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GAMBLING: SOMETIMES UNSEEMLY; NOT WHAT IT SEEMS

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Gambling offers opportunities for basic research and theory, and has hugely important applied implications. As Fantino (2008) said recently, "The current view of pathological gambling as an addiction cries out for a functional analysis of the controlling variables and for strategies of behavioral intervention." This view echoed that of Dixon (2007) who called out for behavior analysts to apply their very relevant skills to discovering the causes of gambling disorders. To understand the behavior of gambling, one must understand the basic processes and variables involved in making the decisions gamblers make. Behavior analysts, those experimental psychologists who approach psychological phenomena from a behavioral (or functional) perspective, have long concentrated on the choices organisms make. Thus, they should be in a strong position to contribute to our appreciation of the factors controlling gambling. In this paper we will examine some of the advances already made, and also propose some directions for future research.

Keywords: Gambling, decision-making, behavior analysis, self-control.

First, we briefly review some contributions behavior analysts have made towards understanding gambling. Then we turn to our main focus, the role of discounting in decision-making with an emphasis on its relevance for gambling. As Fantino, Navarro, and O'Daly (2005) have noted, many basic principles in the learning literature can be applied in a straightforward manner to explain the acquisition, maintenance, and durability of addictive behaviors such as compulsive gambling (including superstitious behavior, the partial-reinforcement effect, and behavioral persistence). They point out the critical role played by accurate discriminative stimuli in encouraging optimal and rational decision-making. In most cases, choices become more optimal under conditions in which the true contingencies and probabilities governing the outcomes are made more transparent. Conversely, when the true contingencies are disguised, as they are in some gambling situations, players may be led to make less-than-optimal decisions. For example, Ladouceur and Sévigny (2005) found that subjects persisted longer in playing a video lottery game when they believed that pressing the screen activated a "stopping device" that made the reels stop spinning. This gave players the illusion of control over outcomes; in reality, the outcomes were pre-programmed and the device had no effect.

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SALIENCE OF CONTINGENCIES

Research on well-known failures of rational decision-making such as probability matching and the sunk-cost effect (for probability matching, see Fantino & Esfandiari, 2002, and Benhsain, Taillefer, & Ladouceur, 2004; for the sunk-cost effect, see Navarro & Fantino, 2005) show that providing transparent cues to the prevailing contingencies makes behavior more optimal. We illustrate with experiments on the sunk-cost effect, a type of behavioral persistence in which the subject persists in a non-optimal course of action. Navarro & Fantino (2005) placed pi-

geons individually in an operant chamber in which they could peck either of two keys: a "reward" key colored white, or an "escape" key displaying a white 'X'. College students were faced with a corresponding task on a computer console. For a large number of trials, the subjects had to peck (or press) the reward key an unknown number of times until they received a reward. At any time they could respond on the escape key to cancel the current trial and initiate a new one. A new trial began either after a peck to the escape key or after a reward (i.e., food for the pigeon, points for the college student). The reward key modelled a course of action gone awry: it offered a diminishing chance of reward as responses incremented. In other words, as subjects responded without getting a reward, the amount of work remaining for reward became increasingly large. A subject's optimal strategy was to escape after 10 non-rewarded responses to the reward key. Navarro & Fantino made the advantage of escaping more salient in each of two ways with pigeons and in the second of these two ways with the college students. First, they manipulated whether or not discriminative stimuli were present on the reward key that were correlated with the average number of responses remaining to reinforcement. In half of the conditions the same stimulus was always present on the reward key. In the other half of the conditions, discriminative stimuli signalled the pigeon's lack of progress. As expected, when discriminative stimuli were present, pigeons selected optimally. When the key light changed after 10 non-rewarded responses, the pigeon immediately selected the escape key, initiating a new trial. When the discriminative stimuli were absent, however, only one of four pigeons selected optimally. The remaining three pigeons consistently persisted in responding on the food key until food was ultimately (and arduously) obtained. Thus, this finding could be seen as a non-human analogue of the sunk-cost effect. Second, they created a situation in which there were no discriminative stimuli associated with the changing fortunes on the reward key, but in which the difference in conditions were more extreme than they had been in the prior experiment. The assumption was that if the value of escaping were sufficiently greater than the value of persisting, then subjects would learn to escape even without explicit discriminative stimuli. The results for both pigeons and college students supported this assumption (Navarro & Fantino, 2005).

Other examples of the sunk-cost effect may be explained, at least in part, because we have learned (and have been taught) not to be "wasteful". Indeed much non-optimal human decision-making may be traced to the misapplication of rules that under other circumstances promote adaptive behavior (see Fantino, 1998, for a discussion). That our histories affect persistence has been demonstrated by Goltz's research (e.g., Goltz, 1993, 1999). She has shown that people playing an investment game may tenaciously persist in a losing strategy if they have a history of reinforcement for persisting (as most of us have). In one study, Goltz (1992) exposed subjects to a variable reward history and others to a fixed reward history in which gains and losses strictly alternated (e.g., WLWLWL...). When the game changed so that all future investment decisions resulted in losses (a change that was not signalled to the subjects), those with the variable reinforcement histories persisted in placing investment bets far longer than those with the regular ("fixed") reward histories. Results from other studies are also consistent with this conclusion that humans choosing in mock investment scenarios will more readily abandon a bad investment strategy when the value of persisting versus abandoning that strategy is made more salient. This of course raises the question: How salient are the contingencies in standard gambling situations?

SELF-CONTROL

In many cases gambling settings include precise odds telling the prospective players exactly what the probabilities of success are for each alternative, for example, odds or "betting lines" in most sports (one team favored by x points; a horse with one chance in three to win, etc.). The fact that a small share is taken by the bookmaker (or "the house"), while generally not emphasized, is certainly known to gamblers, especially experienced ones. The fact that the basic contingencies in much everyday gambling are salient suggests that additional factors are involved in the decision to gamble. In particular, there must be factors that help determine why most individuals do not gamble or do so without developing pathology, while others become compulsive gamblers. A key factor may be the way we react to immediate and delayed rewards, the issue of self-control versus impulsiveness. Many of society's problems stem from a preoccupation with short-term gain. Perhaps this is most evident when considering crime. However, the dearth of self-control is manifest elsewhere. Consider the environment, where the pressures for practical immediate solutions to industrial and political problems may lead to decisions which make good sense in the short-term. For example, there may be more jobs, more housing, or lower taxes, but these may wreak havoc in the longer term, resulting in a poorer quality-of-life, higher rates of cancer, and a legacy of environmental problems.

Stock analysts and investors place tremendous emphasis on short-term earnings prospects, as revealed in a company's quarterly reports. Often there is risk in undertaking long-term restructuring of the corporation or in taking measures that, while costly now, would produce a stronger corporation five years in the future. The specter of a mediocre short-term outlook may trigger "sell" recommendations by analysts, eroding the investment of the shareholders. And the corporate leaders who make the decisions are usually the largest shareholders, in other words, the ones with the most to lose. Do the leaders of corporations fail to realize this? Don't they see that, ultimately, it is in the best interest of the corporation to adopt goals consistent with a longer-term perspective? Generally, they do, in the same way that a dieter knows that there is a greater long-term benefit in passing up an inviting slice of apple pandowdy. They know it in the same way that a smoker knows there is a greater long-term benefit in not lighting up. But the corporate leaders face the same pressures as the dieters and the smokers: The pressure to accept the immediately available short-term gain. Moreover, any given corporate leader may not be part of the same corporation five years later ... so, in economic terms, the benefit of the long-term gain to the corporation may be "discounted" somewhat by the possibility that long-term gains may not benefit the individual making the decisions.

Politicians face a host of comparable problems on a daily basis. For example, consider education. Money spent to better educate our youth should have tangible and dramatic positive effects on our society: With increased education our young will develop into adults who are fit for more skilled work positions which, in turn, will lead to reduction in crime and a more competitive economy. But the catch is that these benefits are many years away, whereas the costs are immediate. Also relatively immediate are the politicians' re-election concerns. They may perceive—often correctly—that their re-election chances will be damaged by programs that cost the taxpayers' money. Again, the bias is toward making decisions that increase the likelihood of short-term gains at the expense of greater long-term benefits. If, in confronting major economic, educational, and environmental problems, society—with all of its resources—often opts for small, short-term gains rather than the greater long-term gains, it is not sur-

prising to find that individuals make non-optimal choices when confronted with similar dilemmas.

DISCOUNT FUNCTIONS

If self-control can be viewed as underlying the maintenance of many non-adaptive behaviors, including addictive ones such as gambling, then discounting may be seen as a mechanism whereby impulsive behavior is justified. Consider discounting of rewards in terms of increasing (temporal) delays. For an individual with a very shallow temporal discounting function $100 five years from now is almost as good as $100 now. For an individual with a very steep temporal discounting function $100 five years from now may be of almost no value. In general we admire the individual with the shallow discounting function as someone possessing a good bit of "self-control" (or "will power"). The impulsive individual with the steep discounting function is seen as weak or perhaps neuroanatomically challenged. Of course there are situations where steep discount functions make more sense: that slice of apple pandowdy won't be much to look at (or taste) several months from now. Likewise, $100 five years down the road may not be of any value to a terminally ill patient. So, immediately the question arises about the conditions under which we get different degrees of discounting. Across conditions, is there stability in the discounting functions of individuals? Is there a single type of mathematical function that can describe discounting across the broad range of possible situations? More generally, what can the facts of temporal and probability discounting tell us about gambling? Equally important, what remains incomplete in any account of gambling based on discounting?

Dealing with fundamental principles first, is there a mathematical function that well describes temporal discounting? There is general agreement that for most situations hyperbolic discounting equations, such as that proposed by Mazur (1987), provide an excellent account of the impact of delay (or probability) on the value of a commodity (e.g., Charlton & Fantino, 2008; Estle, Green, Myerson, & Holt, 2006; Madden, Ewan, & Lagorio, 2007). A more general view was presented by Killeen (2008) in his paper "The Mother of All Discount Functions." We need not review the supporting data and arguments here, except to note that the hyperbolic form appears to work well. But we will review how discounting is affected by certain characteristics of the commodities being selected and by the nature of the organism doing the selecting. And we will conclude by discussing how external variables may influence the likelihood of gambling and how altered discounting rates may be seen as a mechanism for these influences.

It is perhaps intuitively appealing to attribute problem gambling to steeper discounting characteristics of the subject. And, in fact, pathological gamblers and other addicts have been shown to have steeper discounting functions than control subjects (e.g., Bickel, Odum, & Madden, 1999; Petry, 2001; Dixon, Marley, & Jacobs, 2003). However, upon reflection, this account may be somewhat incomplete or at least oversimplified. For there are several reasons why we might expect that what is known about discounting would *inhibit* rather than encourage gambling. For one, the commodity generally gambled is money; money supports relatively shallower discount functions, at least where delay is concerned, than other commodities studied. The observation that the characteristics of the delayed commodity affects rate of discounting has been termed the "domain effect" by Baker, Johnson, & Bickel (2003). Charlton & Fantino (2008) referenced studies in which each of the following commodities is discounted more steeply than money: cigarettes for smokers; health gains; crack-cocaine for cocaine-dependent individuals; and consumable commodities such as candy, food, soda,

and alcohol for users of these goods. It has also been shown that commodities that are perishable (such as that piece of apple pandowdy) are discounted more steeply than less perishable commodities. Based on this earlier research and on their own comparison of discount rates for different types of commodities, Charlton & Fantino (2008) concluded that there is a continuum of discount rates based on the nature of the commodity being discounted. This continuum is anchored at the low end with commodities, such as money, that serve an exchange function rather than a direct function, and at the high end by those serving a direct metabolic function (e.g., food, alcohol, other drugs).

WHY WE SHOULDN'T EXPECT PROBLEM GAMBLING

Since most gambling involves monetary payoffs, based on the discounting findings that we have just summarized, we should expect relatively shallow discount functions and relatively little pathological gambling. Second, gambling generally involves variable amounts of monetary rewards, not variable delays. A rich literature with both human and non-human subjects suggests that preference for variable amounts, as found in gambling, is far less likely than preference for variable delays. Third, the literature also suggests that probabilistic discounting may be flatter than delay discounting. Yet many gambling settings involve probabilistic outcomes. Fourth, humans tend to be *risk-averse*, not risk-prone. All of these factors, which we consider briefly in turn, ostensibly argue that many contingencies should conspire against the tendency to gamble. Yet on closer analysis we will see that these contingencies may not be the ones that are most relevant to our problem gambler.

Fantino *et al* (2005) have reviewed much of the huge literature on choosing between certain and variable outcomes. Whereas pigeons and other non-human subjects show robust preferences for variable over fixed delays, human data are harder to categorize. And where fixed versus variable *amounts of reward* are being chosen, the data for non-humans is mixed, dependent on sometimes subtle variables (e.g., O'Daly, Case, & Fantino, 2006), whereas the data from humans tend to support risk-aversion (e.g., Pietras, 2001; Weiner, 1966). In fact risk-aversion under a wide variety of circumstances is thought to be one of the hallmarks of human decision-making (see, for example, Tversky & Kahneman, 1992).

What of the issue of whether discounting functions involving delays or probabilities are steeper? This is a false question since time and probability involve different dimensions. However, there is a rich literature on choice behavior suggesting that, when schedules of reinforcement are degraded by inserting delays between one choice and the following reinforcer, there is a dramatic weakening effect on preference. Not so when the degradation is made by decreasing the probability that the reinforcer will occur (e.g., Fantino, 1967; Spetch & Dunn, 1987).

With respect to risk-aversion, a widely-cited example involves a problem Samuelson (1963) posed to a colleague, asking him whether he would accept a single bet with a 50% chance to win $200 and a 50% chance to lose $100. The colleague turned him down, and there is ample evidence from everyday life that most other people would do the same. Tversky & Bar-Hillel (1983) gave a hypothetical version of the gamble to a sample of 230 Stanford undergraduates; it was rejected by 70% of them.

So, when all is said and done why do we observe problem gambling?

WHY WE SHOULD EXPECT PROBLEM GAMBLING

While each of the four factors discussed above would seem to argue against the likelihood of gambling, there are reasons for fram-

ing the gambling situation in a different way. While the actual wager may not involve temporal discounting, the first three points ignore an aspect of temporal discounting that may be very much a part of the gambling equation. The gambling situation may be viewed as a choice between possible immediate rewards (on successful gambles, which occur in almost any gambling situation) and much more delayed—and less clearly defined—larger rewards in the form of fiscal and familial well being, etc. The steep discounting functions that are inherent in this setting may contribute to an increased propensity to gamble. Holt, Green, and Myerson (2003) argue against the idea that impulsivity is a general trait encompassing both risk-taking and inability to delay gratification. They found that college students with and without gambling experience reacted similarly on a temporal discounting task, but that those who gambled were less sensitive to changes in the probability of rewards, a possible sign of being more likely to take risks. With respect to the fourth factor discussed above, that humans are typically risk-averse, it may be that this aversion is limited to certain situations and to certain (albeit a majority of) individuals. For example, the gambling context may provide cues more conducive to gambling than, say, a questionnaire about hypothetical gambles made in a psychology experiment. Equally important, we should explore whether problem gamblers, non-problem gamblers, and non-gamblers evince the same degree of risk-aversion. We wager that they do not.

Our discussion thus far has emphasized contingencies that should make gambling more or less likely. The implication is that people should act rationally in terms of responding appropriately to the constraints imposed by the prevailing contingencies. But if we know anything about human decision-making we know that it is not necessarily rational, logical, or optimal (e.g., Fantino, 2004). Gambling is also affected by social considerations (e.g., Rockloff & Dyer, 2007) and by verbal behavior (e.g., Dixon & Delaney, 2006). The present authors (Fantino & Stolarz-Fantino, 2002) have discussed the likelihood that internal events may affect overt behavior. We noted:

> For example, it may well be that the drug addict under treatment is more likely to take drugs after a prolonged period of thinking about them than after a period of thinking about an upcoming basketball game. That these two episodes of thinking can be understood as a function of the addict's reinforcement history does not necessarily render them irrelevant to a complete account of behavioral causation (Fantino & Stolarz-Fantino, 2002, p. 124.)

The problem gambler may well be more likely to associate cues in his or her environment with past gambling behavior including memorable "wins," and therefore be more prone to thinking about gambling. A closely related question, deserving of research, is whether problem gamblers are more susceptible to the role of instructions or advertising about gambling than are non-problem gamblers and non-gamblers.

May we affect the propensity to gamble by "getting inside the gambler's head?" In a first effort to do so, we conducted two studies in which subjects were given $10 and had the opportunity to bet any amount of it on a 50/50 wager based on the throw of a fair die. Subjects were randomly assigned to conditions in which they were instructed to concentrate on a particular thought for several minutes while the experimenter was out of the room getting the materials used in the study. In each case, some of the assigned thoughts were gambling related (e.g., betting and winning; betting and losing), while others were chosen to evoke feelings (e.g., having a dream vacation; doing well or poorly on an exam). Would gambling-related thoughts serve as discriminative stimuli for wagering, thus influencing subjects to bet more of their $10? In fact, as might be predicted, the situation has proven to be more

complicated. First, men wagered a great deal more than women. This may be an effect of differential experience, and we are looking into this possibility. Second, thoughts of a pleasant nature (e.g., having a dream vacation; doing well on an exam) were at least as likely to lead to wagering as were gambling-related thoughts. Further investigation is ongoing.

In summary, there are many reasons to gamble and many reasons not to do so. A more satisfying and complete account awaits after a great deal more research is undertaken. Discounting functions certainly play a central role in helping us appreciate the nature of gambling, but they are only a part of a rather rich tapestry of contingencies, including the social, emotional, and verbal.

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