to have multiple addictions and other co-morbid psychopathology and personality disorder features (Sharpe, 2003). In this sub-group, the impulsivity is thought to leave the individual particularly vulnerable to the pattern of reinforcement provided by gaming environments, as described above. Despite some differences in emphasis between the Pathways model and biopsychosocial model, both agree that the structural characteristics of EGMs provide a learning environment that encourages the development of beliefs about gambling that promote

continued play. These beliefs are thought to be necessary to the development of problem gambling, although not necessarily sufficient. The emphasis on erroneous beliefs in the development of pathological gambling has given rise to increased research in recent years on the cognitions of problem and pathological gamblers.

Cognitions and gambling

All forms of gambling are based to a large degree on the outcome of a chance occurrence. However, some forms of gambling (such as horse race gambling or card games) include an element of skill. The outcomes from electronic gaming machines (EGMs), on the other hand, are legislated to be entirely random, and as such, the skill or luck of the player will not influence the outcome of the wager. Moreover, in EGMs each individual bet is independent from the previous bet. Therefore, the probability of having a win is identical regardless of whether the previous wager resulted in a win or a loss. However, it is well documented that the majority of people do not have a good understanding of the concept of randomness, nor of independence between different outcomes (e.g. Ladouceur and Walker, 1998). As such, it is perhaps unsurprising that irrational beliefs are common amongst those who play EGMs regularly (Griffiths, 1993).

A number of cognitive errors have been described in relation to problem gambling. One common cognitive error, the 'gamblers fallacy' was first described by Leopold (1978). The gambler's fallacy refers to belief that if a series of losses have occurred, the chance of a win is increased. Players who believe that this is the case are argued to change their betting strategy when faced with a series of losses, in the belief that the win is imminent. This leads to the behaviour described as chasing losses, where the player continues to bet increasing amounts in the hope of recouping the growing losses that they have sustained.

Griffiths (1993) has also described the illusion of control, whereby players believe that they can control the outcome of wagers even on fruit machines where there is no skill involved. Some players attribute their control to such variables as luck, while others believe that during interactive phases of play (such as holding or nudging), they are able to influence the outcome. These beliefs are termed erroneous because the outcome of any period of play is pre-determined electronically and is not influenced by the player and their behaviour.

The first methodological approach into the association between irrational beliefs and gambling behaviour was the 'talk aloud'

approach developed by Ladouceur and Gabourey (1988). The 'talk-aloud' approach required participants to talk aloud as they gambled, verbalising their thought processes. The experimenter then categorized the verbalisations into irrational and rational verbalisations. Ladouceur and Gabourey (1988) found irrational verbalisations were present even in low frequency gamblers. Indeed, a large proportion of verbalisations during play have been found to be irrational. For example, both Ladouceur et al (1991) with video poker players and Walker (1992) in poker machine gambling, found that 80% of verbalisations during play could be regarded as irrational. A similar result was observed more recently. Delfabbro and Winefield (2000) using the talk aloud method found that 70% of gambling-related cognitions could be categorized as irrational.

Coventry and Norman (1998) criticised the talk aloud method because although irrational verbalisations may occur, this does not mean that gamblers actually believe them or that these verbalisations influence play. Their study did not find a relationship between irrational verbalisations and heart rate measures or bet size. In contrast, an earlier study by Coulombe, Ladouceur, Desharnais, & Jobin (1992) did find evidence that irrational verbalisations were associated with larger increases in heart rate during play. More recently, Tavares (2003)

conducted a series of studies that demonstrated that a series of small wins prompted illusions of control and skill over chance games. Moreover, his results indicated that there was a direct relationship between irrational verbalisations and increased bet size (Tavares, 2003).

Similar results have also been found in questionnaires asking people to endorse various beliefs. For example, Griffiths (1990) obtained questionnaire data from 39 male and 11 female pathological fruit machine players and reported that 48% of participants reported some degree of skilful activity involved in playing the fruit machines. More recently, Joukhador, Blaszczynski, & Maccallum (2004) also demonstrated that pathological gamblers endorsed more erroneous beliefs than regular gamblers. Hence, the available research strongly suggests that erroneous beliefs are common amongst gamblers and more common amongst pathological gamblers. Although relatively little data is available, the available data suggest that erroneous beliefs do, in fact, affect play.

One cognitive distortion that has been discussed in the literature, but less often studied is that of the 'near miss'. The near miss was first coined by Reid (1986) refer to a losing outcome that is close to a win. Reid (1986) defined the near miss as a characteristic of

gaming environments where, for example, on scratch lottery cards it is more common to have two out of three matching symbols than would be expected by chance. Reid argued that players believe that because the outcome was close, that they had 'nearly won'. However, nearly winning combinations are, in fact, losses and the chance of winning is not altered as a result of nearly gaining a winning combination. However, if as Reid (1986) argued these 'near misses' influenced players gambling behaviour, then players must perceive that gaining a near miss makes a win on subsequent wagers more likely. If this is the case, then the near miss is simply another form of cognitive distortion.

The near Miss

Although the 'near miss' was originally discussed in relation to scratch lottery tickets, it has become discussed more widely in the context of problem gambling and applied to the study of fruit machines. Defining a near miss on traditional fruit machines is relatively straightforward. With traditional fruit machines, there is usually one payout line that is located in the middle of a three by three matrix. When three winning symbols (of the same nature) are displayed on the middle line, the jackpot is won. When two winning combinations occur on the middle line, and a third matching symbol appears either marginally above or below the position which would have resulted in a win, it

is argued that this represents a 'near miss'. Griffiths (1990) argues that a near miss is still strongly reinforcing despite the fact that there is no financial gain resulting from such a combination. Presumably this is because players believe that they almost won the jackpot. As such, Griffiths (1990) argues that the near miss is an additional 'intermediate' reinforcer that occurs in between winning outcomes, but which by association is also rewarding and serves a similar function to a winning outcome.

Despite the fact that the near miss has been discussed for nearly two decades, there is relatively little research that has sought (a) to confirm whether gamblers do identify near misses in gambling situations; or (b) to examine whether the presence of near misses affects arousal and/or gambling behaviour. Most of the available literature has focused on the second question.

Griffiths (1991) reported the first published study of the 'near miss' in a sample of poker machine gamblers. Griffiths (1991) asked participants to subjectively rate their mood and subjective arousal before, during and after playing on fruit machines. The researchers then documented winning outcomes and outcomes corresponding to near misses. Increases in subjective arousal were reported in response to winning outcomes and near

misses but not in response to losing outcomes. Although this suggests that players are affected by the near miss, no attempt was made in this study to determine whether players identified near misses, or whether these influenced aspects of their play. Moreover, there was no independent measurement of arousal.

In contrast, Gulliford (2000) compared the autonomic responses of pathological gamblers with social gamblers who watched videotaped segments of play using two conditions. In one condition, the wins (identical in both conditions) were punctuated with all 'near misses' while in the other wins were interspersed with outright losses. The results showed that pathological gamblers became more aroused in response to the near miss condition than the loss condition. However, this was not the case for social gamblers. Gulliford (2000) also asked players how likely they believed it was that the player on the video would win if they continued to gamble. The pathological gamblers rated it as more likely that they player would win following the 'near miss' video, whereas the reverse was true for social gamblers. Nonetheless, participants future behaviour was not directly assessed. Moreover, near misses were defined in relation to only one reel, however, 92% of problem gamblers reported that they would use the maximum bet strategy (i.e. bet 20 lines by 1 credit) compared to only 13% of the high frequency group and 0% of low frequency,

when asked. Therefore, it remains possible that the problem gamblers were responding to wins rather than 'near misses'. Since none of the participants were able to identify the difference between the segments, it was unclear whether the participants (either problem or social gamblers) actually identified near misses. Only three studies have empirically examined the effect of near misses on gambling behaviour. Although the term near miss was not coined until 1986, Strickland and Grote (1967) conducted an experiment on the old style of slot machine that is relevant to the phenomenon. They argued that the first reel on a slot machine tends to have a larger proportion of winning symbols than were observed on the second reel. Since on the old style machines, the reels stop spinning from left to right, Strickland and Grote (1967) argued that the player is most likely to see a winning symbol early on in the outcome sequence and believe that a win is more likely. Strickland and Grote (1967) tested the effect of the order of winning symbols appearing on reels on subsequent play. Hence, they manipulated whether frequent winning symbols occurred on the first or third reel of the machine. They found that when the winning symbol occurred more frequently on the first reel it led to significantly longer play than when it occurred later. They interpreted the results as indicating that winning symbols occurring on earlier reels convinced players that the machine was more

likely to win and hence encouraged further play. This effect is almost identical to the effect that has subsequently been linked to the 'near miss'. Despite this result that seems to support the relevance of the near miss, it was not until 1990s when research returned to this question.

Chantal, Vallerand, Ladouceur and Ferland (1996) examined the effect of the near miss on persistence using a computerised roulette wheel. Three losing streaks were programmed to yield 0%, 33% and 67% of losses as near misses. A near miss was defined as an outcome of fewer than three numbers away from the number that had been chosen for the wager. Results showed that half the participants in the 33% condition, made additional bets during the free choice period compared to none in the other conditions. Thus it appeared that when there were too many near misses, participants no longer viewed these as signalling a win was close at hand. However, when the near misses occurred intermittently, participants continued to believe that wins were more likely if the outcome was close to the win. These results supported the contention of Reid (1986) in the original paper who stated that repeated exposure to near miss stimuli would reduce their value as signals that success was imminent.

In another roulette simulated investigation, Wohl and Enzle (2003) studied the effect of a

near 'big' win and a near 'big loss in a series of two related experiments. In experiment 1, researchers assigned the 30 participants to one of two conditions, a near big loss and a near big win condition. In the big loss condition, the person landed just past the 'bankrupt' section, (indicative of a near loss). In contrast, participants in the near big win condition, just missed winning the jackpot. Wohl and Enzle (2003) hypothesized that the degree to which the person viewed him/herself as lucky, would affect their betting behaviour. Thus their participants were asked to rate the degree to which they perceived themselves to be lucky. Participants in the near big loss condition were found to perceive themselves as luckier compared to those in a near big win, even though all participants had won an identical amount. In addition, these differences in self-perceived luck affected future gambling behaviour. Participants experiencing a near big loss bet a significantly greater number of tokens in the subsequent roulette game compared to those participants in the near big win condition.

In the second experiment 100 participants to one of five different types of win/loss conditions. Results supported those findings from the first experiment that participants who experienced any type of near big loss perceived greater personal luck and subsequently chose to bet more tokens in the

next roulette game. No effect was found between the near big win or any of the control conditions. These results seem to suggest that nearly losing everything, but not losing convinces people that they are lucky. Further, perceptions of luck appear to influence betting strategy. However, nearly missing the jackpot did not lead participants to view themselves as luckier, nor did it influence gambling behaviour. Hence, these results are in contrast to those of Chantal et al., (1996). There are two major differences between these two studies. The first is that Chantal et al., (1996) focused on an 'ordinary' win, where in a typical roulette game players would win 32 times their stake, whereas Wohl and Enzle (2003) focused exclusively on winning a 'jackpot' versus becoming 'bankrupt'. Clearly, the nature of the latter game differs somewhat from a usual gaming scenario (where becoming bankrupt on only one spin is only possible where one chooses to risk everything) and it is unclear the degree to which this changes the contingencies. The second major difference is that Chantal et al., (1996) looked at persistence (i.e. whether players made additional bets) rather than size of the wager following a one-off near loss or near win. It may be that the influence of near misses on persistence and bet size differ. Clearly, however, these results attest to the importance of considering both the nature of the game in question, but also a range of behavioural outcomes.

In the only study to explicitly investigate the near miss in an experimental design on EGMs, Kassinove and Schare (2001) examined the effect of the near miss and early big win on persistence at slot machine gambling. One hundred and eighty male and female undergraduates played a four wheel, one line slot machine. The slot machine was programmed so that the the outcomes were near misses on 15%, 30% or 45% of the trials.

Similarly, the program also varied whether or not a big win was experienced early on. Surprisingly, the big win did not influence subsequent play in terms of persistence. However, in keeping with the findings from Chantal et al., (1996) using a roulette based paradigm, the 30% near miss condition led to greater persistence than either the 15% or 45% near miss conditions.

While Kassinove and Schare's (2001) study appears to demonstrate the applicability of the near miss to the study of EGMs, there are potentially two reasons to question the relevance of the results to modern-day EGMs. The first is that despite a series of studies that appear to find that the near miss or related phenomenon do in fact influence behaviour, none of the studies have reported whether or not players actually identify the resulting outcomes as 'near misses' since these decisions are made a priori by the researchers.

The only study that has addressed this question is a recent study by Dixon and Schreiber (2004). They investigated win estimations of 12 participants who played a commercial slot machine in a casino-like setting. According to the protocol, when a near miss occurred, which the researchers defined as two out of a possible three symbols was present, participants were asked to determine whether the outcome was closer to a loss or a win. All 12 participants rated the near-miss trials as closer to a win than a loss. Clearly, this study is limited by the small sample size. Nonetheless, it is the first study to date to indicate that players actually link losing outcomes that are close to wins, as closer to wins than losses (i.e. a near miss).

The second reason to question the applicability of studies to date to modern EGMs is the level of complexity that characterises EGMs, in NSW and increasingly in other jurisdictions. Both Kassinove and Schare (2001) and Dixon and Schreiber (2004) relied on a machine where the winning combination occurs (or does not occur) on one line. Hence, it is easy to determine whether or not the outcome is a win or a loss, or whether the person needed only one symbol in a particular place in order for a win to have resulted. The complexity of modern EGMs in NSW makes this a much more difficult task. Research has suggested that on these machines, most players use a maximin strategy

(Blaszczynski, Sharpe & Walker, 2001). That is, they bet one credit on the maximum number of lines that the machine offers. In some instances this is as many as 25 lines. In fact, the combination of lines is so confusing that machines display the lines and combinations in a series of tables with five lines per table, because otherwise the possible winning combinations would be indistinguishable. Anecdotally, naïve gamblers often do not understand the outcomes of these complex machines and in some instances do not understand why a particular combination resulted in a win. Hence, is it possible on these machines to determine whether there is a 'near miss' if naïve players have difficulty identifying a win.

To exemplify this, take the definitions typically applied in previous research. Typically, a near miss is defined as when two symbols occur in one line with the matching symbol occurring either in the line above or below the other two symbols. If a player is wagering on as few as five lines on a typical EGM in NSW, this combination would actually represent a small win. To confuse matters further, if a player bet on 20 lines, some winning combinations of three symbols might pay as little as 5 credits when the original wager was 20 credits. This represents a net loss of 15 credits. However, we do not know how players view such an outcome. Is it viewed as a win of 5 credits?

Alternately, is it viewed as a loss of 15 credits? Or, is it viewed as nearly winning a larger amount: a near miss? Moreover, is the way in which a player interprets such outcomes related to how much exposure players have had to the machines and/or to their status as a regular or problem player? To date, the research has concentrated on simple paradigms where wins and losses are fairly unambiguous and so the chance of recognising a near miss is great. Moreover, because those experimental studies that have manipulated the near miss have required participants to play a simulated gambling game, studies have been confined to university undergraduates, many of whom are likely to be naïve to such games. Therefore, whether problem players or regular, non-problem players are more likely to identify near misses has yet to be explored.

Relevance and importance of study

The bulk of the research that has been conducted seems to suggest that near misses increase persistence and thus have the potential to contribute to the development of irrational cognitions that contribute to excessive gambling, regardless of the gambler's personality, environment or genetic makeup (Griffiths 1990). There has recently been considerable legislation introduced to minimise the harm associated with problem gambling (see Blaszczynski et al., 2001 for a review).

This has led to increased efforts to explore the effectiveness of various harm minimisation strategies by changing the structural characteristics of EGMs. However, the gaming industry has expressed considerable concern at the effect of such strategies in reducing their profit, while little evidence is available to suggest that such strategies specifically target problem players. If the near miss was found to be associated with problem gambling and to lead to increased persistence, programs could be developed that prohibited near miss screens at no cost to the manufacturer. However, the effect of near misses on play needs to be demonstrated on simulated games that reflect the level of complexity that is typical of modern day EGMs.

If the near miss is relevant as a potential harm minimisation strategy, it would need to be demonstrated that (a) a sizeable proportion of players identify near misses on screens not only when just one line is played, but also when the maximum number of lines is played; (b) that problem gamblers view screens more positively (i.e. more likely to rate screens as wins or near misses) than regular, non-problem players; and (c) that the inclusion of near misses in simulated games based on modern day EGMs increases persistence or bet size.

Hence, the aims of this research were:

1. To determine whether a consensual definition of a 'near miss' can be achieved.
2. To investigate the predictors of the proportion of outcomes viewed positively (i.e. wins or near misses) in comparison to negatively (i.e. as losses)
3. To investigate whether the definitions vary as a function of gambling status (i.e. regular versus problem gamblers.
4. To determine what effect the inclusion of near misses has on persistence in play, satisfaction and patterns of play.

The outcome of this study will be significant in that if near misses are found to influence the play rates of participants in this study and their beliefs about this game, this will be helpful in developing effective harm minimisation strategies to reduce the risk of electronic gaming machines for those who are vulnerable to problems with gambling.

Study 1

Aim

The major aim of study 1 was to determine whether a consensual definition could be reliably achieved in three groups. To date, only one study has aimed to determine whether, on questioning participants identify 'near miss'

outcomes as being closer to wins than losses. Dixon and Schrieber (2004) asked gamblers, during play in a real venue and found that all 12 participants identified near misses as being closer to wins. However, this study was limited by an extremely small sample size of players about whom little information was presented. For example, it was not known whether these players were all problem gamblers or regular players who did not have problems with their gambling behaviour. Moreover, the nature of the machine on which those players were gambling was considerably less complex than modern day EGMs.

The present study aims to investigate whether a consensual definition of a near miss can be obtained by asking participants to rate a series of consecutive screens from a real EGM (The Queen of the Nile), which is the popular machine in NSW (Aristocrat Industries). The responses of three groups of participants were compared: university undergraduates, regular, non-problem gamblers and problem gamblers. It was anticipated that the degree to which near misses may be able to be identified would depend upon the complexity of the game, such that where a large number of combinations could potentially result in a win, fewer near misses would be identified. In order to test this prediction, screens were presented where only one line was played (simple), five lines were

played (moderately complex) and twenty lines were played (complex).

It was predicted that for some screens the majority of participants would rate them as a near miss. It was also predicted that more screens would be rated as near misses when only one line was available, than when five or twenty lines were available. Further, it was predicted that problem gamblers would rate screens more positively than regular players (i.e. would be more likely to identify wins, and near misses), who would in turn rate screens more positively than university undergraduate students.

Method

Participants

The study included three samples from an adult population: an undergraduate sample, a social gambling and a problem gambling group. The undergraduate sample (n= 92) were all university students who were studying in their first year of a psychology course, who are required to participate in experiments as part of their studies. They all received course credit for participating in the project. Participants were informed of the study through the experimatrix system, which gives students information about each available experimental study and allows

participants to choose studies of interest in which to take part.

The social gambling group (n=57) was recruited at a popular leagues club where members were approached to participate in the study. Participants were paid \$20 for the time and effort spent participating in the study. The study was advertised at one local club in the weeks preceding experimentation and those interested were invited to sign up and given available times to complete the experiment. The problem gambling participants (n=59) were drawn from both the university and social gambling samples and selected based on a score above three, which has been argued to represent at risk problem gamblers, on the South Oaks Gambling Scale (Lesieur & Blume, 1987).

Procedure

Participants were given information regarding the experiment, either in writing (undergraduate sample) or through announcements and written advertisements (social gambling sample) and were asked to sign up for an available time. Once participants arrived at the experimental session, all participants were given a subject information sheet describing the nature and purpose of the study and asked to sign a consent form prior to commencing the study. The study protocol was approved by the

Human Research Ethics Committee of The University of Sydney. Prior to the experiment, players were given the opportunity to read the Player Information Pamphlet that explained the rules of a popular electronic gaming machine 'Queen of the Nile', to ensure familiarity with the basic rules. In addition, a brief explanation of gaming machines was given to ensure that all participants were familiarized with the nature of the game, from which the screens were derived.

Six hundred consecutive electronic gaming machine screens that had been photographed using a digital camera prior to commencing the study were loaded onto a computer. Two hundred screens were photographs of play on only one line, 200 reflected play on five lines and 200 reflected play on 20 lines on a standard Queen of the Nile machine. Screens were then randomized in blocks (one line, five lines and 20 lines) by a computer function to appear randomly to ensure that the order of presentation did not influence participants' responses. Each screen was presented for five seconds to each participant and then replaced with the following screen. Five seconds was chosen, as this was recently found to be the average rate of play for a large sample of regular gamblers who were observed during the regular play ($n = 779$) (Blaszczynski et al., 2001). It was therefore likely that five seconds represented a realistic time frame in which players might have to judge the outcome

before placing their next wager. Participants were then asked to make judgements about each screen as it appeared on a pre-prepared recording sheet with the number of screens and the corresponding choices of: win, loss and near miss. The researchers called out the number of each consecutive screen to ensure that participants knew which screen to rate and to minimize errors. Following the presentation of all 600 screens, participants were asked to complete the South Oaks Gambling Screen (SOGS) and the Impaired Control Scale (ICS). The whole procedure took approximately 1 1/2 hours.

Measures

All participants were requested to complete two self-report questionnaires relating to gambling behaviour and levels of impaired control.

Measures were selected in concordance with the aims and projected hypotheses as well as the reliability and validity of the measures.

1. The South Oaks Gambling Screen (SOGS) (Lesieur & Blume, 1987) is a 20-question screening measure which asks subjects to describe their gambling habits. The SOGS has demonstrated good reliability and validity as an instrument for measuring problem gambling behaviour. Internal consistency data indicates an alpha of

.97, and a coefficient of .71 was obtained for test-retest reliability (30 days apart). Discriminate validity of this screening questionnaire suggests that it reliably identifies 95% of problem versus social gamblers. A score of 5 or more on the SOGS indicates a 'probable pathological gambler', a score of 3 to 4 suggests 'some problem gambling' and a score of 0-2 suggests 'no problem gambling' (Lesieur & Blume, 1987).

2. The Scale of Gambling Choices (Baron, Dickerson & Blaszczynski, 1995) was based in part on the Impaired Control Scale (Heather, 1993) in the field of alcohol addiction, together with data of impaired control in gamblers. The questionnaire includes a set of 18 questions, measuring aspects of control of gambling on a four-point frequency scale. Additionally each item includes a 'does not apply' option for participants for whom gambling is not applicable. The questionnaire was trialled in large-scale community based surveys and on a clinical sample, which demonstrated high internal validity and concurrent validity (SOGS).

Analyses

The outcome of interest in this study was the number of screens for which a consensual

definition could be obtained. Preliminary examination of the frequency of responses indicated that there were no screens where all participants in any group agreed on the definition of a screen. Indeed, the frequencies with which participants identified near misses as the outcome was very low and even amongst clear screens of wins and losses, very few screens resulted in over 90% agreement. As a result, it was decided that a consensus would be screens for which at least 75% of the sample identified the screen as either a loss or a win. However, such a criterion would have resulted in no screens be identified as near misses due to the very low frequency of near miss ratings. As such, it was decided to relax the criterion to near misses to where at least one quarter of participants identified the screen as a near miss.

The proportion of screens that resulted in a consensual win, loss or near miss (as defined above) were calculated for each condition (i.e. one line, five lines and 20 lines) and for each group (students, social and problem gamblers). The screens were also rated by one of the researchers (CG) to determine the rate in each condition that screens represented each outcome, objectively. Screens were defined as a near miss under the following conditions: (a) two matching symbols appeared on one line, with the symbol appearing in the line below, where the combination did not result in any

monetary payout (i.e. on one line); or (b) three or four matching symbols appeared on one line, with the fifth symbol missing, where the combination did not result in a payout. All other screens were rated as either a win or loss. A loss was rated as any outcome where no credits were returned at the end of the wager. In contrast, a win was identified as any outcome where the combination had resulted in a payout even if the payout was a net loss compared to the original stage (e.g. winning 15 credits when wagering 20 credits). However, the number of wins that resulted in a net gain or net loss was recorded by the researcher. This seemed to be important to provide some way of interpreting how the groups of players were interpreting these ambiguous screens. We purposely did not ask the participants to make this distinction because it was of interest to see how they perceived each outcome as either a winning combination (i.e. positive outcome), a near miss (moderately positive outcome: that is nearer to a win than a loss) or a loss (i.e. a negative outcome). Those three outcomes were coded as a 3, 2 or 1, respectively. Hence, a total score could be calculated to indicate the degree to which each individual participant viewed the outcomes across screens as positive.

The derived 'positivity' score was then compared in a 3 x 3 mixed model analysis of variance, with group being the between

subjects variable (student, social, problem gamblers) and lines being the repeated measures variable (one line, five lines, 20 lines). In addition, to determine individual predictors of 'positivity' of interpretation, a multiple regression analysis was conducted. Age, gender, SOGS score and the score of the Impaired control Scale were entered as covariates to predict ratings of positivity.

Results

A series of independent one-way ANOVAs were performed to compare participants from the three on gender (Kruskal-Wallis ANOVA), age, SOGS and ICS score. There were no significant differences between the groups on gender, although differences did approach significance (Chi-square $(2, 210) = 5.348$, $p = 0.069$). As can be seen from Table 1, this result indicated that the highest proportion of females was in the university sample (78%) compared with 66% of the social gamblers and 61% of the problem gamblers. Significant differences emerged on the other three variables. Highly significant differences were observed between the three groups for age ($F_{(2, 210)} = 156.109$, $p = 0.000$). This indicated that the university sample were, not surprisingly significantly younger than the other two samples, with the problem gambling sample being the next oldest and the sample of social gamblers being significantly older. As such, both age and

gender were included as covariates in the multivariate analyses of group by line differences. Differences also emerged between the three groups on SOGS and ICS, such that the problem gambling group had higher SOGS scores than the other two groups ($F_{(2, 210)} = 132.269, p = 0.00$). This is to be expected since the problem gambling group was chosen on the basis of higher SOGS scores. Differences also emerged on ICS between groups ($F_{(2, 210)} = 9.889, p = 0.000$). This difference should also be expected, although surprisingly there was difference between the university sample and the other two groups, but no significant difference in control over gambling between the social and problem gambling groups.

Measure	Students	Social Gamblers
Gender	78% females	66% females
Age	22.3 (6.5)	60.6 (10.8)
SOGS	.76 (.83)	.86 (.78)
ICS Total	26.1 (17.0)	37.7 (14.9)

Table 1: Means (and standard deviations) of demographic and gambling variables.

Objective ratings of the screens indicated that the vast majority of all screens on the one line combinations were losses (83%), with 6%

being near misses and 11% being wins (by definition, when only one cent is wagered, all wins are outright wins since the minimum win is 2c). For five line combinations, losses characterized 69% of screens, with 25% of screens resulting in some monetary payout. Of these winning screens, 72% resulted in a net win (i.e. more than 5c returned), while 22% represented a net loss and the remaining one screen (i.e. 2%) resulting in an even return. For 20 line combinations, 64% of screens were losses, with 35% of screens being wins and only one combination being a near miss. Although the rate of 'wins' on 20 lines was higher to that on five lines, only 28% of recorded wins resulted in a net win, with the remainder either resulting in a return of the original stake (5%) or a net loss (67%).

Lines	Losses	Near Misses
1 cent	166	12
5 cents	137	13
20 cents	127	1

Table 2: Objective ratings of each series of 200 screens according to losses, wins and near misses. For 5 and 20 line combinations, the number of wins constituting net wins versus net losses is also presented.

Where there was consensus, it was typically around losing screens. For the one line combinations, 61% of screens were rated by problem players as losses, 64% by social gamblers and 54% by students. Students were the only group who identified any screen as either a near miss or a loss. They identified only one screen as a win and 6% of screens as a near miss. For the five line combination, 56% of screens were rated as losses by problem players, in contrast to only 30% of screens for social gamblers and 40% amongst the student sample. All three groups identified some screens as wins, with two screens being rated consensually as wins amongst problem and social gamblers and one screen being rated as a win by students. However, again, only the students rated any screens as near misses, with 6% of screens being so rated. For 20 line combinations, there was considerably less agreement amongst problem gamblers than for the less complex combinations. Problem players rated only 43% of screens as losses. Similarly, social players rated 34% of screens as losses, with students rating 32% as losses. Problem players rated only two screens as wins, with social gamblers agreeing five screens were wins and only one screen being rated as a win by the student sample. None of the three groups identified any screen as being a near miss in the 20 line condition.

<i>1 Line Combination</i>	<i>Loss</i>	<i>Win</i>
Problem Gamblers	122	0
Social Gamblers	127	0
Students	109	1
<i>5 Line Combination</i>		
Problem Gamblers	112	2
Social Gamblers	59	2
Students	80	1
<i>20 Line Combination</i>		
Problem Gamblers	86	2
Social Gamblers	77	5
Students	72	1

Table 3: Consensually agreed screens across group by condition.

In order to determine whether the groups differed in how positively they rated screens across condition, a 3 (group) x 3 (condition) mixed model ANCOVA, controlling for age and gender as covariates was conducted. There was no main effect for group ($F(2,207) = 0.48$,

$p = 0.62$), however, there was a main effect for condition ($F(2,207) = 4.633$, $p = 0.033$).

Inspection of the means, presented in Table 4 indicate that screens on the more complex combinations (i.e. five lines and 20 lines) were more positively rated than those one the least complex combination. There was no interaction effect of group by condition ($F(2,207) = 1.764$, $p = 0.174$), indicating the all three groups tended equally to rate more complex combinations as more positive and this effect did not differ according to group.

Descriptive Statistics

	GRP	Mean
POSLIN1	students	285.5000
	Social	264.7069
	problem	271.4000
	Total	275.7286
POSLIN5	students	313.3804
	Social	316.1034
	problem	316.2667
	Total	314.9571
POSLIN20	students	315.3804
	Social	331.6379
	problem	325.1000
	Total	322.6476

Table 4: Mean positivity ratings across group by condition. POSLIN1 = 1 line; POSLIN5 = 5 lines; POSLIN20 = 20 lines. GRP = group.

Although there were no differences between groups on ratings of positivity, it was of interest to determine whether there were differences at an individual level between players and what factors might account for such differences. As such, a hierarchical, linear multiple regression equation was constructed with the positivity rating as the dependent variable. Predictor variables were age, gender, SOGS score and ICS score. Age and gender were entered on the first step of the equation, followed by the two gambling-related variables (i.e. SOGS and ICS). The first step of the equation was highly significant in predicting 'positivity' ($F(2,205) = 8.106, p = 0.000$) and accounted for 7% of the variance in ratings, with age, rather than gender, contributing independently to ratings of 'positivity' ($t(1,205) = -3.660, p = 0.000$). This indicates that younger people gave more positive ratings of screens. The second step of the equation was not significant ($F(4, 203) = 0.098, p = 0.902$) and neither ICS nor SOGS contributed independently in 'positivity' ratings.

Discussion

The major aims of the present study were to determine (a) whether there could be a consensual definition of a near miss on modern

day electronic gaming machines, and (b) whether different groups of players were more or less able to identify such screens; and (c) whether the ability to identify the near miss varied according to the complexity of play.

The results clearly showed that there was surprisingly little consensus amongst players as to how to define particular screens, in general, and that this became more apparent as the complexity of the game increased. With regard to the phenomenon of the near miss, it was clear that few players used this category. Indeed, even after relaxing the criterion to only a 25% consensus, only the student group rated any screens as being near misses. This seems to indicate that approximately one quarter of naïve players do identify some screens as near misses, but the majority of players do not. Indeed, in no instance did more than 40% of the student sample agree that any screen was a near miss. Nonetheless, it is of interest to note that the proportion of screens identified as near misses in both the one and five cent condition were almost identical to the number of screens that met the objective definition. Therefore, it may be that near misses are identified by players early in the gambling experience, but players learn that these are not associated with increased chances of winning and so more experienced players no longer continue to identify them even in a task where they are primed to do so by the nature of the

question. Of the screens rated by students, however, in all but three instances, the screens would have resulted in a payout had the maximum number of lines been chosen. Hence, an alternative explanation for the lack of use of this category amongst problem and social gamblers is that they may not have considered these screens to be a near miss because they realised that on the maximin bet strategy (favoured by most regular players) these screens would have been wins.

This explanation can not be excluded, however, it was surprising how few screens were actually rated as wins. Across all three groups, the number of screens rated as wins was very low and indeed, even a number of screens where the objective win was greater than the original wager, less than 75% of each group indicated that these screens were wins. This result is surprising and difficult to explain. For the more experienced and/or problem gamblers one might argue that the wins generated from the sequences in this study, were not sufficiently large to be considered as “wins”; by some players resulting in a low level of consensus. However, this result seems unlikely considering the fact that even the naïve gambling group did not consistently categorise winning screens as wins. Moreover, if individual, gambling related factors were likely to contribute to the way in which the screens were perceived then one might expect that

gambling related variables, such as SOGS or ICS scores would predict ratings, which they did not. Further, since the largest was 738 credits from a wager of 20 cents, and at five further wins were over 400 credits from the 20 line combinations, it seems difficult to understand how participants failed to accurately identify these screens as winning combinations.

One explanation for the general lack of consensus is the difficulty associated with the task. Participants were required to make judgements within five seconds of the screen appearing as to whether the screen contained a win, loss or a near miss. It may be that there was insufficient time to make these determinations. This explanation makes intuitive sense and could explain why the overall proportion of screens where consensus was reached was highest in the least complex task (i.e. where only one line was of interest) and lowest for the most complex task (i.e. where all 20 lines were wagered). Although this may be due to the design of the experiment and the time allowed for presentation of each screen, this is the average time that regular players appear to use between wagers in the natural course of play. In routine play, the only additional information that is provided is the sound of a win and the credits rolling over. It may be that many players know that they have won as a result of these sound effects rather

than a good understanding of the machines, the lines wagered and the resulting combination of symbols. Hence, this provides some support for the notion that as gaming machines become more complex simple concepts, such as the near miss, lose their importance.

One of the major problems with the present study was the lack of balance between the groups in terms of age and gender. To some degree, these differences represent the differences between the groups of interest. That is, university undergraduates in psychology tend to be around 22 years of age, on average, and women are over-represented amongst these. Further, those attending clubs during working hours tend to be older individuals (as in the present study) who do not have daytime responsibilities, such as paid employment. The differences between these two groups are further compounded by the fact that men between the ages of 20 and 45 were relatively over-represented in this sample by those reporting problems with their gambling, given that they were drawn from the other two samples. If samples of age- and gender-matched people had been recruited, these would have been unlikely to have been representative of the populations from which they were drawn. Nonetheless, these differences are likely to have been associated with other differences in variables that were not

measured, such as education. Although one can control statistically for the likely influence of these variables, it is impossible to rule out the fact that other associated differences may have contributed to the differences that were observed between groups. This would be problematic had major differences been revealed between the groups, however, the major findings from this study did not reflect differences between groups. It is also problematic that problem gamblers were not defined in this study as those meeting DSM-IV criteria for pathological gambling and/or presenting for treatment. Different results may have been found if more severe pathological gamblers were included in the sample. However, the range of SOGS scores was quite high with many participants scoring over 10, which is generally considered to represent severe problems, and if this was the case one might expect SOGS scores to have correlated with participant ratings, which they did not.

Indeed, the findings of this study were that no group of players consistently identify near misses even on straightforward machines. Although more than 25% of naïve players did identify near misses when one or five lines was played, when they were present, the majority of players did not. For more experienced players, the rate of identification of the near miss was considerably lower. This seems to suggest that, even under situations that involve offering a

definition of a near miss, where the rules of the game are explained and where demand characteristics of a forced choice option (i.e. is this a win, loss or near miss), the majority of players in all three groups did not nominate any screen as reflecting a near miss. These results suggest that it is unlikely that near misses are identified in the course of routine play. It may be that a small proportion of naïve players may identify near misses, but these results suggest that those experienced players do not. Nonetheless, it is not impossible that the presence of screens that are close to winning are not recognised, but at the same time influence play. For example, Gulliford (2000) found that despite the fact that the presence of near misses in videotaped stimuli led to increases in autonomic arousal in problem gamblers, no participant was able to articulate the differences between the video footage. She argued that this indicated that near misses had an effect on arousal that was independent of conscious awareness. Therefore, it may be that although players do not routinely assess screens for the presence or absence of near misses, and although even when prompted they appear not to describe screens in this way, that the presence of screens that are close to wins still have an impact on the way in which they gamble. Study 2 was designed in order to determine whether or not this was the case.

Study 2

Although in study 1, players were generally reluctant to describe screens as representing a 'near miss', what experimental evidence is available appears to suggest that near misses do influence play in experimental paradigms. There are two recent experimental studies that have manipulated the nature of losses (i.e. outright losses or near misses) and their relationship to persistence in gambling. Chantal et al. (1996) found that where near misses made up 33% of the non-winning screens, there was an advantage in comparison to where there were no near misses, or when near misses constituted 67% of the losses. Kassinove and Schare (2001) also found that a moderate level of near misses (30%) resulted in the greatest persistence. However, the paradigm used in Kassinove and Schare's (2001) study relied on the outcome of only one line. As the results in study 1 indicated, even where naïve players can identify near misses, the number of lines that are played is a determinant of whether or not they do. That is, naïve players recognised objective near misses on one or five line combinations, but where 20 lines were played, they did not.

This is an important difference, because of all those screens (n = 26) identified as near misses (either objectively or by the participants) only four were found that would not have

resulted in a payout of some kind if 20 lines were chosen. This is the reality on modern day EGMs and therefore whether these particular screens influenced play remains an empirical question. Furthermore, the only choices to date that have been measured are (a) the size of a bet in roulette (Chantal et al., 1996) and (b) persistence in EGMs (Kassinove & Schare, 2001). However, on modern day EGMs there are a number of choices that are available to the gambler. That is, they can decide whether to continue or cease play (persistence) and how many credits to wager (bet size), but they can also vary the number of lines that they choose to play in conjunction with the number of credits. Moreover, the size of a bet is not a singular choice. That is, since each individual wager on a modern day electronic gaming machine takes 3.5 seconds to be completed, gambling on EGMs constitutes a series of decisions about how to respond in the following wager. To date, no study has investigated the complex series of decisions involved in gambling and the effect that manipulating near misses may have on these decisions.

This is the aim of the second study. That is, the second study aims to compare the responses of naïve gamblers (i.e. undergraduate students) to a simulated game based on the Queen of the Nile. Students were randomly allocated to conditions that represented either mixed losses and near misses; all outright losses; or all near

misses. It was hypothesized that the mixed condition would result in increased persistence in gambling, increased maximum bet, increased difference between minimum and maximum bet, fewer credits left at the end of the gamble and greater losses.

Method

Participants

One-hundred and forty university students participated in the study, who were enrolled in the first year of a psychology degree.

Participants were recruited through advertisements at the University of Sydney and all participants received course credit for their participation. The study had approval from the Human Research Ethics Committee of The University of Sydney. Forty-six percent of subjects were male and 54% were female.

Measures

Based on levels of consensus found in study 1, a series of pre-determined screens were entered into the computer to simulate a popular electronic gaming machine 'Queen of the Nile'. Nine wins were chosen from those screens where at least one of the groups had identified a win as existing and there was a net win when 20 lines were chosen. These nine wins were programmed in such a way to appear in an

identical position for each participant regardless of the condition to which they had been assigned to ensure that the nature or amount of wins could not affect their behaviour. Choosing “near miss”; screens proved more difficult since in total only 24 screens were identified by 25% or more of the university sample as constituting a “near miss”;. These screens were then independently rated by three of the researchers (AW, CM and LS) to ensure that they would not result in a pay-out if 20 lines were played. Four such screens were identified. Clearly, if the four same screens were to recur throughout play it was likely that participants might identify this pattern, which could influence their responding. However, on a Queen of the Nile machine there are ten symbols (excluding the pyramid and queen of the Nile) that can result in win in the same combination. Hence, the four “near miss”; screens could be increased to represent 40 screens simply by changing the symbol that resulted in the near miss. In order to ensure that the near miss screens were not more repetitive than the loss screens, four loss screens were chosen randomly from the 20 line combinations (to ensure that they were outright losses regardless of how many lines were played) and in these four screens the symbols were substituted for each to produce 40 combinations in a similar manner to that for the near miss screens.

Hence, three programs were developed. In the first, the nine wins were combined with the loss screens to produce the LOSS condition. In the second, the same wins were combined with the near miss screens to produce the NEAR MISS condition. In the final program, the nine wins were combined with the loss (50%) and the near miss (50%) screens to produce the MIXED condition. The nine wins appeared in each program at an identical place, with the first scheduled to appear on the ninth reel to ensure that all participants were likely to hit the first win to allow a maximum range on the measure of persistence. The other screens were then programmed to appear randomly so that for each individual the proportion of screens that were losses or near misses was determined by the group to which they were allocated, but the screens appeared according to a random schedule in order to control for any order effects.

Procedure

Participants signed up for an experimental time, using the experimentrix system. At the beginning of their session, they were given a participant information sheet that was read and if they were happy to continue with the experiment, they signed an informed consent form. Participants were then asked to complete some demographic information (age and gender). Participants were told that the

experiment was designed to investigate how various factors affected the choices that people made with regard to gambling. The concept of the near miss was not included in this information to ensure that participants remained naïve to the hypotheses of the study. Participants were then provided with ten minutes prior to playing the machine to read the player information pamphlet on how to play the EGM. The player information pamphlet contained information on winning combinations and the pay schedule. This information was then reinforced verbally and with a brief demonstration.

The participants were then given 1000 nominal credits (equivalent to \$10 on an electronic gaming machine) and asked to imagine they were playing with their own money and to make choices on the basis of what they would choose to do if this were the case. They were told that they could play with that credit in any way that they wished and can play as long as they like until their money ran out. The way in which they chose to bet was recorded by the computer. The program recorded the lines and credits that they chose on each wager, the number of wagers, time played, amount left at the end of play, the median bet, the minimum bet and the maximum bets waged. After play, they were asked to rate their satisfaction playing the game and complete the SOGS and ICS.

Analyses

Preliminary analyses were completed in order to ensure that randomization had been successful and that there were no differences between groups. Specifically, one-way analyses of variance were conducted for the variables of age, gender (Kruskal-Wallis analysis of variance), SOGS and ICS.

The major analysis was a one-way analysis of variance comparing the three groups (LOSS; NEAR MISS; MIXED) on the major outcome variables described above. It was also of interest to know whether the betting strategy changed over the course of play. As such, an additional dependent variable was created to examine the difference between the average initial bet and the average end bet. The average of the first ten bets was calculated. In order to ensure that those players who were running out of money did not have underestimated end bet scores, the average of the last ten bets prior to any bets where they appeared to be "running down" their total was taken. The "running down" period was objectively defined by a period where the amount of credits left was less than the median bet that the player had used. The ten bets prior to "running down" the credits were chosen as the average end bet score. A mixed model 2 (time:

initial vs end) x 3 (loss, near miss, mixed) analysis of variance was conducted to examine any effect of each condition on betting strategy over time.

Results

No significant differences were found for gender, (Chi-square (2,137) = .012, $p > 0.05$) age ($F(2,137) = .1065$, $p > 0.05$), SOGS scores ($F(2,137) = 1.866$, $p > 0.05$) or ICS scores ($F(2,137) = .160$, $p > 0.05$) between the win, near miss and loss conditions.

Therefore, none of these variables were included in the analysis as a covariate. Details of the session characteristics for the 140 participants are provided in Table 1. This shows the total number of wagers placed for each player, the number of credits left at the end of the experiment, the most common bet waged (median) and the maximum bet placed.

Table 5: Gambling characteristics for players in the loss, near miss and mixed conditions

(n=140)



	Number Median Maximum of wagers bet	Credits left at bet
end		
Loss condition (N= 47)	65.40	291.51
Mean	34.23	266.32
SD	65.40	291.51
	34.23	266.32
	(46.30)	
	(1168.98) (43.68)	
	(181.46)	

Near miss condition (N=49)		
Mean	60.87	347.46
	32.95	199.14
SD	(43.77)	
	(1249.70)	(32.21)
	(160.30)	
Mixed condition (N=44)		
Mean	74.34	170.79
	29.20	182.15
SD	(46.28)	(446.26)
	(38.36)	(161.22)
Overall mean	66.69	272.35
	32.22	217.32
SD	(45.47)	
	(1027.44)	(38.36)
	(171.07)	



Table 1 illustrates that on average, players placed 67 wagers each session and had a mean amount of \$2.72 left at the end of the experiment. Of the 140 participants that took part in the study, 10 made a profit during the session. The results also indicate that players placed an average median bet of 32.22 cents (SD= 38.36) and an average maximum bet of \$2.17 (SD = 171.07). A series of one-way analyses of variance indicated no significant differences between the groups on the number of wagers made, the number of credits left at the end of the experiment or the median bet placed. The ANOVA investigating maximum bet revealed a significant group effect ($F(2, 137) = 3.865$, $p = .023$). Post-hoc analyses revealed that participants in the loss condition ($M=266.32$, $SD= 181.46$) placed significantly higher maximum bets than those in the mixed condition ($M=182.15$, $SD =166.22$). Differences between the loss and near miss conditions

were not significantly different. No significant differences were found in the level of satisfaction playing the machine ($F(2, 137) = .185, p > 0.05$). The condition that subjects were assigned to did not affect participant responses.

A within subjects design was then conducted to determine whether the groups differed in the wagers placed at the start and end of play.

However players did not significantly differ in the initial bets waged compared to their end bet ($F(1, 137) = 0.463, p = 0.497$). As illustrated in table 3, a mixed model 2 (time) x 3 (condition) repeated measures design failed to find differences between the groups over time in terms of the initial bet compared to end bet ($F(2, 137) = .221, p = 0.80$). Results indicate that participants in the loss and near miss conditions, increased their wagers towards the end of play. Although the near miss group began play by waging higher bets, there was no change over time.



Condition	Initial bet	End Bet
Loss (n=49)	46.78 (6.15)	58.28 (7.68)
Near Miss (n=47)	52.17 (6.28)	52.37 (7.85)

Mixed (n=44)	36.05 (6.49)	47.79 (8.11)
Total (n=140)	45.21 (43.28)	53.00 (53.60)

Table 6: Median amounts expended on the initial and end bet periods across conditions.



Discussion

Although the concept of the near miss is an intuitively appealing one that has been widely discussed in the gambling literature, there has been little empirical evidence to either support or refute the importance of the near miss as a construct. The aim of the present study was to fill this gap by answering two important questions: (a) can a consensual definition of a near miss be developed; and (b) does the presence of near misses in a gambling simulation affect the way in which naïve players choose to wager. Overall, the results of this study suggest that not only can near misses not be reliably identified, but they do not appear to have a major impact on the choices that players make when choosing wagers on a simulated gaming machine.

The present study is the first to examine whether players reliably identify the same outcomes of gaming as indicating a near miss on a modern day EGM. Our results clearly indicate that the 'near miss' cannot be reliably

identified. This was true of a group of naïve gamblers, a group of social gamblers and a group corresponding to problem gamblers who scored above the cut-off point for likely problems with gambling on the SOGS. Indeed, our hypotheses suggested that problem gamblers may be more inclusive of both near misses and wins than the other groups, indicating a bias towards positivity in interpretation of gambling outcomes. Contrary to our hypotheses, problem gamblers were not more inclusive of near misses than social gamblers or non-regular gamblers. Indeed, the reverse was true. Not one of the 600 screens in any of the line combinations were rated as near misses by even a quarter of the problem or social gambling samples. In contrast, although the proportion of screens where even one quarter of the student sample identified a near miss were small, these were indicative of the objective presence of near misses if defined according to rigid objective criteria. However, these occurred only in the conditions where either one or five lines were played. In the more complex combination where 20 lines were played, those screens that would have been near misses actually resulted in small pay-outs. Hence, neither objective nor subjective ratings could identify the presence of a phenomenon akin to the near miss on modern day machines when the most popular betting strategy (i.e. maximum number of lines and minimum number of credits) was played. Indeed, only

four such screens could be identified in a consecutive sample of 600 screens that were photographed for this experiment. This suggests that while the near miss is able to be identified on straightforward games where only one (or even five) lines are played, that more complex situations where multiple lines are played do not result in near misses.

The second part of this study aimed to determine whether, even if the near miss could not be identified, the near miss had an effect on gambling behaviour. This was not supported. Participants assigned to the near miss condition did not gamble any differently from players in the loss or mixed conditions. This is despite careful attention to detail in the present study. That is, near miss screens were very carefully chosen according to both objective and subjective criteria. Moreover, all other aspects of the simulated game, including wins, were held constant. Randomization was successful and resulted in three groups who did not differ in terms of the demographic variables of age and gender, nor in relevant gambling-related variables.

The findings of the current study are discrepant in this respect with past research which has found evidence that the near miss phenomena promotes persistence in play (Kassinove & Schare, 2001) and bet size following a series of near misses (Chantal et al., 1996). Our failure

to replicate previous findings is likely to be a result of differences between our experimental methodology and those of previous researchers. However, there are a number of potential differences that could explain the differing results. Firstly, previous research into the near miss based its' methodology on players who gamble on traditional 3 x 3 matrix slot machines (Kassinove & Schare, 2001 & Dixon & Schreiber, 2004) or one line of a 3 x 5 electronic gaming machine (Gulliford, 2000). In all these studies, a near miss was unambiguously defined by the researchers as a spin that resulted in two identical symbols and one different appearing on the payout line adjacent to the winning line. These studies were based on very basic paradigms that do not reflect the changing face and complexity of current modern electronic gaming machines. The complexity of the modern electronic gaming machine allows players a variety of ways in which to gamble and, in practice, the vast majority of players do not gamble on only one line of the machine but rather choose to play on the maximum number of lines available. The likelihood of this difference in methodology contributing to the different outcomes is supported by the differences in those players who did recognise near misses amongst the student sample on one or five lines in comparison to 20 lines. Although few near misses were identified and by a sizeable minority, rather than majority, of that sample,

objective analyses confirmed the absence of a large number of near misses as have been previously described in the literature. Thus, the present study does find evidence to support the fact that the complexity of design of modern day machines has affected the degree to which the near miss is identified on EGMs.

However, there is one other difference which can not be excluded as accounting for the difference in outcome between the studies and that is the proportion of near misses that were presented in the MIXED condition. Both Kassinove and Schare (2001) and Chantal et al. (1996) used a series of mixed conditions from 25-50% and both found that 30-33% was the optimal schedule for near misses to affect play. To have replicated these schedules exactly would have been problematic because they used slightly different schedules, however, we could have used a 33% condition in preference to a 50% condition. We choose not to do so because near misses were so poorly identified in the first study. Therefore, we felt that some participants would not identify many of screens as near misses, unlike those presented in the earlier studies based on the more straightforward paradigms used by previous authors. The decision to retain a 100% near miss condition and compare with a 50% and 0% condition was based on the results of study 1, where we would expect not all participants to identify each of the screens

as a near miss and so hence, functionally, the schedules are likely to be smaller than those intended. Nonetheless, it can not be excluded that had a different schedule been used that near misses would not have had an identifiable effect on some aspects of their gambling behaviour.

In contrast to our predictions, our results did find that there was an effect of the loss condition on one aspect of gambling, which was the maximum bet. This finding can be explained in the context of previous research that has found that gamblers attempt to 'chase bets' in response to continued losses (Leopard, 1978). Those participants, where all losing screens were outright losses, were more likely to increase their bet to a higher maximum bet than those who had a mixed series of screens or all near misses. This is known as the 'gamblers fallacy' in which gamblers are thought to develop erroneous ideas about the nature of play such as a lack of understanding of the randomness and independence of events. When a series of losses is presented, the player mistakenly believes that the losing streak must surely come to an end shortly and change their gambling in order to capitalize on the imminent win and recoup the losses that they had sustained in its pursuit.

There are a number of limitations to the study that need to be acknowledged in interpretation

of the results. Firstly, in study 1, the three groups were not well matched on basic demographic variables. Although we were able to control for these statistically and they are likely to represent real differences between the groups that our samples represent, it would nonetheless be difficult to attribute particular differences to groups. The only result where this criticism is likely to be relevant is the finding that it is only the university sample who were able to identify near misses. It can not be excluded that some other factor(s), other than inexperience or naivety were responsible for this group identifying near misses that the other groups were unable to identify. Nonetheless, the striking finding of this study was the difficulty with which participants had in identifying screens as near misses. One can be more confident in the conclusion that near misses are not identified regularly, even under prompted conditions, in three relatively diverse samples with different characteristics, including their experience with gambling.

The second limitation with study 1 is that we only sampled 600 consecutive screens. Although this is a large number of screens, it is only 200 in each level of complexity. Because screens are random, it is possible that these screens were not representative of screens on EGMs. Moreover, we made no attempt to ensure that there were a high proportion of near miss screens and had we done so it is

possible that the results would be different. However, if in 600 consecutive screens so few near misses were identified, either objectively or subjectively, then the likelihood of these having a major influence on the play habits of gamblers seems small. The chance that they are important is further minimized by the fact that even with objective near misses on the most straightforward games (i.e. when one line was played), no screen was rated by the majority of participants as being a near miss. Further, when those were unambiguously defined (i.e. at least 25% of participants in the student sample rated them as near misses and this was confirmed by objective raters), the presence of near misses did not influence the nature of bets that players made. Indeed, if anything, the reverse was true. That is, the absence of near misses appeared to affect the maximum bet, such that those who did not have any near misses made significantly larger maximum bets.

With regard to study 2, the major limitation was the ecological validity of the task. The task was a simulated gambling task and considerable effort was made to have the task appear like the real game. That is, in the simulation game, aspects of the game such as reel spin, the ability to bet in an identical fashion to real life and even the symbols were similar to those that are used in real EGMs. Nonetheless, the game was played on a laptop computer and not

in a real gambling venue. Individuals played with credits, rather than their own money and hence motivations to continue or stop were likely to differ. To further compound the ecological validity, the sample were drawn solely from a university sample and therefore the level of familiarity with the game and their interest can not be determined. Hence, the generalisability of the results is unclear. It is possible that had this been a real game, in a real venue, played with the player's own money, that near misses may have had an influence on play. While this can not be excluded, one might expect that if this were the case near misses would have been more readily identified by regular players, when if anything the results of study 1 suggest that the reverse was indeed the case.

These limitations notwithstanding, the present study has a number of design strengths. All the screens on which ratings were based and the subsequent analogue study was designed were based on a real EGM and thus were more like real gambling opportunities than previous research. A relatively large number of screens were presented in study 1 to relatively large samples with ample power to identify even moderate effect sizes. As such, we can have relative confidence in the results. The design of study 2 was based on the results of study 1, as such each of the screens had been subjectively defined to fall into each category. Further, three

independent raters confirmed the allocation of each screen to its particular category.

Therefore we can be confident that those screens identified as near misses were indeed near misses, as with the screens in the loss and win categories. Invariant and intermittent wins occurred at the same point in time in each condition and the speed and presentation of the screens mirrored the speed of reels in a real play situation. Importantly, participants were given the opportunity of choosing bets from the same range of options as those that are available in the real situation. Moreover, the program that was developed was able to record that information in order to provide a range of outcomes to ensure that if near misses did affect play there was every opportunity to find evidence of its effect.

In conclusion, the present study has confirmed that while the near miss might have considerable relevance to gambling opportunities that are based on simple configurations, their relevance to more complex programs is limited. Regardless of the level of gambling experience, the majority of players do not recognise near misses, even under conditions when one could argue that they have been primed to do so. Perhaps of more interest is the fact the inclusion of near miss screens did not influence play in any way. The near miss has been a relatively under-studied phenomenon with numerous authors assuming

its relevance despite little evidence to confirm its importance. The present study suggests that the emphasis that has been placed on this concept may not have been warranted. While it remains possible that the near miss influences play in some forms of gambling, the present study has provided relatively strong evidence across a range of designs that demonstrate that it has little relevance to modern day electronic gaming machines. It may be that these machines have become so complex, with so many features (including sound and vision) that simple characteristics that may once have influence play are no longer relevant. More research should be conducted on other aspects of gaming machines in order to understand what factors do influence gambling on modern day machines such that harm minimization strategies that are likely to be effective can be introduced.

Acknowledgements: We would like to express our sincere thanks to Dr. Andrew Cartwright who developed the simulated gambling program that was used in the present study.

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