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Commentary - Discounting Within The Gambling Context

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COMMENTARY

DISCOUNTING WITHIN THE GAMBLING CONTEXT

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Fantino and Stolarz-Fantino argue that high rate delay discounting may be correlated with pathological gambling not because of factors at work within the gambling context, but because of discounting of the delayed, diffuse benefits of gambling abstinence. Although I agree that the discounting of events outside the gambling context probably affect the probability of gambling, I will argue below that events occurring within the gambling context would also be expected to predispose high-rate discounters toward problem gambling. The authors make four arguments regarding discounting and gambling. I will restrict my comments to the first two.

HUMANS DISCOUNT MONEY LESS THAN OTHER COMMODITIES.

Citing evidence that humans discount delayed monetary rewards at a lower rate than non-monetary rewards, the authors would seem to predict that humans would make more self-control choices in a traditional gambling context, than in other settings where the rewards are not monetary. Thus, gambling should be more likely to occur when the items wagered and won are nonmonetary items such as food, health, or cigarettes (to name a few commodities that have been used in human delay discounting experiments). This is an interesting prediction worthy of empirical investigation. Until those data are collected, a thought experiment will have to suffice.

Consider two casinos. One in which you can wager and win money and another in which you can wager cigarettes on the chance of winning packs, cartons, or cases of your preferred brand of cigarettes. Obviously, the only people interested in gambling in the latter casino will be smokers who tend to discount delayed cigarettes at a higher rate than comparable amounts of delayed money (e.g., Mitchell, 1999). Accordingly, Fantino and Stolarz-Fantino would appear to predict that, all else being equal, smokers would behave more impulsively (i.e., wager more and longer) in the cigarette casino than in the monetary casino. And what if the two casinos were side by side? Which casino would the smokers be more likely to enter and engage in more gambling? Presumably Fantino and Stolarz-Fantino would predict that because of higher rates of discounting delayed cigarettes, the smokers would impulsively choose to gamble cigarettes rather than money. However, given a choice between the two casinos, I would be surprised to see anyone enter the cigarette casino.

A larger point about how discounting rates may interact with factors in the gambling context will be developed below, but for now let us briefly consider why the monetary

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casino might be favored over the cigarette casino (the answer may have little to do with delay discounting but it is interesting nonetheless). One hypothesis was provided by a recent episode of the television show *Family Guy* (a program I abhor, but my son enjoys immensely). In the episode, the father character, Peter, wins a lottery and proclaims that he is going to take his family out for the best meal of their lives. In the next scene, Peter and family are in their car at the drive-up window of a fast food restaurant. Peter is ordering vast quantities of the hamburgers they eat on a regular basis. This is humorous because only a fool, like Peter, would waste a windfall of cash on more of the same.

The scene illustrates that an apparent appeal of monetary gambling wins is that there is a chance that you could hit the jackpot and, if this unlikely event were to occur, it would afford you the opportunity to purchase something normally out of reach (e.g., a trip to Europe or a new sports car). The same cannot be said of a jackpot of cigarettes; more cigarettes is more of the same. The relation between large monetary wins and access to previously unattainable luxuries was recently made explicit on an advertising billboard for a casino. The billboard illustrated the transformation of one of their customers from a hamburger-eating commoner to a lobster-eating aristocrat. Perhaps the possibility of this transformation underlies the tendency for pathological gambling to be more prevalent among lower SES populations (see review by Petry, 2005). With so many more luxury items out of their reach, gambling on a low probability of winning a monetary jackpot is the only seemingly open road to aristocracy. Of course these are speculations awaiting empirical findings; findings I hope those taking a functional approach to the study of gambling will pursue.

VARIABLE AMOUNTS VS. VARIABLE DELAYS

Fantino and Stolarz-Fantino correctly note that animals prefer variable delays and response requirements over fixed delays/requirements, but less consistently prefer variable reinforcer amounts over fixed amounts. Thus, variable amounts, which are characteristic of gambling wins, should not increase the appeal of gambling. However, as just noted, for humans, a monetary jackpot provides access to previously unattainable luxury items. Perhaps laboratory animals would prefer variable reinforcer amounts if, when they occasionally hit the jackpot, it provided access to a qualitatively different reinforcer – one that can only be obtained by choosing the variable reinforcer alternative. This may more closely model human gambling wins and may yield more systematic preferences for variable reinforcers.

A second component of the Fantino and Stolarz-Fantino argument is that we might expect gambling to maintain more behavior than predictable sources of income if human gambling was characterized by variable delays, but it is not. When one gambles, there are minimal delays between placing the bet and winning or losing. Thus, strictly speaking, Fantino and Stolarz-Fantino are correct about gambling not involving variable delays. However, if one conceptualizes the time between the initiation of a gambling episode (i.e., a series of wagers) and an eventual win as a delay (e.g., Rachlin, 1990), then the delay to the next win is quite variable. If this conceptualization has merit, then there should be a relation between the rate at which delayed rewards are discounted and the value of gambling wins.

How increased impulsivity may put one at risk of problem gambling due to factors *in the gambling context* has been outlined in two separate theories. According to *string theory* (Rachlin, 1990), gamblers take an accounting of the discounted expected value of a string of

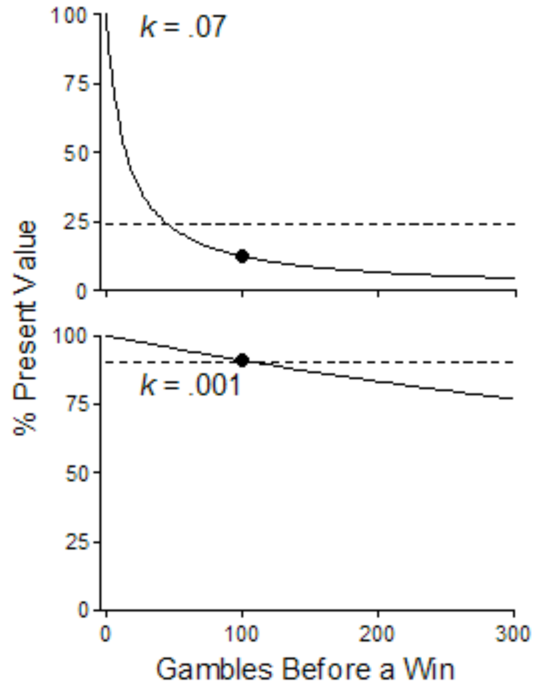

Figure 1. Hyperbolic discounting functions obtained by setting the free parameter (*k*) in Equation 1 to the values shown in each panel. The horizontal dashed line in each panel gives the overall discounted value of a gamble with a 1 in 100 chance of winning (amount constant from win to win). The solid point in each panel shows the discounted value of a comparable win obtained after the 100^{th} "gamble" every time.

gambling events following each win. The delay to this gambling win is the time separating the initiation of the string of gambles and the eventual win. When a win occurs following a single bet, the expected value of the win is not discounted because it is not delayed. When a win follows an extended string of losses, however, the negative expected value is discounted in value because of the delay from the beginning to the end of the string. If an individual discounts delayed losses at a low rate, then the negative expected value of delayed losses retain much of their negative value and outweigh the positive value of gambling wins that occasionally follow short strings of bets (strings with positive expected values). At higher discounting rates (in the range characteristic of pathological gamblers), the negative expected values associated with long strings of losses are more heavily discounted and, therefore, are ineffective in inhibiting the decision to gamble. Thus, according to the string theory of gambling, high-rate discounting should predispose one toward pathological gambling. [1]

The second theory of the relation between discounting events within the gambling context and pathological gambling is based on quantitative predictions of Mazur's (1987) hyperbolic discounting equation (Madden, Ewan, & Lagorio, 2007). The hyperbolic shape of the delay discounting function is shown in both panels of Figure 1 and is given by the following equation (Mazur, 1987):

[1] According to string theory, very high discounting rates are predictive of decreased gambling. However, for this prediction to hold requires that discounting rates be far higher than what has been reported thus far in the human delay discounting literature.

$$V_d = \frac{A}{1 + kD} \quad (1)$$

where A is the objective amount of the reinforcer obtained following delay D. The free parameter k is a quantitative index of impulsivity, as it reflects the steepness of the function (i.e., how rapidly the reinforcer loses its value as it becomes increasingly delayed). Extensive empirical evidence shows that discounting of delayed outcomes by humans and nonhumans is well described by Equation 1 (see review by Green & Myerson, 2004).

The upper panel of Figure 1 shows high-rate discounting characteristic of pathological gamblers (Petry 2001) and the lower panel shows low rate discounting characteristic of humans with no pathology (Kirby, 1997). If the duration of the string of gambles is unpredictable, then so is the delay to a gambling win; indeed, the obtained delay to the next gambling win can occur at any value along the x-axis of Figure 1 (and beyond). This second account of the role of delay discounting in gambling focuses on the discounted value of these unpredictably delayed gambling wins (not gambling losses). To calculate the discounted value of gambling wins (V_g), we use the equation proposed by Mazur (1989):

$$V_g = \sum_{i=1}^{n} P_i \left(\frac{A}{1 + kD_i} \right) \quad (2)$$

where P_i is the probability of experiencing each delay (D_i) and k is the rate of delay discounting. A similar equation has been proposed for unpredictable work requirements, like those arranged by random-ratio schedules of reinforcement (Field, Tonneau, Ahearn, & Hineline, 1996). These equations have been empirically supported in experiments involving nonhuman subjects (e.g., Madden, Dake, Mauel, & Rowe, 2005; Mazur, 1989).

The horizontal dashed lines in Figure 1 show the percent of the present (discounted) value of unpredictably delayed gambling wins (V_g) given discounting rates characteristic of pathological gamblers (upper panel) and no-pathology humans (lower panel). These discounted values of the gambling wins were obtained by a computer-simulated series of 200,000 gambling wins where the odds of winning were 1 in 100 and the discounting rate was set equal to that indicated in each panel. Within the simulation, the number of gambles made before each win provided the value of D_i, and the probability of winning following D gambles (P_i) was empirically obtained for each value of D in the simulation. The solid data point within each panel shows the discounted value of a comparable reward reliably delivered following the 100th "gamble". This predictable delay to a win is equal to the average obtained delay of the 200,000 gambling wins; thus, any difference in the discounted values of the predictable and unpredictable wins is not due to a difference in obtained delay.

In the upper panel of Figure 1, gambling wins are discounted by approximately 75%, but that is unimportant in the decision to gamble or not. What is important is that gambling wins are worth nearly twice as much as a predictably delayed reward of the same magnitude. At this high rate of delay discounting the unpredictably delayed gambling-like reward retains more value and should be strongly preferred over the predictable outcome which may more closely model the more predictable monetary rewards obtained by humans (e.g., regular paychecks). In the lower panel, the discounted values of gambling and non-gambling outcomes are approximately equivalent because the hyperbolic discounting function is shallow and closely approximates linearity. Thus, at low rates of discounting, gambling-like rewards have no

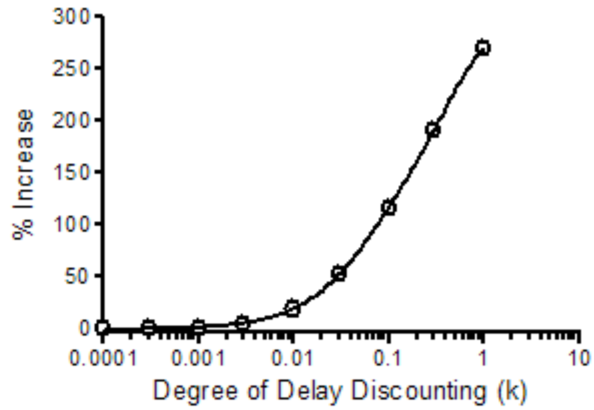

Figure 2. Percentage increase in discounted value that is obtained by selecting unpredictably delayed over fixed delayed rewards. As the degree of delay discounting increases (*k*), the gambling-like rewards increase in value relative to the predictable rewards. Note that the reward amounts and average time to the reward are constant across gambling and non-gambling rewards.

greater value than predictable rewards and thus gambling should have no untoward appeal.

Equation 2 may be used to predict how much the value of gambling-like wins will increase over predictably delayed non-gambling rewards as a function of increases in the degree of delay discounting (*k* in Equation 2). This predicted relation is shown in Figure 2. At *k*-values of 0.001 (typical of humans without a pathology) nothing is to be gained by gambling (% increase = -0.3). However, at *k*-values of 0.03 and above (the range reported for pathological gamblers by Alessi & Petry, 2003) the individual experiences at least a 50% increase in subjective reward value by choosing to gamble. Thus, Equation 2 predicts that, all else being equal, higher delay discounting rates are predictive of stronger preferences for gambling-like rewards.

If factors occurring in the gambling context combine with high rates of delay discounting to render gambling wins more valuable (Madden et al., 2007) and/or strings of losses less costly (Rachlin, 1990), then when combined with greater discounting of the benefits of delayed gambling abstinence, high-rate delay discounting should be predictive of increased rates of pathological gambling. Although we have learned much by studying correlations between delay discounting and addicted populations, further animal research is needed to determine if we can *experimentally* manipulate rates of delay discounting (e.g., Mazur & Logue, 1978) and, if so, if this affects the subsequent development of socially relevant behavior such as drug self-administration and preferences for gambling-like outcomes. I, like Fantino and Stolarz-Fantino, look forward to the results of this functional approach to the study of gambling.

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