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RESPONSE-INDUCED REVERSALS OF PREFERENCE IN GAMBLING: AN EXTENDED REPLICATION IN LAS VEGAS[1]

SARAH LICHTENSTEIN[2] AND PAUL SLOVIC

Oregon Research Institute, Eugene, Oregon

Previous experiments, studying college students in a laboratory setting, have demonstrated the effects of response mode upon information-processing strategies employed in gambling decisions. The present experiment extended, in a Las Vegas casino, the findings of the previous studies. As in the laboratory, the casino patrons were found to employ different strategies when choosing among pairs of bets than when attaching monetary values to single bets. This behavior led to reversals of preference as a function of response mode. The reversals were found for bets with negative as well as positive expected value. These results suggest a bias due to cue-response compatibility that may have implications for information processing in a variety of decision-making situations.

In a previous paper, Lichtenstein and Slovic (1971) argued that variations in response mode cause fundamental changes in the way people process information, and thus alter the resulting decisions. Evidence supporting that view came from 3 experiments in which *S*s chose their preferred bets from pairs of bets and later placed monetary values (prices) on each bet separately. In every pair of bets, one, designated the $ bet, featured a large amount to win; the other, called the P bet, featured a large probability of winning. Many *S*s, after choosing a P bet, would frequently place a higher price on the $ bet. The authors hypothesized that the following process leads to such reversals of preference. When pricing an attractive bet, *S*s use the amount to win as a natural starting point or anchor. Then they adjust downward the amount to win in order to incorporate the other aspects of the bet. This adjustment may be rather crude and insufficient, making the starting point—amount to win—the primary determiner of the response. Thus, the $ bets, with their large winning payoffs, receive higher prices than the P bets. This bias would not be expected in choice responses, where the amount to win does not dominate decisions (Slovic & Lichtenstein, 1968).

The previous study (Lichtenstein & Slovic, 1971) used gambles with positive expected value (EV) exclusively. A more stringent test of the reversal effect was provided in the present study by the inclusion of unattractive (negative EV) bets. Lindman (1971) reported reversals of preference for both positive- and negative-EV bets using imaginary money, but no real-play situation including negative-EV bets has been studied. It was hypothesized that reversals would occur with negative-EV bets because *S*s, when pricing unattractive bets, would use the amount to lose as a starting point and make an adjustment upward in an attempt to account for the other aspects of the bet. If, as with positive-EV bets, this adjustment were rather crude and insufficient, the $ bet, with its large loss, would be underpriced. No such bias was expected in the choice task.

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[2] Requests for reprints should be sent to Sarah Lichtenstein, Oregon Research Institute, P. O. Box 3196, Eugene, Oregon 97403.

TABLE 1

PROBABILITIES AND WIN–LOSS DATA FOR BETS USED

Positive expected value						Absolute expected value	Negative expected value					
P bet			$ bet				P bet			$ bet		
Probability of winning	Win	Lose	Probability of winning	Win	Lose		Probability of winning	Win	Lose	Probability of winning	Win	Lose
7/12	17	7	2/12	97	11	7	5/12	7	17	10/12	11	97
10/12	9	3	3/12	91	21	7	2/12	3	9	9/12	21	91
9/12	10	2	3/12	73	15	7	3/12	2	10	9/12	15	73
8/12	16	11	3/12	94	22	7	4/12	11	16	9/12	22	94
11/12	12	24	2/12	79	5	9	1/12	24	12	10/12	5	79
11/12	10	2	5/12	65	31	9	1/12	2	10	7/12	31	65
10/12	16	2	5/12	48	12	13	2/12	2	16	7/12	12	48
9/12	18	2	3/12	85	11	13	3/12	2	18	9/12	11	85
10/12	20	10	5/12	64	20	15	2/12	10	20	7/12	20	64
8/12	30	15	4/12	95	25	15	4/12	15	30	8/12	25	95

Note. Abbreviations: P = bet featuring a large probability of winning (positive EV) or losing (negative EV); $ = bet featuring a large amount to win (positive EV) or to lose (negative EV).

The present report describes an expanded replication of the previous experiments in a nonlaboratory real-play setting unique to the experimental literature on decision processes—a casino in downtown Las Vegas.

METHOD

The game was located in the balcony of the Four Queens Casino. The equipment included a PDP-7 computer, a DEC-339 cathode ray tube (CRT), a playing table, into which were set 2 keyboards (1 for the dealer and 1 for the player), and a roulette wheel.

The game was operated by a professional dealer who served as *E*. The *S*s were volunteers who understood that the game was part of a research project. Only 1 *S* could play the game at a time. Anyone could play the game, and the player could stop playing at any time (the dealer politely discouraged those who wanted to play for just a few minutes; a single complete game took 1–4 hr.). Some *S*s were recruited through newspaper reports of the project, and some learned of it by watching others play.

All *S*s received complete instructions from the dealer, who explained the game and helped *S* with practice bets until *S* felt ready to begin play. At the start of the game, *S* was asked to choose the value of his chips. Each chip could represent 5¢, 10¢, 25¢, $1, or $5, and the value chosen remained unchanged throughout the game. The player was asked to buy 250 chips; if, during the game, more chips were needed, the dealer sold him more. At the end of the game (or whenever the player quit), the player's chips were exchanged for money.

The game was composed of 2 parts. Part 1 was a paired-comparison task, with 10 pairs of positive-EV and 10 pairs of negative-EV bets. Part 2 was a selling-price task, in which all of the previously presented 40 bets were presented again, 1 at a time. The 40 bets are shown in Table 1. Each negative-EV bet is the mirror image of a positive-EV bet in the same row.

Part 1. Four bets appeared on the CRT, labeled B1 and B2 (for negative-EV, or "bad" bets) and G1 and G2 (for positive-EV, or "good" bets). All 4 bets had the same absolute EV, but the bad bets shown were never the mirror images of the good bets shown. For example, the bad bets of Row 1 in Table 1 were presented with the good bets of Row 2 in Table 1, and vice versa.

The player chose 1 good bet and 1 bad bet by pushing, on the keyboard in front of him, the buttons labeled BET G1 or BET G2 and BET B1 or BET B2. After this selection, the chosen bad bet was displayed alone on the CRT. The player then selected the roulette numbers he wanted to be designated as winning numbers for that bet. After the player chose his numbers for the bad bet, the dealer spun the roulette wheel and exchanged the appropriate chips with the player. The chosen good bet then appeared on the CRT and was played in a like manner. This continued until 10 bad bets and 10 good bets had been played.

Part 2. The second part of the game used the selling-price technique described by Becker, DeGroot, and Marschak (1964) and used by Lichtenstein and Slovic (1971). This technique is designed to persuade *S* to report his true subjective value for the bet; any deviations from this strategy, any efforts to "beat the game," necessarily result in a game of lesser value to *S* than the game resulting when he honestly reports his subjective evaluations.

The CRT displayed 1 bet at a time, and the player was told that he "owned" that bet. He could either play the bet or sell it back to the dealer. His task, then, was to state a selling price, defined by *E* as follows:

Your price for the bet depends on how much you want to play the bet. If you like the bet, and want to play it, you would expect the dealer to pay you for it. So your price would be stated like this: "The *dealer must pay me*____ *chips* to buy this bet." But if the bet is a bet you do *not* like and do *not* want to play, you should be willing to give the dealer chips in order to avoid playing the bet. So you should state your price like this: "*I will pay the dealer*____ *chips* to get rid of this bet." You may also wish, on some bets, to state a price of *no chips*. This would mean that you would *not* demand that the dealer pay you to buy the bet from you, and also you would *not* be willing to pay the dealer to get rid of the bet.

To choose your selling price, first ask yourself whether you like the bet and want to play it. If the bet looks like a good bet to you, you would like either to play the bet or to sell the bet to the dealer and receive chips from him for sure. Your price for the bet should be all three of these things: (*a*) the *smallest* number of chips for which you would be willing to sell the bet; (*b*) the number of chips that you think the bet is worth; (*c*) just that number of chips so that you don't care what the dealer does. If he buys the bet, you'll be happy. If he refuses to buy the bet, you'll be happy to play it. If you think you'd rather play the bet than sell it for a certain number of chips, then that number of chips is the *wrong* price for you. You should raise your price until you don't care whether you sell the bet or play it.

If you think the bet is a bad bet, you must either play it or *pay the dealer* to take it off your hands. Your price for the bet should be both of these things: (*a*) the *largest* number of chips you would be willing to pay the dealer to avoid playing this bet; (*b*) just that number of chips so that you don't care whether the dealer buys the bet or not—the dislike you feel at having to play the bet is just exactly balanced by the dislike you feel for having to pay out that many chips to get rid of the bet.

Players sometimes priced a good bet as if it were a bad bet, and vice versa. The dealer sometimes questioned the price if he thought the player had misread the bet or made a careless error, but such prices were not refused. If the player stated a price for the bet which was more than he could win from it, or offered to pay more to avoid the bet than he could lose, *E* was instructed to refuse the price, explain why it was not acceptable, and let *S* respond again.

After the player entered his price on the keyboard, the dealer generated a counteroffer by spinning the roulette wheel to generate a random number r (disregarding 0 and 00) and entering that number into the computer, which used the following rule to generate a counteroffer:

$$\text{counteroffer} = \begin{cases} \text{EV} + \dfrac{r}{2} - 10, & \text{if } r \text{ is even} \\[2ex] \text{EV} + \dfrac{r+1}{2} - 10, & \text{if } r \text{ is odd.} \end{cases}$$

If the counteroffer was equal to, or greater than, the player's price, the bet was sold at the price of the counteroffer. If the counteroffer was less than the player's price, the player played the bet, using the playing procedure described above. For example, if a player said -10 (*I'll pay 10 chips to avoid playing the bet*), and the counteroffer was -12 (dealer demands 12 chips), the player played the bet; if the counteroffer was -8 (dealer demands 8 chips), the player would pay the dealer 8 chips and not play the bet.

With this set of counteroffers, the player who states the EV of the bet as his price for each bet will maximize his expected winnings. For this strategy, the EV for the entire transaction (pricing and either selling or playing) for a single bet is EV + 2, and the player will play, on the average, half of the bets, while selling half. In order to assure that the game had, at best, a 0 EV, players were required to pay "entrance fees," giving the dealer 16 chips before each 8 bets.

After the player priced and either played or sold all 40 bets, his remaining chips were exchanged for money and the game was ended.

Subjects. During the 10 wk. the game was in operation, the dealer recorded the start of 86 games. There were 53 completed games, played by 44 different *S*s (1 *S* completed 3 games; 7 *S*s completed 2 games). Only data from these 53 completed games were analyzed.

Although *S*s were not questioned about themselves (in fact, they did not have to give their true names), a few did volunteer some background information. Seven of the 44 complete-game players worked in Las Vegas as dealers. Others included a chemist, a ticket vendor for a bus line, a computer programmer, a television director, a mathematician, a sheep rancher, a real-estate broker, an Air Force pilot, an engineer, the owner of a small grocery, and several college students. The dealer's impression was that the game attracted a higher proportion of professional and educated persons than the usual casino clientele.

Results

Stakes and outcomes. Although players could play for chips worth \$1 or \$5 each, none ever did. For the 53 complete games, 32 were played for 5¢ a chip, 18 for 10¢, and 3 for 25¢. The highest net win was \$83.50, the largest loss was \$82.75, the mean outcome was −\$2.36, and the interquartile range was −\$8.40 to +\$5.50.

Excluded data. In the present study, *S*s sometimes placed a positive price on one bet and a negative price on the bet with which it had been paired. Because the present authors assume a different process taking place when *S* views a bet as favorable (and thus gives it a positive price) than when *S* views a bet as unfavorable (and thus gives it a negative price), no prediction about reversals can be made when the prices of the 2 bets in a pair differ in sign. These data were therefore excluded from the reversal analysis. Most exclusions were made from the negative-EV pairs: out of 530 pairs of responses, 134 had a positive price given to the $ bet and a negative price given to the P bet. A few additional response pairs were excluded because of a positive P-bet price paired with a negative $-bet price, or a price of 0 paired with a negative price. In all, 182 response pairs (30%) were excluded from the negative-EV pairs. From the positive-EV bets, 46 response pairs (7%) were excluded; most of these had a positive price given to the P bet paired with a negative price given to the $ bet.

Reversals. The left half of Table 2 shows the 484 sets of responses made to favorable bets. In the choosing task, the P bet was chosen over the $ bet 229 times (47%). The critical question is what happened when the bets of these 229 pairs were presented singly for pricing. The table shows that in 185 instances, the $ bet received the higher price. This is the critical reversal that was predicted: in 81% of those instances in which the P bet was chosen over the $ bet, *S* priced the $ bet higher.

A few unpredicted reversals also occurred with the favorable bets. Of the 255 instances in which the $ bet was chosen over the P bet, the P bet later received the higher price 25 times (10%).

The right half of Table 2 shows the 348 sets of responses made to unfavorable bets. In the choosing task, the $ bet was chosen over the P bet 112 times (32%). For these unfavorable bets, the critical question is what happened when the bets of these 112 pairs were presented singly for pricing. The table shows that in 85 instances, the P bet received the higher price. This is the predicted reversal: in 76% of those instances in which the $ bet was chosen over the P bet, *S* priced the P bet higher.

TABLE 2

FREQUENCIES OF RESPONSES

Choice	Positive expected value: Higher price P	Positive expected value: Higher price $	Positive expected value: Total	Negative expected value: Higher price P	Negative expected value: Higher price $	Negative expected value: Total
P	44	185[a]	229	190	46	236
$	25	230	255	85[a]	27	112
Total	69	415	484	275	73	348

Note. Abbreviations: P = bet featuring a large probability of winning (positive EV) or losing (negative EV); $ = bet featuring a large amount to win (positive EV) or to lose (negative EV).
[a] Predicted reversals.

Unpredicted reversals were slightly more frequent with the unfavorable bets than with favorable bets. Of the 236 instances in which the P bet was chosen over the $ bet, the $ bet later received the higher price 46 times (20%).

Was this predominance of predicted reversals over unpredicted reversals widespread across *S*s? Six *S*s chose the $ bet from all favorable pairs. Thus, predicted reversals were impossible; the rate of such reversals was undefined. Five *S*s chose the P bet from all favorable pairs, so that unpredicted reversals were impossible. The remaining 33 of the 44 *S*s chose at least 1 $ bet and at least 1 P bet, so that rates of both types of reversals (predicted and unpredicted) could be computed. Of these 33 *S*s, 28 showed a higher rate of predicted reversals than unpredicted reversals (significant by the sign test, $p < .01$). For negative-EV (unfavorable) bets, 29 of the 44 *S*s chose at least 1 $ bet and at least 1 P bet. Of these 29 *S*s, 23 showed a higher rate of predicted reversals than unpredicted reversals (sign test, $p < .01$). These data indicate that the reversal effects shown in Table 2 were widespread across *S*s.

Since *S*s in this and previous experiments were not asked to respond repeatedly to each stimulus, the reliabilities of the 2 response tasks are not known. However, as discussed in the previous report (Lichtenstein & Slovic, 1971, pp. 52–53), reasonable assumptions about error rates cannot explain results such as those reported here.

Discussion

There is a natural concern that the results of any experiment may not be replicated outside the confines of the laboratory. But the results of this experiment, carried out in a Las Vegas casino, were strikingly similar to the findings of previous experiments based on college students gambling with hypothetical stakes or small amounts of money. The widespread belief that decision makers can behave optimally when it is worthwhile for them to do so gains no support from this study. The source of the observed information-processing bias appears to be cognitive, not motivational.

In addition, this study demonstrates that the observed bias occurs with unfavorable as well as favorable gambles. For positive-EV bets the observed reversal phenomenon, which depends on *S*s setting relatively high prices for the high-payoff $ bets, might be interpreted simply as the result of 1 or 2 less interesting biases. First, *S*s may believe that they gain some advantage by overpricing bets, even though the design of the task precludes this. Second, by setting high selling prices, *S*s increased their chances of playing rather than selling the bets. Thus, the results may stem from a predilection for playing rather than selling bets, thereby enjoying more "action."

With negative-EV bets, however, any tendency to overprice the bets, or any effort to increase the probability of playing the bets, would have worked against the reversal effect. But predicted reversals did occur, because *S*s tended to underprice (i.e., avoid, by choosing a large negative price) the $ bets.

The overdependence on payoff cues in pricing a gamble suggests a general hypothesis that the compatibility or commensurability between a cue dimension and the required response will affect the importance of the cue in determining the response. Compatibility-induced biases in information processing may appear in many areas of human judgment. For example, one might expect a used-car buyer to give too much weight to the seller's asking price for the car, and too little weight to other factors (e.g., condition, mileage, etc.) when selecting his counteroffer. Or, the monetary awards granted by proposal review committees and by juries in personal-injury suits may be overdetermined by the amount of money that the researcher or the plaintiff has requested.

The strain of amalgamating different types of information into an overall decision may often force an individual to resort to judgmental strategies that do an injustice to his underlying system of values. The systematic bias in the pricing responses of the present study is one demonstration of this. Most individuals are unaware of the biases to which their judgments are susceptible. Research that explores the locus of such biases is a necessary precursor to the development of aids to decision making.

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