

Irrational Thinking Among Slot Machine Players

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According to the cognitive perspective on gambling, regular gamblers persist in trying to win money at gambling because they hold a set of false beliefs about the nature of gambling, the likelihood of winning, and their own expertise. In order to investigate this claim, twenty seven university students were recruited who played one of three types of games at least twice a week: slot machines, video draw poker, and video amusement games. Subjects played their preferred machines on site (clubs, hotels and amusement arcades) first for at least thirty minutes and then the other two games for a minimum of twenty minutes each. During play, each subject spoke aloud into a microphone describing what he or she was doing or thinking about in the game. It was hypothesised that slot machine players would verbalise more irrational thinking than video poker or video amusement players and that slot machines would elicit more irrational thinking than video poker or video amusement machines. Most importantly, it was hypothesised that slot machine players would exhibit relatively greater amounts of irrational thinking when playing their preferred game. The data supported all three hypotheses. Out of all of the statements made by slot machine players when playing slot machines, 38% were categorised irrational. Furthermore, 80% of the strategic statements made by slot machine players while playing slot machines were categorised as irrational. These results are consistent with earlier work which showed high levels of irrational thinking in artificial gambling games. Together, the results provide support for a cognitive view of the origins of gambling problems.

One of the central questions in the psychology of gambling concerns why people gamble at all. It is well known that the odds in all legalised gambling games are against the gambler and in favour of the house. Thus, apart from exceptional circumstances, no rational person would gamble if winning money was the only consideration. The

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psychological explanation of gambling takes one of two paths from this assumption: either people are not rational or winning money is not the only consideration. The research reported here focuses on the proposition that people gamble for irrational reasons. It is quite possible that both propositions are correct: that people are irrational in their pursuit of money through gambling and that people gamble for other reasons than making money. If both propositions are correct then research must seek to demonstrate which is the dominant explanation for gambling.

The concern with explaining why people gamble goes beyond explicating a curious and unexpected behaviour. Unfortunately, gambling can become a problem for some people. It is not simply that some people gamble but that some people gamble to such an extent that the losses jeopardise other aspects of their lives that they value. It is in the explanation of heavy gambling of the kind which causes problems for the gambler and his or her family that the distinction between the two propositions listed becomes important. According to the proposition that gamblers gamble for other reasons than making money, problem gambling results from a failure to control these other aspects of gambling. One example of this claim which is currently attracting great support is that the problem gambler is addicted to the arousal or excitement generated by gambling. This kind of claim is not examined in the study to be reported. However, by seeking to establish that gamblers are behaving irrationally in their attempts to make money by gambling, the alternative proposition, that gamblers are gambling for other reasons than making money, is undermined. Indeed, the theoretical perspective which guides the research reported here is firstly, that problem gambling is about the winning and losing of money and little else; and secondly, that the problem gambler holds a set of false beliefs about gambling from which he or she concludes that money will be won as a result of gambling. It is this second claim which is referred to as "irrational thinking" although, from the perspective of the gambler, neither the beliefs nor the gambling behaviours are irrational.

In gambling games in which skill plays a role, it is not difficult to see how some gamblers may over-estimate their own ability to win. However, in games of pure chance, there appears to be no basis for believing that one has any special ability to win. Slot machines, for example, produce outcomes which are independent of any strategy of play which the player might introduce. Yet slot machines are popular with large numbers of people wherever they have been legalised. With essentially no chance of winning in the long run, why do people play?

REASONS FOR PLAYING SLOT MACHINES

Amusement

Leary & Dickerson (1985) provide data suggesting that arousal is higher in high frequency slot machine players than low frequency slot machine players. Furthermore, slot machine players report playing for amusement and excitement (Caldwell, 1974; Dickerson, Fabre & Bayliss, 1986). "Amusement" can be taken as an inclusive term representing the measures and reports of players that the activity of playing slot machines is amusing, exciting, arousing and rewarding as an activity in itself.

Observers of slot machine players report that the excitement of playing the machine is rarely evident in the faces of the players other than when the machine has a large pay-out (Caldwell, 1974). Thus, there is some disagreement between the self-reports and physiological data on the one hand and observer ratings of excitement on the other hand. What causes the subjective excitement and physiological arousal of slot machine players? Both cognitive and behavioural explanations are possible. However, among the cognitive explanations, a likely candidate is "anticipation of winning."

If it is the excitement of simply playing the machines that attracts regular slot machine players then one would expect these players to plan their play in such a way that time on the machines is maximised. It has been suggested by Daley (1987) that slot machine players "are buying time." The function of the time might be leisure, social involvement, escapism or relaxation. The player spends time on the machine because this activity is intrinsically rewarding quite apart from the money involved. Thus, if it is assumed that these players start with limited financial resources, then, other factors being equal, they will choose their machines in such a way as to maximise their playing time. Daley points out that, "the newer type of multi-coin type devices harbour the potential to reduce poker machine (slots) playing time by as much as 80%." (Daley, 1987, p. 237). According to Daley regular players will prefer single-coin machines over the newer multi-coin or multi-line machines because they allow enjoyment of a longer playing period.

Daley compared the playing rates on two types of machines (single-coin and multi-line) in 600 clubs throughout New South Wales, Australia, during a one month period. Whereas 269 million dollars was

invested on 3400 single-coin machines, a larger sum of 335 million dollars was invested on 2400 multi-line machines. Clearly multi-line machines proved popular with large numbers of club patrons, although possibly, these machines were not as popular as the makers had expected. That multi-line machines are so popular despite the fact that, on average, the playing time is cut by 50% (Daley, 1987, pp. 239–240), suggests that Daley's argument concerning playing time as a major motivation for the majority of players is incorrect. Daley provides data showing that there is a drift from higher denomination coin machines to lower denomination coin machines. This may well represent the actions of some players to extend their playing time in this way. However, the argument that slot machine players are primarily concerned with "buying time" appears to be invalidated by the continuing popularity of multi-coin and higher denomination single-coin machines.

Social Interaction

Walker (1988) asked punters in TAB shops (TAB shops are parimutuel betting shops) and slot machine players in clubs whether they came with a friend or not. Whereas 73% of punters reported that they went to the TAB alone only 41% of slot machine players went to the club alone. One possible interpretation of this difference is that clubs in general and slot machine playing in particular represent a social milieu in which the company of others is a significant part of the attraction. Fifty-five percent of Walker's sample of slot machine players were aged 50 years or more. It seems reasonable to assume that people attend clubs in groups rather than as individuals for social reasons and that slot machine playing for many people may be simply an extension of the social group into an area other than eating and drinking. Older people who may have retired or whose families may have left home would have more time to spend in clubs and perhaps more need to spend time with friends (having lost the company of family or work mates). From this perspective slot machine playing for a large number of older people may be motivated neither by the hope of winning money nor by the excitement of playing the machine but rather because the activity legitimises the time spent in the company of peers. While attention appears to be focused on the machine and its outcomes, the conversations that continue with others throughout the course of playing may be of greater importance. Furthermore, by

being engaged on a parallel activity with other players, each player can feel a sense of fraternity and group solidarity.

Although the social interaction perspective makes sense of the involvement of some older groups of people in the activity of playing slot machines, there are several reasons why this perspective should not be considered central to understanding slot machine playing in general. First, many people play the slot machines alone and reject attempts at conversation. Second, if conversation was the main motive for playing the machines, then, the higher quality time available at coffee tables nearby would surely lead to a drift away from the machines. Third, Caldwell (1974) has discussed the social rules which surround the activity of playing slot machines. Strict rules of access to machines are held in place by social consensus. If the machine was simply an excuse for social interaction, these rules would not be expected to be so rigorously imposed. Players would not need to protect their machines against interlopers if, in fact, any machine would fulfil the social function.

To Win Money

Gambling explicitly involves risking money on an outcome, that is wholly or partly determined by chance, in order to win money. By definition, gamblers are attempting to win money. However, legalised gambling is so constructed that the public who invest their money must expect to lose. Thus, although some gamblers will win, the expectation of nearly all gamblers should be that they will lose. If gamblers are trying to win money, why do they not give up as their overall losses increase? Other factors being equal, the more often a person gambles the greater is his or her expectation of losing. However, if it is assumed that the gambler believes that money can be won by gambling (believes that other factors are not equal) then the involvement of the heavy gambler would be expected. What then needs to be explained is the continued gambling despite recurring losses.

Cognitively based explanations of heavy gambling assume that the gambler holds a set of invalid beliefs which are maintained by a biased interpretation of the evidence (Walker, 1985). Specifically, heavy gamblers believe that they can 'beat the system' and make money. They believe that through logic or special insight they have an advantage over other gamblers. They believe that there is more opportunity to use skill or special knowledge in picking the outcome than there is in fact.

They discount losses as being caused by factors beyond their control but count wins as evidence that their system or special knowledge is working. Thus, despite losing large sums of money, the gambler can continue gambling with the firm expectation that shortly the gambling investments will begin to pay, the losses will be erased, and a small fortune will be acquired.

Evidence for this view of the heavy gambler comes from a number of sources. Langer (1975) has demonstrated the illusion of control that gamblers have over outcomes: raffle ticket buyers believe that the ticket they choose themselves is more likely to win than the ticket that they are given by the vendor. Gilovich (1983) has found evidence of biased evaluations of outcomes among basketball bettors: it is possible for fans of both teams in a close game to believe that they made the correct choice of the better team. Finally, Dickerson, Fabre & Bayliss (1986) report that 44% of TAB punters believe that their bet selections are based on skill rather than chance and Walker (1988) reports that heavy TAB punters compared to light TAB punters believe that more skill is involved in their betting. Thus, the cognitive explanation of heavy gambling is supported by data from a range of different gambling games.

Unfortunately, there are no equivalent data available for slot machine playing.* Furthermore, while skill plays a role in betting on horse racing, there is no place for strategic skill in playing the slot machine. Consistent with this, both Caldwell and Dickerson found that slot machine players report playing for amusement and entertainment rather than as a way of making money. Furthermore, Walker (1988) found that 77% of heavy slot machine players report that there is no skill involved in playing slot machines. Caldwell, Dickerson and Walker all report that slot machine gamblers report losing on the whole and expect to lose on the next machine they play. Thus, a cognitive errors theory of slot machine gambling must explain not only why players persist with the game but also why they do not subscribe to the mistaken beliefs they are assumed to hold. If regular slot machine players believe that they have special knowledge which gives them an advantage over the machine, why do they not report this in questionnaires and interviews?

*Editor's Note: however, see Coulombe et al. pp. 235-244, this issue.

IRRATIONAL THINKING AND SLOT MACHINE PLAYING

According to the cognitive theory, heavy gamblers have a set of beliefs which maintain their gambling despite losses. In particular, the gambler believes that he or she has the skill or special knowledge necessary to exploit a particular type of gambling. This is true whether the gambling involves a game of skill, such as bridge, or a game of luck, such as slot machines. However, slot machine playing is generally acknowledged as involving no skill and leading to an inevitable loss of money. In interviews and questionnaires, the slot machine player must subscribe to this view in order to avoid ridicule or in order to preserve their advantage over other players. According to the cognitive theory the heavy slot machine player privately accepts another belief: that his or her special knowledge of machines will provide a winning edge. Examples of such special knowledge are available in anecdotes but, until the work of Robert Ladouceur (Gaboury & Ladouceur, 1988; Ladouceur & Gaboury, 1988), it was difficult to see how such a theory could be tested at a general level. Players can be observed talking to their machines as if persuasion might influence the outcome. Similarly, croupiers report that many gamblers carry lucky charms to bring good luck (that is, to influence the machine to pay out). Ladouceur has suggested a way in which the presence of such erroneous beliefs might be discovered in a more general and systematic way.

Ladouceur introduced a method of studying the cognitions of gamblers while they play, which does not rely on the questionnaire approach. Players are required to say aloud what they are thinking while playing the machines. By studying choices made during the game of roulette, Ladouceur found that irrational thoughts predominate in the strategic thinking of the player. By irrational thinking, Ladouceur means beliefs such as the gambler's fallacy ("if my choice loses this time it is more likely to win next time"), personification of the machine ("this machine is making me mad on purpose"), and illusions of control ("I am getting good at this game. I think I've mastered it").

Ladouceur's results suggest that irrational thoughts are commonly present among gamblers and that they may play a central role in maintaining gambling in games of chance. However, Ladouceur's empirical work has relied heavily on gambling in artificially created game environments. It is not clear that his results and conclusions reached from games in a laboratory setting can be generalised to slot

machine playing in the club environment (Anderson & Brown, 1984). In the study to be reported, the link between irrational thinking and heavy use of slot machines is investigated. It is hypothesised that gamblers whose preferred style of gambling is the slot machine will exhibit irrational thinking especially when playing slot machines.

METHOD

The data reported in this study were collected in Australia where, until recently, slot machine playing was legal only in the state of New South Wales. Slot machines are played in licensed clubs but not elsewhere. However Caldwell (1974) has pointed out that approximately one in every three adults in New South Wales belongs to a club. Furthermore, many clubs have few or no restrictions on visitors' entry; hence, access to slot machines in the state is generally available. Johnson (1985) published figures that show that slot machines provide the largest tax revenues per year from gambling in New South Wales (slot machine taxes provided nearly 50% of the Government revenue from gambling). It is clear that many people in the state play slot machines and the survey evidence available indicates that large numbers of people play the slot machines once a week or more frequently (Caldwell, 1974; Dickerson, Fabre & Bayliss, 1986; MacMillan, 1985; and Walker, 1988).

Independent Variables: Type of Game Played and Preferred Game

The design of the study involved two independent variables. Players were recruited whose favourite games were either some form of video machine such as might be found in an amusement arcade (hereafter referred to as "video amusement"), video draw poker as played on video draw poker machines found in hotel bars (hereafter referred to as "video poker"), and slot machines as found in clubs throughout Sydney (hereafter referred to as "slot machines"). These three games were chosen because of the variations in skill involved in play, and whether or not the game is typically used for gambling. Both video poker and slot machines are gambling games whereas video amusement machines are not. Both video poker and video amusement involve an element of skill whereas slot machines do not. In terms of skill, it is assumed that

the play of video amusement machines involves the most skill and slot machines the least.

Each player was required to play all three kinds of machines for a period of thirty minutes each. Thus, a two factor design (preferred machine, type of machine) was used with repeated measures across type of machine.

Players

Experiments of this kind face a number of methodological problems. If regular players were recruited for the experiment at the site of play, a confounding of variables would occur. If, for example, slot machine players were found to produce more irrational thinking than video amusement machine players, the effect may be caused by the different kind of game or by the different kinds of players who play those games. Slot machine players may be older, less well-educated, and more often women whereas video amusement players may be younger, better educated, and more often men. In order to minimise the problems caused by confounding, player attributes must be carefully controlled. In this study, the problem of confounding was resolved by recruiting subjects from the Psychology 1 population at the University of Sydney. Although sampling from such a limited population introduces new problems involving ability to generalise, the impact of these new problems is not as severe as might be expected. If it is argued that students who are regular slot machine players are not typical of the population of slot machine players, the basis would be that the students are younger and better educated than the general population. However, such attributes are likely to inhibit irrational thinking and thus minimise the effect being investigated. Thus, if it is found that student slot machine players exhibit more irrational thinking than student video amusement machine players, that effect is likely to under-estimate the real differences in the use of irrational thinking between the general run of slot machine players and the general run of video amusement machine players.

Students for the study were recruited through an advertisement placed on the Psychology 1 notice board at the University of Sydney. Twenty-six first year Psychology students volunteered for the study. Their ages ranged from 18 to 40 years. Students who did not meet the

criterion of playing at least two times each week at their preferred game were excluded from further investigation. The students participated in return for course credit. The analyses presented here are based on nine slot machine players (three females and six males), eight video poker players (two females and six males), and nine video amusement players (three females and six males).

Measurement of Irrational Thinking

The student played his or her preferred machine first and then played the other two machines subsequently. Each player on each machine was requested to play for thirty minutes. However, in several instances the player would refuse to play for the full length of time on a machine which was not their preferred type of machine and so the actual playing time on non-preferred machines was cut to twenty minutes. The players played with their own money in each game.

The players were asked to say aloud whatever they were thinking while playing. Specifically, the instructions were: "We want to know how you are playing the game. We want you to talk all the time so we know what you are thinking about while you are playing the game. When you are ready we will begin recording." Each player practised talking aloud with their preferred machine until they were comfortable with requirement and used to the presence of a microphone. Extensive training of the type reported by Gaboury and Ladouceur (1988) was not given but statements such as "Please keep on talking", "That's fine", and "That's OK", were used to maintain the talking while the student was playing.

The verbalisations of each player were recorded during the period of play by a hand held microphone linked to a portable Sony recorder. The speech of the player and recording person was subsequently transcribed fully for further analysis. The transcriptions listed the speech by speech acts where the speech act was defined as all of the speech on one topic between one pause in talking and the next pause in talking. Pauses in talking were frequent for all players in each type of game.

Each separate speech act of the player was coded into one of five categories:

1. *descriptive*: a statement describing some aspect of the game;
2. *rational*: a statement of strategy which is correct (optimal with respect to winning) in relation to the structure of the game;

3. *irrational*: a statement of strategy which is incorrect or an attempt to influence the outcome in a way which is inappropriate;
4. *emotional*: a statement which expresses feelings about an outcome in the game;
5. *other*: any other statements (such as talk addressed to the recording person) and speech acts (such as grunts) which could not be categorised under 1-4.

Typical speech acts categorised as rational included:

statements about probabilities or odds which are correct;
 statements about inability to control the outcome when accurate;
 differentiating between reasonable and unreasonable courses of action;
 statements of strategy for the long term when correct;
 objective analysis of various options of play.

Typical speech acts categorised as irrational included:

incorrectly linking cause and effect;
 superstitiously based hypotheses, systems, or predictions;
 rationalising a loss or near miss in terms of inappropriate factors or agents;
 personification of the machine;
 referring to personal skill when absent or impossible;
 referring to personal luck as a predictive or explanatory factor.

The dependent variable, amount of irrational thinking, was measured by two indices:

$I/(I + R + D + E + O)$ and $I/I(I + R)$ where I = freq (irrational statements)
 R = freq (rational statements)
 D = freq (descriptive statements)
 E = freq (emotional statements)
 O = freq (other statements).

The first index measures the rate of production of irrational statements whereas the second index measures the relative amount of

irrationality in the strategic statements. In each case the higher the index the more that irrational thinking is present.

Reliability of the Coding

Eight judges (postgraduate students at the University of Sydney) were used in coding the data from one subject. The three protocols from that player were used for measuring interjudge reliability. The transcript was divided into speech acts by the recording person. Each speech act was then coded independently by the eight judges. For each speech act the dominant category was ascertained and nominated as the correct category for that speech act. Where two categories were equi-dominant, the dominant category was determined after discussion between the judges. Judge reliability was scored as the percentage of judgments by that judge in agreement with the dominant category. Interjudge reliability was calculated as the average judge reliability. Interjudge reliability was 84%. The transcripts of the remaining twenty-five subjects were coded by one or another of the eight judges.

RESULTS

The mean rate of production of irrational statements (I/Total) is shown in table 1 as a function of game type and preferred game type.

Table 1
Rate of Irrational Thinking in Playing Video Amusement Machines, Video Poker and Slot Machines

<i>Preferred machine</i>	<i>Type of machine played</i>			<i>overall proportion</i>
	<i>video amusement</i>	<i>video poker</i>	<i>slot machines</i>	
video amusement	0.012	0.066	0.139	0.072
video poker	0.012	0.118	0.170	0.100
slot machines	0.017	0.199	0.379	0.198
overall proportion	0.014	0.127	0.229	

Each cell gives the proportion of irrational statements out of the total number of statements averaged across the players.

Analysis of variance demonstrates that both the main effects and the interaction effect are significant at the 95% level of confidence. The proportion of irrational statements is affected most strongly by the type of machine played ($F_{2,46} = 23.03$, $p < 0.01$). Post hoc comparisons using Duncan's multiple comparisons show that slot machines elicit more irrational statements than video poker machines ($p < 0.01$) which in turn elicit more irrational statements than video amusement machines ($p < 0.01$). Player preferences also have a significant effect on the measure of irrational thinking. Players whose preferred machines are slot machines emit more irrational statements than players whose preferred machines are either video poker or video amusement machines independently of type of game ($F_{2,23} = 5.02$, $p < 0.05$). Most importantly, the hypothesised interaction between machine played and machine preference was supported ($F_{4,46} = 2.74$, $p < 0.05$). The highest levels of irrational thinking occurred when slot machine players played their preferred machine whereas the lowest levels occurred when video amusement machine players played their preferred machines.

The index of relative amount of irrational strategic thinking (I/I + R) was similarly calculated for each cell and the means for each game according to player preference are shown in table 2.

Although the same trends are evident in table 2 as were present in table 1, only the main effects for game type ($F_{2,46} = 57.95$, $p < 0.01$)

Table 2
Irrational Strategic Thinking as a Proportion
of All Strategic Thinking in Playing Video
Machines, Video Poker and Slot Machines

<i>Preferred machine</i>	<i>Type of machine played</i>			<i>overall proportion</i>
	<i>video amusement</i>	<i>video poker</i>	<i>slot machines</i>	
video amusement	0.083	0.380	0.606	0.356
video poker	0.133	0.576	0.657	0.456
slot machines	0.150	0.815	0.803	0.589
overall proportion	0.122	0.590	0.689	

Each cell gives the proportion of irrational statements out of the total number of strategic statements.

and preferred game ($F_{2,23} = 8.74, p < 0.01$) are significant. The interaction effect expected between preferred machine and machine played did not occur ($F_{4,46} = 1.91, n.s.$). Regardless of preferred game, the relative amount of irrational strategic thinking is highest for slot machines and lowest for video amusement machines. Similarly, players who prefer slot machines exhibit most irrational thinking and players who prefer video amusement machines exhibit least irrational thinking across all three machines.

DISCUSSION

The results of this study are an important link in the explanation offered by the cognitive perspective on heavy gambling. Where gambling games provide a basis for skillful play, heavy gamblers on those games report using skill and claim to have an edge over less skillful players (poker — Hayano, 1977; bridge — Walker, 1987; betting on horse races — Walker, 1988). Even in some games of chance, some players report using skill in order to win money (roulette — Letarte, Ladouceur & Mayrand, 1986). However, slot machine players typically report that their game is purely a matter of chance and involves no skill (Leary & Dickerson, 1985; Walker, 1988). According to the cognitive perspective, heavy gamblers persist in gambling because they believe that they will win where others fail: they have the skill or special knowledge to enable them to win. Therefore, a key issue concerns whether slot machine players, despite public acknowledgement of the absence of skill in playing their game, might privately believe that they have the skill or special knowledge necessary to turn a slot machine into a winning proposition.

The results reported here show that slot machine players, when asked to say aloud their thoughts, emit more irrational statements than do video poker or video amusement machine players independently of the type of game they are playing. Very high levels of irrational statements are made by heavy slot machine players when playing their preferred machine: 38% of all their speech can be regarded as irrational and 80% of their strategic statements are irrational rather than rational. This last figure is similar to 86% irrational thinking found by Gaboury & Ladouceur (1988) using a similar measure for roulette players. Players frequently talk to their machine making encouraging statements such as, "C'mon baby!" and "Come to mama!", reminders

such as, "You owe me!", and bargains such as, "You pay me and I'll pay you". This high level of irrational thinking suggests that slot machine players attempt to influence their machines and may actually believe that they will succeed in this endeavour. One player reported being successful by getting "in tune" with the machine and then visualising winning combinations.

That heavy slot machine players believe that they have special means of influencing the machines is consistent with the practices observed among regular players. One common practice involves placing a few coins in several machines in order to select the one that is going to pay back more often and more money. Some players maintain certain "essential" levels of credit in the machine whereas others engage in superstitious behaviours such as holding certain denominations of coins in their hands while playing. If slot machine players believe that they can influence the machine to display winning combinations then it follows that they may be able to extract an edge where other less fortunate or more ignorant players cannot. The occasional large pay-off will ensure that occasionally the heavy slot machine player does win. Biased evaluation of the outcomes may then maintain the illusion that with diligence and persistence, an overall winning performance can be expected.

Although this study has focused on the irrational thinking of slot machine players, data were also gathered from video poker players and from people playing amusement machines in the arcades. Video poker machines elicited significantly more irrational statements than did the video amusement machines. The low level of irrational thinking elicited by the amusement machines is partly explained by the apparently lower need or opportunity to engage in superstitious behaviour on these machines. However, it is not simply the differences between the machines that accounts for the differences in irrational thinking: regular video poker players produce more erroneous strategy statements than regular amusement machine players independently of the type of machine being played. The data available suggests that the players attracted to gambling machines (slots or poker) are more disposed to use irrational thinking and that the machines they play elicit this kind of thinking. Video amusement players, by contrast, are less attracted to gambling machines, are less disposed to use irrational thinking, and prefer games in which opportunities exist to develop high levels of skill. If this interpretation of the data is correct then the transition from playing non-gambling machines to playing gambling machines will not

be automatic. In this regard, amusement arcades in Britain provide a natural experiment in which this hypothesis can be tested. In such amusement arcades, video amusement machines are placed alongside slot machines (in Britain, 'fruit machines') and adolescents can be observed playing both kinds of machines. The data presented here suggests a natural division will be found in such arcades between the fruit machine players on the one hand who will use irrational thinking to influence the outcomes on their machines and the video amusement machine players who will use rational thinking to influence the outcomes on their machines.

While this study suggests that an important link has been made in the cognitive chain maintaining gambling behaviour, there is good reason to remain cautious. First of all, the data is drawn from an extremely small sample ($n = 9$) of slot machine players; confirmation with a larger more diverse sample is necessary before this result should be generalised to all slot machine players. Second, the results are dependent on the assumption that what players say relates in a direct way to what they think. If slot machine players make irrational statements because they are self-presenting in a way they believe is expected, then the analysis of spoken 'thoughts' may be worthless. Finally, there is an untested hidden assumption that cognitions can cause behaviour: that irrational thinking maintains gambling behaviour. The results of this study are consistent with this view. However, the alternative view that gambling behaviour is maintained other factors, such as reinforcement schedules, and that cognitions are simply post hoc rationalisations of prior behaviour (see Nisbett & Wilson, 1977) cannot be discounted. According to this interpretation it is the gambling behaviour which maintains the irrational thinking rather than the reverse. Although there is no way that these two explanations can be separated in what is essentially a correlational study, the fact that players frequently specify what they will do in a given situation ('keep the 9s, draw three'), before the action is carried out, suggests that it is the cognition that precedes the action.

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