

**Preference Reversals and Keeping Score without Monetary Incentives:  
Evidence for Noisy Maximization\***

by

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**Abstract**

Traditional economic theory assumes subjects have stable preferences across risky gambles based solely on the potential outcomes of the gambles. “Noisy maximization” assumes stable preferences, but allows them to be expressed with random errors. Preference reversal research calls both models into question because the choice pattern in many experiments conflicts dramatically with stable, outcomes-based preferences even if they are expressed with random errors. Here, reviewing and replicating some prior research and running new experiments, we study conditions that lead to behavior that is consistent or inconsistent with noisy maximization. When subjects price and choose between gambles that are not played out, the choice pattern conflicts with noisy maximization. When gambles are played out and a clear outcomes-based objective function exists, subjects display a choice pattern consistent with noisy maximization. While this is strongest when risk preferences are induced using truth-revealing monetary incentives, it also occurs even when subjects are not paid based on outcomes as long as bets are played out. We argue that generating outcomes allows subjects to evaluate their choices relative to the experimental medium of exchange and this becomes their objective function. “Keeping score” using outcomes results in a weak form of induced value. When bets are not played out, “keeping score” is diminished and subjects’ objective functions may be based on other attributes of the gambles

## Preference Reversals and Keeping Score without Monetary Incentives:

### Evidence for Noisy Maximization

Money was never a big motivation for me, except as a way to keep score. The real excitement is playing the game.

--Donald Trump, "Trump: Art of the Deal"

#### I. Introduction

Starting with Lichtenstein and Slovic (1971), preference reversal research calls into question economic assumptions of stable preferences across gambles. In a preference reversal experiments, subjects are asked to compare two gambles, using two different methods to reveal their preference across gambles. Usually, the two tasks are (1) a direct "choice task" in which the subject indicates the preferred gamble, and thus directly reveals preference and (2) a "pricing task" in which the subject assigns values to the two gambles and the values assigned reveal preference. A preference reversal occurs when the preferences revealed by the two tasks are inconsistent. Reversals are common. Lichtenstein and Slovic (1971) observe reversals in 46% of observations on bet pairs. Further, they show that the pattern of reversals cannot be explained by a model of consistent preferences across gambles expressed with random errors.

In a study of incentive effects in preference reversal research, Berg, Dickhaut and Rietz (2010) summarize research replicating Lichtenstein and Slovic (1971). Reversal rates range from 22% to 54%. Reversal rates are somewhat lower if subjects are paid based on outcomes in a incentive compatible, truth revealing manner, but rates remain high and the effect is marginally significant ( $p$ -value = 0.0893). However, there *is* a definite, significant change in the *pattern* of reversals. Replications without incentives largely accord with Lichtenstein and Slovic's (1971) pattern. The choice pattern is *inconsistent* with models that assume stable preferences across gambles even if expressed with random errors. In contrast, truth revealing, monetary incentives result in patterns that *are consistent* with stable preferences expressed with random errors, i.e., "noisy maximization." Berg, Dickhaut and Rietz (2010) conclude that "incentives can generate more economically consistent behavior" presumably because the incentive structure creates a clearly defined objective function consistent with Smith's (1976) idea of induced value.

In related research, Berg, Dickhaut and Rietz (2003) show that inducing preferences over risk can have a strong impact on the pattern of preference reversals. Commonly the gambles in

preference reversal research have similar average payoffs but differ significantly in variance. One bet, the “p-bet,” has a high probability of a relatively low payoff and a low variance. The other, the “\$-bet,” has a low probability of a relatively high payoff and a high variance. Inducing risk aversion (risk seeking) creates a strong preference for the p-bet (\$-bet). This reduces reversal rates overall and makes the pattern consistent with noisy maximization. Berg, Dickhaut and Rietz (2003) argue that the risk preference induction mechanism creates stronger preferences across gambles than simple induced value.

The underlying idea of induced value theory is that paying subjects based on experimental outcomes makes them care about the outcomes in a predictable manner. The typical economic argument is that, while money itself has no intrinsic value, money has value because of what it can purchase. That is, money serves as a medium of exchange. However, consistent with Donald Trump’s view from *Art of the Deal*, some researchers argue that money, the medium, in and of itself becomes the objective. In particular, Hsee, Yu, Zhang and Zhang (2003) argue that money, experimental currency units, points, or whatever medium of exchange is used in experiments, becomes the objective of subjects. Subjects engage in “medium maximization” as a way of keeping score in the experiment even if the medium has no direct value.<sup>1</sup>

Here, in preference reversal experiments, we study the effects of “paying” subjects in experimental “dollars” that can be used as a way of keeping score, but have no other value. To allow subjects to keep score, the gambles are actually played out and “payments” are recorded. Subjects are paid a flat fee for participating, but receive no payment based on these outcomes. Subjects know this in advance. In some treatments, we induce risk preferences over the experimental payments using Berg, Daley, Dickhaut and O’Brien’s (1986) binary lottery procedure. The gambles and lotteries were played out and records kept but, again, this had no bearing on subject payments. We compare and contrast the results of these sessions with similar sessions in which gambles were not played out and in which subjects were paid based on outcomes.

In a session without playing out the gambles, we replicated Lichtenstein and Slovic’s (1971) and similar results from the literature that (1) reversals are prevalent and (2) the pattern is inconsistent with noisy maximization. We review the existing research, including our own experimental sessions, which shows that, when the gambles are played out and subjects are paid with truth revealing incentives, (1) reversals remain but (2) the pattern becomes consistent with noisy maximization. Further, reversal rates fall if subjects are induced to be either risk

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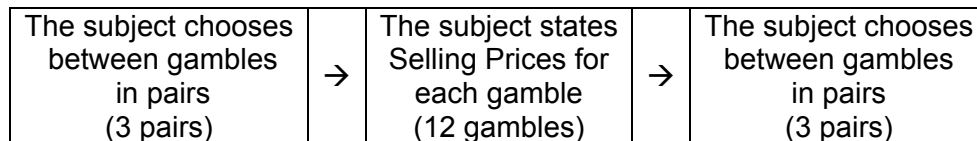
<sup>1</sup> Consistent with this, Camerer and Hogarth (1999) observe that subject behavior accords with economic theory even without being paid.

seeking or risk preferring. Finally, we present new experimental evidence from sessions in which gambles are played out, but subjects receive no outcome-contingent payments. Data from these sessions are consistent with noisy maximization. Apparently, playing out the gambles, seeing outcomes and having the ability to keep score drives more economically consistent behavior even when subjects are not actually being paid.

## II. Preference Reversal

### A. Preference Reversal Tasks

The timeline for the typical subject in a preference reversal experiment (for example, Lichtenstein and Slovic (1971)) is:



In typical research,<sup>2</sup> there are six pairs of gambles. First, three pairs are presented to the subject who must state which gamble in each pair is preferred. Then, the subject values each individual gamble. Finally, the last three pairs are presented to the subject. The gambles in each pair have approximately the same expected value as one another. One gamble, the “P-bet,” has a high probability of winning a low amount while the other, the “\$-bet,” has a low probability of winning a large amount.

Data on each gamble pair includes the valuations of each gamble and the choice between the gambles. Each observation is either consistent in the sense that the revealed rankings are the same across the valuation and choice tasks or it represents a “reversal” because of inconsistent rankings. **Figure 1** shows a typical pattern of data from a preference reversal experiment (specifically Lichtenstein and Slovic’s (1971) Experiment 1. In Cell a, the P-Bet is both priced higher and chosen and in Cell d the \$-Bet is both priced higher and chosen. These represent consistent rankings. Cells b and c represent reversals with the P-Bet chosen but the \$-Bet priced higher (Cell b) or the \$-Bet chosen with the P-Bet priced higher (Cell c). The reversal rate here is  $(b+c)/(a+b+c+d) = (441+32)/(88+441+32+477) = 0.456 = 45.6\%$ .

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<sup>2</sup> Including the experiments run for this paper and in Berg, Dickhaut and Rietz (2003).

Figure 1: Typical pattern of Preference Reversal Responses (from Lichtenstein and Slovic, 1971, Experiment 1, 1038 observations)

	P-bet priced higher	\$-bet priced higher
P-bet chosen	Cell a 88 8.48%	Cell b 441 42.49%
\$-bet chosen	Cell c 32 3.08%	Cell d 477 45.95%

### B. The Noisy Maximization (Two-Error-Rate) Model

Lichtenstein and Slovic (1971) develop a “two-error-rate” model and test it on their data. This model assumes that (1) individual subjects have stable preferences across gambles but (2) preferences are revealed with random errors in the two tasks. The error rates can differ across tasks because of differential task characteristics. However, the tasks do not affect preferences nor do preferences affect error rates. This is what we define as “noisy maximization” (Berg, Dickhaut and Rietz (2003) and (2010)).

To parameterize the model, let “ $q$ ” represent the percentage of subjects who prefer the P-Bet, “ $r$ ” represent the error rate in the choice task (rate at which the non-preferred gamble is chosen) and “ $s$ ” represent the error rate in the pricing task (rate at which the non-preferred gamble is valued higher). If we assume that errors in the choice task and the pricing task are random (that is, error rates do not differ across bets or subjects) and independent (that is, making an error in the choice task does not affect the probability of making an error in the pricing task), then the pattern of observations generated in a preference reversal experiment should conform to Figure 3, where  $a$ ,  $b$ ,  $c$  and  $d$  represent the percentage of observations that fall into each cell.

Figure 3: Two Error Rate Model

	P-Bet Priced Higher	\$-Bet Priced Higher
P-Bet Chosen	$\begin{aligned} &(q)(1-r)(1-s) \\ &+ (1-q)(r)(s) \end{aligned}$ <p style="text-align: right;">a</p>	$\begin{aligned} &(q)(1-r)(s) \\ &+ (1-q)(r)(1-s) \end{aligned}$ <p style="text-align: right;">b</p>
\$-Bet Chosen	$\begin{aligned} &(q)(r)(1-s) \\ &+ (1-q)(1-r)(s) \end{aligned}$ <p style="text-align: right;">c</p>	$\begin{aligned} &d \\ &(q)(r)(s) \\ &+ (1-q)(1-r)(1-s) \end{aligned}$

where:  
 $q$  = percentage of subjects whose underlying preference ordering ranks the P-Bet higher  
 $r$  = error rate in the paired-choice task  
 $s$  = error rate in the pricing task

If behavior is explained by the two-error rate model, then these proportions are also functions of  $q$ ,  $r$  and  $s$  as defined in Figure 3. When solutions exist for  $q$ ,  $r$  and  $s$  that match the observed frequencies, these solutions are the maximum likelihood estimates of the parameters.<sup>3</sup> These estimates are:<sup>4</sup>

$$\hat{q}(1-\hat{q}) = \frac{ad-bc}{(a+d)-(b+c)}, \quad (1)$$

$$\hat{r} = \frac{a+b-\hat{q}}{1-2\hat{q}}, \text{ and} \quad (2)$$

$$\hat{s} = \frac{a+c-\hat{q}}{1-2\hat{q}}. \quad (3)$$

Notice that the two error rate model cannot always be parameterized to fit the data. In particular, equation (1) may not have a real solution. If  $\hat{q} = 0.5$ , there is no solution for  $\hat{r}$  or  $\hat{s}$ . For other estimates of  $\hat{q}$ ,  $\hat{r}$  or  $\hat{s}$  would fall outside the valid 0 to 1 range. Whether the two-error-rate model can be parameterized to fit the data and, if not, whether restrictions imposed by the two error rate model are significant is one factor we use to determine whether incentives affect behavior in preference reversal experiments.

<sup>3</sup> See Berg, Dickhaut and Rietz (2010) for details.

<sup>4</sup> Due to the quadratic form, there are two equivalent sets of parameters that satisfy these equations because  $q$  and  $1-q$  are interchangeable. The resulting estimates of  $r$  and  $s$  are each one minus the original estimate. We do not take a stand on which set of estimates is "correct" because it is irrelevant to the likelihood function (both sets give the same likelihood) and, hence, to the likelihood ratio tests discussed below. We let the data choose which set we display in the tables by minimizing the sum of the error rates  $r$  and  $s$ . This is also gives P-bet preference measures ( $q$ 's) that accord with **Error! Reference source not found.**

### III. Incentives, Preference Induction, and Keeping Score in Preference Reversal Experiments

Lichtenstein and Slovic (1971) find (1) that reversals are common and (2) that the two-error-rate model does not match their data. Subsequently, researchers<sup>5</sup> investigated whether incentives reduce reversal rates, generally reaching the conclusion that they do not. However, this differs from asking what behavioral model of choice appears to fit the data.

Lichtenstein and Slovic (1971) and Berg, Dickhaut and Rietz (2010) show that the data from the Lichtenstein and Slovic (1971) experiment differs significantly from a data pattern that could be explained by noisy maximization. This results not just from the reversal rate alone, but from the overall pattern of choices and, in particular, from the pattern of conditional reversal rates (the reversal rate in one task conditional on the choice(s) in the other task). Further, this is generally the case when subjects are not paid based on the outcomes of their choices. Here, we run an experiment that replicates this result. We also show that in data from experiments where subjects are paid in a truth-revealing manner, reversals remain. However, the data accords with noisy maximization. This holds for Grether and Plott (1979) experiment 1b, most of the experiments in the literature and on aggregated data across experiments.

In Berg, Dickhaut and Rietz (2003), we study how inducing risk preferences (using the Berg, Daley, Dickhaut and O'Brien (1986) procedure) affects behavior. Again, the pattern accords with noisy maximization. In addition, creating a strong preference across gambles using risk preference induction can decrease the overall reversal rate.

All these experiments fall into one of two designs. When subjects receive outcome contingent payments, the gambles are played out. When subjects do not receive outcome contingent payments, the gamble are not played out. Note that providing incentives and playing out gambles are completely confounded. In the experiments with incentives, the outcomes can be used to "keep score." In the experiment without incentives, there is no way to keep score. Could it be that the change in behavior is not driven by payments per se, but rather by keeping score through observing the outcomes? This is the question we study.

### IV. Experimental Procedures and Data

We compare three sources of data:

- (1) aggregated outcomes from the prior research that replicated Lichtenstein and Slovic (1971) with and without incentives as reported in Berg, Dickhaut and Rietz (2010),
- (2) individual experiments reported in Lichtenstein and Slovic (1971), Grether and Plott (1979) and Berg, Dickhaut and Rietz (2003), and

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<sup>5</sup> For example, Lichtenstein and Slovic (1971) experiment 3, Lichtenstein and Slovic (1973), Grether and Plott (1979) and many others.



(3) new experiments.

The prior research allows us to benchmark our results and place them in context. Our new experiments use essentially the same design and instructions as used in Berg, Dickhaut and Rietz (2003). Modifications to the instructions depend on the treatment as discussed below.

Treatment variables across experiments include:

- (1) whether subjects are paid based on experimental outcomes (which requires that gambles be played out);
- (2) whether subjects have risk preferences induced using the binary lottery procedure (which requires that gambles and lotteries be played out);
- (3) whether the gambles are actually played out (this necessarily occurs when there are outcome-contingent incentives, but can be present or not when there are no outcome-based incentives).

This leads to the following basic design:

**Table 1:** Design

Play Treatment	Induction Treatment	Incentives Treatment	
		No Incentives Tied to Gamble Outcomes	Incentives Tied to Gamble Outcomes
Gambles Not Played	Native Preferences	NP-N-NI	<del>P-N-I</del>
	Native Preferences	P-N-NI	P-N-I
Gambles Played and Outcomes Revealed	Induced Risk Averse	P-RA-NI	P-RA-I
	Induced Risk Neutral	P-RN-NI	P-RN-I
	Induced Risk Seeking	P-RS-NI	P-RS-I

Cells are labelled NP or P to indicate whether gambles are Not Played out or Played out; N, RA, RN or RS to indicate Native preferences, induced Risk Aversion, induced Risk Neutral and induced Risk Seeking preferences; and NI or I to indicate No Incentives tied to gamble outcomes and Incentives tied to gamble outcomes.

For data in cell P-N-I (played out gambles, native preferences, and incentives tied to gamble outcomes), we use aggregate data from the literature as reported in Berg, Dickhaut and Rietz (2010) (labelled “Lit. Agg.”) and use Grether and Plott’s (1979) Experiment 1b (labelled G&P1b) as a benchmark data set. For data in cell NP-N-NI (gambles not played out, native preferences, no incentives tied to gamble outcomes), we use aggregate data from the literature as reported in Berg, Dickhaut and Rietz (2010) (labelled “Lit. Agg.”) and use Lichtenstein and Slovic’s (1971) Experiment 1 (labelled L&S1) as a benchmark data set. For data in the other cells with incentives tied to gamble outcomes, we use the experiments from Berg, Dickhaut and Rietz (2003) (labelled BDR-RA, BDR-RN and BDR-RS). Finally, for data in all of the cells with no incentives tied to gamble outcomes, we run new experiments for this paper (this creates a

**Table 2:** P-Bet Preferences and Reversal Rates across Treatments

Incentives Category	Data Set	Obs.	Avg. Pref. For the P-Bet According to Choices $(a+b)/(a+b+c+d)$	Avg. Pref. For the P-Bet According to Prices $(a+c)/(a+b+c+d)$	Difference Between P-Bet Preference Measures	Reversal Rate $(b+c)/(a+b+c+d)$
NP-N-NI	Lit. Agg.	4644	0.524	0.318	0.206	0.409
NP-N-NI	L&S1	1038	0.510	0.116	0.394	0.456
NP-N-NI	New	134	0.672	0.396	0.276	0.410
P-N-NI	New	141	0.603	0.496	0.106	0.390
P-RA-NI	New	158	0.703	0.570	0.133	0.399
P-RN-NI	New	156	0.564	0.513	0.051	0.462
P-RS-NI	New	157	0.299	0.433	0.134	0.401
P-N-I	Lit. Agg.	3185	0.411	0.284	0.127	0.362
P-N-I	G&P1b	262	0.363	0.183	0.179	0.347
P-RA-I	BDR-RA	275	0.927	0.880	0.047	0.164
P-RN-I	BDR-RN	244	0.553	0.590	0.037	0.365
P-RS-I	BDR-RS	247	0.146	0.324	0.178	0.372

new replication in cell NP-N-NI). Instructions for the existing experiments can be found in the original papers. The appendix contains instructions for the new experiments.

## V. Results

### A. Aggregate Results

Table 2 presents summary data across treatments. The first three rows (labeled NP) are all treatments in which gambles were not played. The other rows (rows 4-12) are all treatments in which gambles were played. As discussed in the prior research (ranging from Grether and Plott (1979) to Berg, Dickhaut and Rietz (2010)), reversal rates themselves are largely unaffected by the payment treatment. The lone exception is a drop in the reversal rate when in treatment P-RA-I, where the gambles are played out, and subjects are paid based on outcomes under induced risk aversion.

Though there appears not to be an effect of the level of reversals, Table 2 reveals that there is an effect on the level of consistency in revealed preference across the choice and pricing tasks. The largest inconsistency occurs when there are no outcome-based incentives and the gambles are not played out. In Lichtenstein and Slovic's (1971) data, pricing responses indicate a much greater preference for the \$-Bet than the P-Bet as indicated by the difference between P-Bet preference measures. In our replication of Lichtenstein and Slovic, the subjects are more likely to reveal preferences for the P-Bet in both tasks, but the large shift across the tasks remains.

In contrast, revealed preferences are more consistent when the gambles are played out, whether or not there are outcome-based incentives. As discussed in Berg, Dickhaut and Rietz (2010), there is a greater consistency in revealed preferences across the choice and pricing tasks when subjects are paid. But, our new experiments reveal that just playing the bets reduces the level of inconsistency. Comparing the consistency of the P-Bet revealed preferences across the new experiments (NP-N-NI versus P-N-NI) shows more consistent preferences when the gambles are played out, even when subjects are not paid (P-N-NI).

**Table 3:** Conditional Reversal Rates Across Treatments

Incentives Category			Conditional (on Choice) Reversal Rates			Conditional (on Pricing) Reversal Rates		
			P-Bet (b/(a+b))	\$-Bet (c/(c+d))	Difference	P-Bet (c/(a+c))	\$-Bet (b/(b+d))	Difference
NP-N-NI	Lit. Agg.	4644	0.586	0.213	0.374	0.318	0.451	-0.133
NP-N-NI	L&S1	1038	0.834	0.063	0.771	0.267	0.480	-0.214
NP-N-NI	New	134	0.511	0.205	0.307	0.170	0.568	-0.398
P-N-NI	New	141	0.412	0.357	0.055	0.286	0.493	-0.207
P-RA-NI	New	158	0.378	0.447	-0.068	0.233	0.618	-0.384
P-RN-NI	New	156	0.455	0.471	-0.016	0.400	0.526	-0.126
P-RS-NI	New	157	0.447	0.382	0.065	0.618	0.236	0.382
P-N-I	Lit. Agg.	3185	0.595	0.199	0.396	0.414	0.342	0.072
P-N-I	G&P1b	262	0.726	0.132	0.595	0.322	0.458	-0.136
P-RA-I	BDR-RA	275	0.114	0.800	-0.686	0.066	0.879	-0.813
P-RN-I	BDR-RN	244	0.296	0.450	-0.153	0.340	0.400	-0.060
P-RS-I	BDR-RS	247	0.667	0.322	0.344	0.850	0.144	0.706

Table 3 shows the conditional reversal rates. In Berg, Dickhaut and Rietz (2003) and (2010), we argue that the pattern of conditional reversal rates under induced risk preferences is consistent with noisy maximization model with error correction.

Consider the data under risk averse preferences (Incentives Category P-RA-I). Subjects should be risk averse. If they “err” in the choice task, by choosing the \$-Bet (inconsistent with risk aversion), the reversal rate should be high if they correct the “error” in the pricing task. On the other hand, the reversal rate should be low if they choose the P-Bet. Similarly, if they err in the pricing task, by pricing the \$-Bet higher, the reversal rate should be high if they correct the error in the pricing task. The rate should be low if they price the P-Bet higher. This is exactly the data we observe. Subjects who choose the P-Bet reverse 11.4% of the time in the pricing task. Subjects who price the P-Bet higher reverse 6.6% of the time in the choice task. In contrast, consistent with error correction, the reversal rates skyrocket if the subjects choose the \$-Bet (80.0% of the time) or price the \$-Bet higher (87.9% of the time).

Though somewhat weaker, the opposite pattern holds for risk seeking preferences (Incentives Category P-RS-I). Under risk neutral preferences and native preferences, there is

**Table 4:** Estimates of the Two-Error-Rate Model Across Treatments

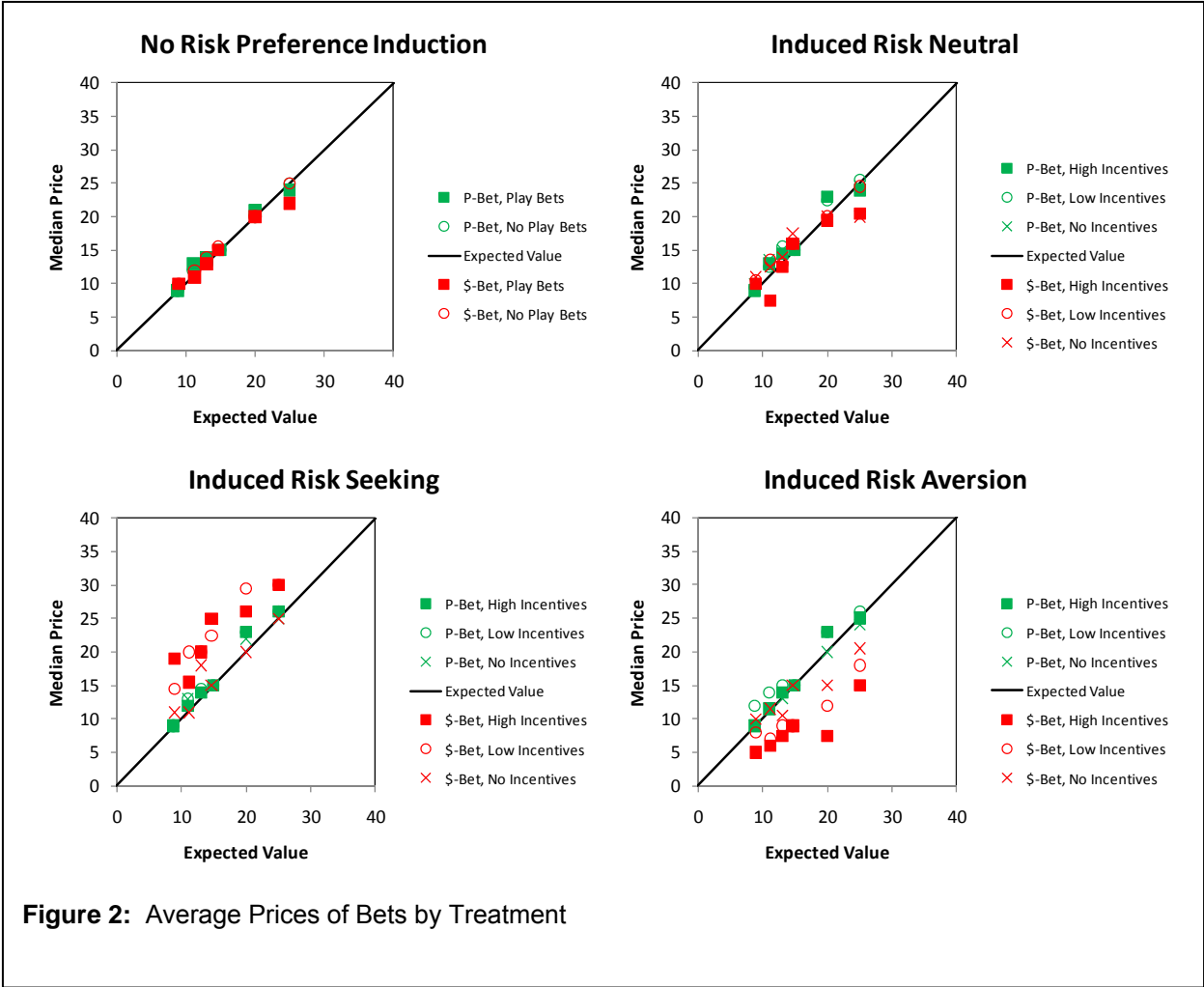
Incentives Category	Data Set	Obs.	Two-Error-Rate Model			LR Test Stat
			q	r	s	
NP-N-NI	Lit. Agg.	4644	0.318	0.409	0.000	74.65*
NP-N-NI	L&S1	1038	0.116	0.456	0.000	20.42*
NP-N-NI	New	134	0.396	0.410	0.000	22.36*
P-N-NI	New	141	0.603	0.000	0.390	0.425
P-RA-NI	New	158	0.764	0.116	0.368	Equal
P-RN-NI	New	156	0.603	0.190	0.438	Equal
P-RS-NI	New	157	0.239	0.115	0.372	Equal
P-N-I	Lit. Agg.	3185	0.236	0.331	0.091	Equal
P-N-I	G&P1b	262	0.122	0.318	0.080	Equal
P-RA-I	BDR-RA	275	0.991	0.065	0.113	Equal
P-RN-I	BDR-RN	244	0.633	0.300	0.162	Equal
P-RS-I	BDR-RS	247	0.005	0.142	0.322	Equal

no strong pattern in the conditional reversal rate. This is consistent with relatively risk neutral subjects and random errors.

While the differences are considerably smaller, they remain under induced preferences even when the subjects are not paid. Under induced risk aversion without outcome-based incentives (Incentives Category P-RA-NI), the \$-Bet conditional reversal rates exceed the P-Bet conditional reversal rates. Under induced risk seeking without outcome-based incentives (Incentives Category P-RS-NI), the P-Bet conditional reversal rates exceed the \$-Bet conditional reversal rates.

Table 4 shows estimates of the two error-rate model from the aggregate data in each incentives category. There is a clear shift in the data. When gambles are not played out, (Incentives Category NP-N-NI), the two error rate model cannot accommodate the data. This occurs both in individual experiments in the existing literature, on average in the existing literature, and in our new experiment.

When gambles are played out, the two-error-rate model fits the data exactly in all but one case, and in that case, the difference is insignificant. Estimates of the preferences for the P-Bet (q) are highest under induced risk aversion (Incentives Categories P-RA-NI and P-RA-I) and nearly 1 when subjects are paid based on outcomes (Incentives Category P-RA-I). Estimates of the preferences for the P-Bet (q) are lowest under induced risk seeking (Incentives Categories P-RS-NI and P-RS-I) and nearly 0 when subjects are paid based on outcomes (Incentives Category P-RS-I). As a result, we conclude that playing out the gambles, allowing subject to keep score, generates more economically consistent behavior. Risk preference induction does so while generating behavior consistent with the induced preferences. This effect is strongest when subjects are paid based on outcomes.



**Figure 2:** Average Prices of Bets by Treatment

**B. Analysis of Individual Prices**

In this section, we study the data from the six treatments in Berg, Dickhaut and Rietz (2003) and the three new data sets that use identical gambles, instructions and risk preference induction procedures. The only difference in procedures is that, in the sessions run for this paper, subjects are paid a flat participation fee. There are no outcome-contingent payments. In all cases, risk preferences are induced using Berg, Daley, Dickhaut and O'Brien's (1986) lottery procedure with an induced utility function of  $U(w) = e^{\gamma w}$ , where  $w$  is the payoff from a task and  $\gamma = -0.11$  for risk averse,  $\gamma = 0$  for risk neutral and  $\gamma = 0.11$  for risk seeking preferences.<sup>6</sup>

Under risk averse, risk neutral and risk seeking induced preferences, prices for individual gambles should be successively higher in theory. Figure 2 shows average prices for each gamble under each treatment. The \$-bet (riskier bet) in each pair is graphed in red while the P-bet (less risky bet) in each pair is graphed in green. The upper left graph shows prices when

<sup>6</sup> See Berg, Dickhaut and Rietz (2003) for details.

**Table 5:** Gambles and Certainty Equivalents

Pair	Type	Probability of Winning	Points if Win	Points If Lose	Expected Points (Risk Neutral Certainty Equivalent)	Risk Averse Certainty Equivalent	Risk Loving Certainty Equivalent
1	P	35/36	9	2	8.81	8.71	8.86
	\$	11/36	27	1	8.94	4.09	17.33
2	P	33/36	14	2	13.00	12.13	13.43
	\$	9/36	40	4	13.00	6.56	27.90
3	P	32/36	15	14	14.89	14.88	14.89
	\$	12/36	36	4	14.67	7.55	26.54
4	P	30/36	23	5	20.00	16.52	21.59
	\$	18/36	40	0	20.00	6.19	33.81
5	P	27/36	26	22	25.00	24.82	25.15
	\$	18/36	39	11	25.00	16.89	33.11
6	P	29/36	13	3	11.06	10.01	11.74
	\$	7/36	37	5	11.22	6.90	23.16

preferences are not induced. Regardless of whether the gambles are played out or not, the prices of gambles within a pair align closely. This is consistent with subjects' native risk preference being approximately risk neutral.

The upper right graph shows some divergence under induced risk neutral preferences. But, again subjects are approximately risk neutral.

The bottom two graphs show increasing divergence under induced risk seeking (left) and risk averse (right) preferences. As expected, under induced risk seeking preferences, valuations are higher than expected values and dollar bet (riskier) bet prices exceed p-bet (less risky) bet prices. Also as expected, under induced risk averse preferences, valuations are lower than expected values and p-bet (less risky) bet prices exceed dollar bet (riskier) bet prices. Recall that the gambles are played out in all the experiments shown in Figure 2. As seen by comparing the incentives and no incentives treatments, simply playing the gamble makes subject behavior conform to the noisy maximization model. However, effects appear stronger for incentives treatments than no-incentives treatments.

Under induction, we can compute the theoretical certainty equivalent for each gamble as:

$$CE = \frac{\ln(p_h e^{vh} + (1-p_h)e^{vl})}{v}, \quad (4)$$

where CE is the certainty equivalent, h is the high payoff, l is the low payoff and  $p_h$  is the probability of the high payoff. This provided a benchmark value for each gamble under each risk preference. Table 5 (reproduced from Berg, Dickhaut and Rietz (2003)) presents the gambles

**Table 6:** Deviations from Induced Certainty Equivalents by Risk Preference Induction Treatment and Incentives Levels

Risk Preference Induction Treatment	Item	Incentives Treatment			Kruskal-Wallis Tests of Incentives Effects	
		High	Low	None		
Averse	Observations	288	276	360		
	Mean	2.0656	3.5078	4.0927	$\chi^2$ Statistic	18.005***
	Std. Dev.	6.0237	6.4361	7.8432	d.o.f.	2
	Robust T-Stat. #	3.56***	5.21***	4.89***	p-value	0.0001
	p-value	0.002	0.000	0.000		
Neutral	Observations	312	288	360		
	Mean	1.3905	1.4896	2.0236	$\chi^2$ Statistic	6.202**
	Std. Dev.	7.4993	5.9743	6.6652	d.o.f.	2.0000
	Robust T-Stat. #	1.88*	2.21**	4.32***	p-value	0.0450
	p-value	0.0720	0.0380	0.0000		
Seeking	Observations	264	288	348		
	Mean	-1.967	-2.033	-3.983	$\chi^2$ Statistic	6.976**
	Std. Dev.	9.611	9.569	8.674	d.o.f.	2
	Robust T-Stat. #	-1.70	-2.44**	-6.32***	p-value	0.0306
	p-value	0.104	0.0230	0.0000		

# Clustered by subject.

\* Significant at the 90% level of confidence.

\*\* Significant at the 95% level of confidence.

\*\*\* Significant at the 99% level of confidence.

and certainty equivalents for these data sets. The certainty equivalents tell us what prices should be if subjects maximize expected utility under the risk preference induction technique. We can compare this to actual prices. Alternatively, we can estimate the risk aversion parameter displayed to a particular subject's choices using non-linear regression by setting gamma to minimize the squared deviation between (4) and the actual prices submitted by that subject across the twelve gambles.

Table 6 shows the deviations of prices from certainty equivalents for each treatment. On average, induced risk averse subjects over price gambles. There is a significant incentive effect. The overpricing is most severe with no outcomes based incentives and least severe under high incentives levels. Induced risk neutral subjects also tend to over price gambles. Again, there is a significant incentive effect with the most severe (and most significant) over pricing under no incentives and the least severe (and least significant) over pricing under high incentives. Without incentives, induced risk seeking subjects under price gambles. Again, there is a significant incentive effect. The magnitude of the under pricing falls with incentives and the significance of the under pricing disappears under high incentives. However, notice that often the standard deviation of prices relative to certainty equivalent goes up with incentives. Overall, prices move closer to theoretical predictions as incentives increase even though incentives may

**Table 7:** Individual Risk Aversion Parameter Estimates by Risk Preference Induction Treatment and Incentives Levels

Risk Preference Induction Treatment	Item	Incentives Treatment			Kruskal-Wallis Tests of Incentives Effects	
		High	Low	None		
Averse	Observations	24	23	20		
	Median	-0.0743	-0.0463	-0.0134	$\chi^2$ Statistic	16.033***
	Inter-quartile Range	0.0619	0.0454	0.0686	d.o.f.	2
	Sign Rank Test Statistic <sup>#</sup>	2.029**	3.315***	3.527***	p-value	0.0003
	p-value	0.0425	0.0009	0.004		
Neutral	Observations	26	24	30		
	Median	-0.0020	0.0062	0.0118	$\chi^2$ Statistic	1.825
	Inter-quartile Range	0.0645	0.0497	0.0198	d.o.f.	2.0000
	Sign Rank Test Statistic <sup>#</sup>	0.317	0.914	2.808***	p-value	0.4015
	p-value	0.7509	0.3606	0.0050		
Seeking	Observations	22	24	29		
	Median	0.0479	0.0577	0.0311	$\chi^2$ Statistic	2.883
	Inter-quartile Range	0.0832	0.0753	0.0976	d.o.f.	2
	Sign Rank Test Statistic <sup>#</sup>	-2.808***	-4.000***	-3.925***	p-value	0.2366
	p-value	0.0050	0.0001	0.0001		

<sup>#</sup>Sign rank test statistics measure whether the median estimated risk aversion parameter differs from the predictions of -0.11, 0 and 0.11 for risk averse, neutral and seeking induced preferences, respectively.

\*Significant at the 90% level of confidence.

\*\*Significant at the 95% level of confidence.

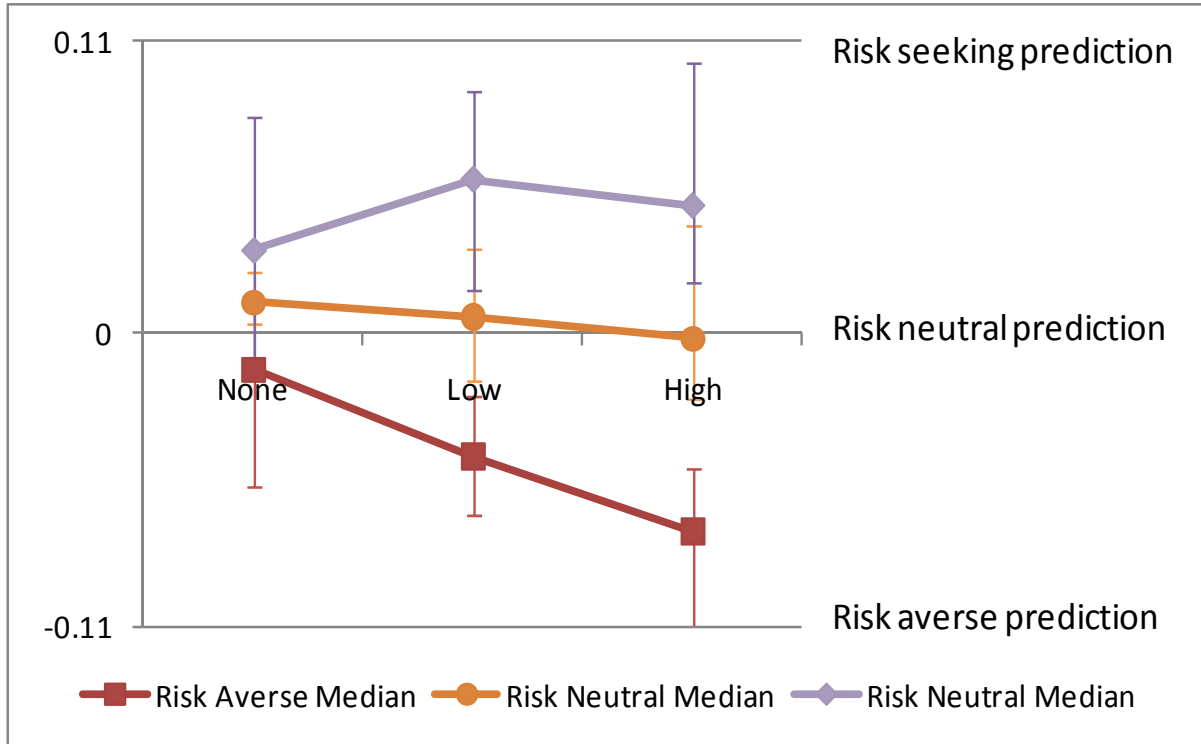
\*\*\*Significant at the 99% level of confidence.

not necessarily abate noise. This is why reversal rates may not fall with incentives even though prices are more coherent on average.

As a final analysis, we estimate the risk aversion parameter from (4) for each individual subject using non-linear least squares. We compare these estimated to the induced risk aversion parameters of -0.11, 0 and 0.11 for risk averse, risk neutral and risk seeking treatments, respectively. For all subjects, the non-linear regressions converged. For most subjects, it converges to reasonable estimates. However, a few produce estimates that are clearly outliers (e.g., if a subject prices several gambles above (below) the maximum (minimum) possible payoff, the estimate may show extreme risk seeking (aversion)). Because of these outliers, we use medians as our measure of central tendency and non-parametric sign-rank and Kruskal-Wallis tests for deviations from predictions and incentives effects.

Table 7 shows median estimates of the risk aversion parameter under each treatment. Median estimates of the risk aversion parameter are all negative for risk aversion (as predicted), but fall short of the predicted level of -0.11. There is a significant incentive effect, with high incentives created more risk averse estimates which are closer to the predicted level. The median induced risk neutral subject without incentives displays a risking preference parameter.





**Figure 3:** Medians and Inter-Quartile Ranges of Estimated Risk Aversion Parameters by Treatment. However, when subjects are paid, the medians do not differ significantly from zero. Median induced risk seeking subjects all have positive estimated risk preference parameters (as predicted) but they fall short of the predicted value of 0.11. With increasing incentives, the inter-quartile range does not necessarily fall. As a result, risk preference induction moves subjects in the right direction but not as far as predicted by theory. When there is an incentives effect, higher incentives push behavior closer to predictions. But again, in this context, incentives do not necessarily abate noise.

Figure 3 shows the median estimated risk aversion parameter and inter-quartile ranges under each treatment. While risk averse parameters are always lower and risk seeking parameters are always higher than risk neutral (as predicted), the differences are small and the inter-quartile ranges overlap without incentives (labeled “none”). As incentives increase, the median estimated values remain close to zero (as predicted) for induced risk neutral preferences. They fall dramatically for risk averse induced preferences (as predicted). They rise and level off for risk seeking induced preferences. These effects are significant as shown by the following median regression:

$$\begin{aligned}
& 0.0118 \quad -0.0050 \times \begin{pmatrix} \text{Incentives} \\ \text{Category} \end{pmatrix} \\
& \quad (2.00^{**}) \quad \quad \quad (-1.05) \\
\hat{\gamma}_i = & + 0.0219 \times \begin{pmatrix} \text{Risk} \\ \text{Seeking} \\ \text{Dummy} \end{pmatrix} + 0.0134 \times \begin{pmatrix} \text{Risk} \\ \text{Seeking} \\ \text{Dummy} \end{pmatrix} \times \begin{pmatrix} \text{Incentives} \\ \text{Category} \end{pmatrix} + \varepsilon_i, \quad (5) \\
& \quad (2.06^{***}) \quad \quad \quad (1.96^*) \\
& - 0.0291 \times \begin{pmatrix} \text{Risk} \\ \text{Averse} \\ \text{Dummy} \end{pmatrix} - 0.0241 \times \begin{pmatrix} \text{Risk} \\ \text{Averse} \\ \text{Dummy} \end{pmatrix} \times \begin{pmatrix} \text{Incentives} \\ \text{Category} \end{pmatrix} \\
& \quad (-3.48^{***}) \quad \quad \quad (-3.57^{***})
\end{aligned}$$

where the incentives category is a category defined as 0 for no incentives, 1 for low incentives and 2 for high incentives; risk seeking and risk averse dummies are 1 under the appropriate risk preference induction treatments; “\*\*\*” denotes significance at the 99.9% level of confidence, “\*\*” denotes significance at the 99% level of confidence and “\*” denotes significance at the 90% level of confidence.

Without incentives, but playing out the gambles, subjects appear slightly risk seeking under induced risk neutrality (intercept>0). Inducing risk aversion or risk seeking affects the estimated risk preference parameter significantly in the predicted direction even without incentives (significance on both dummy variables alone with the appropriate signs). Increasing incentives has little effect under induced risk neutrality. Increasing incentives moves estimated risk aversion parameters closer to their predicted values (significance on the interaction terms with the appropriate signs).

## VI. Discussion

Previous preference reversal studies documenting incentive effects all confound incentives and playing out gambles. In this paper, we introduce new experimental treatments that allow us to tease apart the effect of truth-revealing incentives from the effect of providing a “score keeping” mechanism by allowing subjects to play out the gambles. We find that both incentives and “keeping score” have an effect on behavior. When gambles are played out, so that subjects can keep score, behavior conforms to the noisy maximization model. Adding truth-revealing incentives appears to have an additional effect, resulting in even greater consistency in preferences across the two tasks.

Our results are consistent with Donald Trump’s observation about money being a score keeping mechanism. It explains why simple mechanisms, such as publishing “employee of the month” could have an effect on behavior even when there is no noticeable incentive tied to the

designation. It also helps explain how competitions among groups can have incentives when there are no explicit prizes except "bragging rights."

## VII. Bibliography

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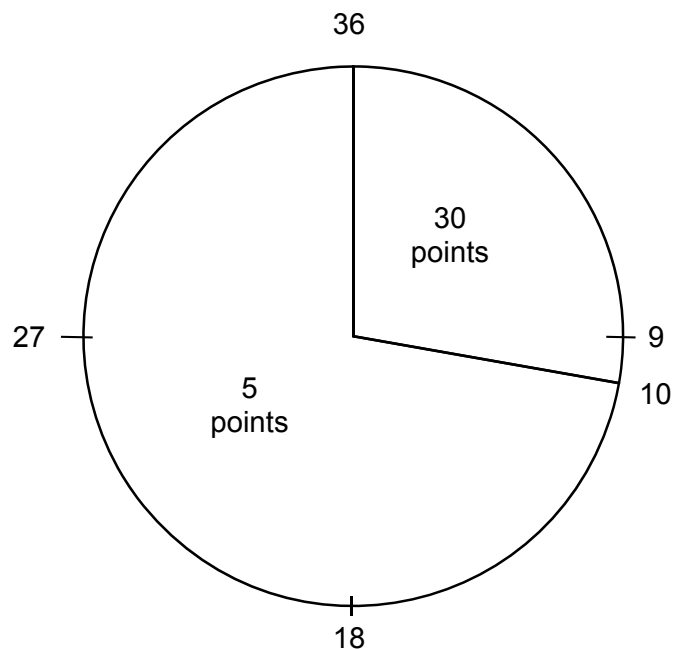
## Appendix: Instructions

### Instructions for NP-N-NI (No-Play, Native Preferences, No Incentives)

This is an experiment in individual decision making. At the end of the experiment, you will receive your \$5 show up fee and a flat fee of an additional \$15 for participation in the experiment. These are the only payments you will receive for participating.

As a participant in this experiment, you will make decisions. There are 18 decision items in this experiment.

Each decision you make will involve one or more bets. These bets will be indicated by pie charts as shown below. The point areas in each bet correspond to a hypothetical draw from a bingo cage that contains 36 red balls numbered 1, 2, ..., 36. The ball drawn would determine the point outcome of the bet. For example, suppose you were playing the bet below. If the red ball drawn was less than or equal to 10, you would receive 30 points. If the red ball drawn was greater than 10, you would receive 5 points.



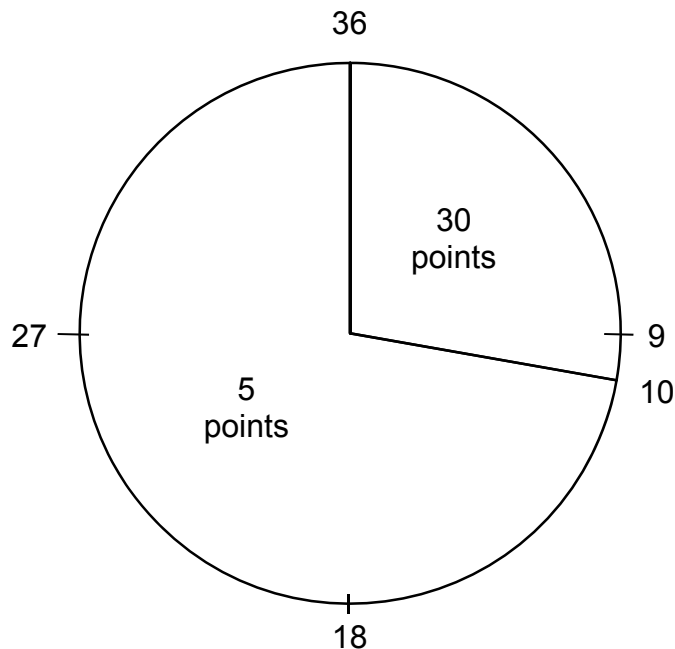
Part 1:

In this part you will be asked to consider several pairs of bets. For each pair you should indicate which bet you would prefer to play or indicate that you are indifferent between them.

Part 2:

In this part you are given several opportunities make decisions. For each bet you must indicate the smallest number of points for which you would give up the opportunity to play the bet.

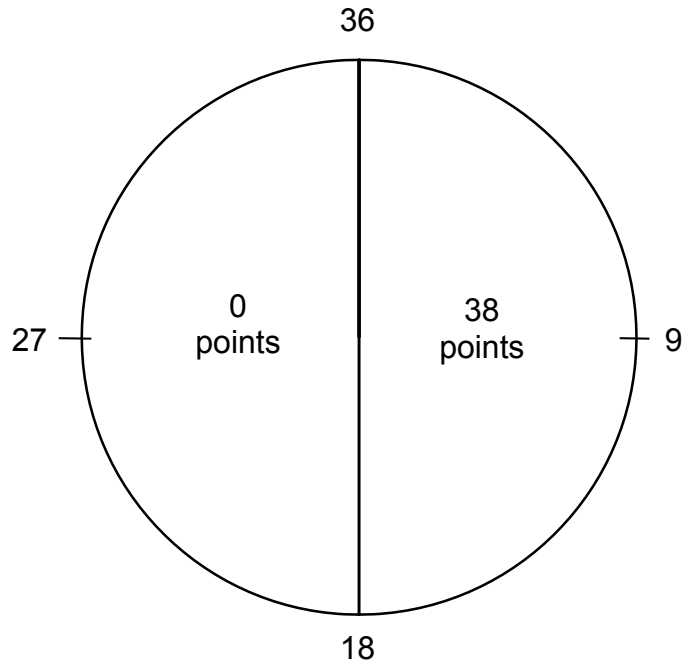
Practice Item 1: Suppose you have the opportunity to play the bet shown below. What is the smallest number of points for which you would give up this opportunity?



Decision \_\_\_\_\_ .

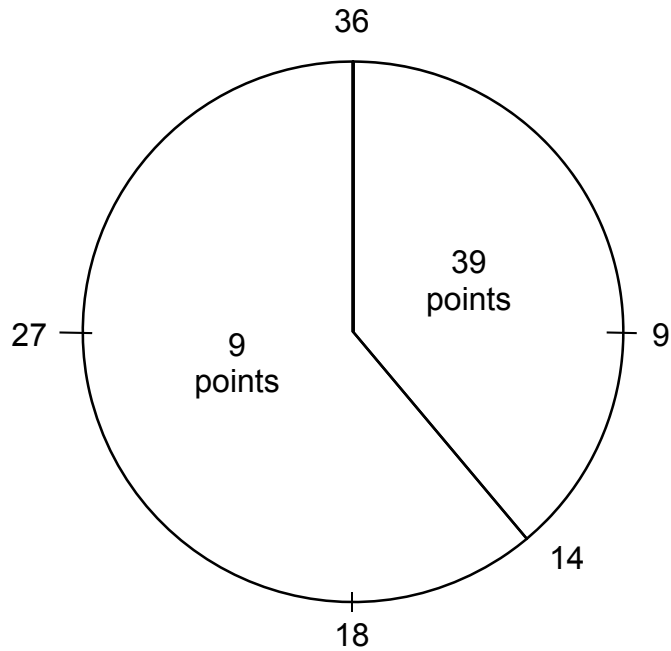
Stop here and wait for the experimenter to tell you to go on to the next practice item.

Practice Item 2: Suppose you have the opportunity to play the bet shown below. What is the smallest number of points for which you would give up this opportunity?



Decision \_\_\_\_.

Practice Item 3: Suppose you have the opportunity to play the bet shown below. What is the smallest number of points for which you would give up this opportunity?



Decision \_\_\_\_.

### Part 3:

This part is exactly like Part 1. You will be asked to consider several pairs of bets, and for each pair you should indicate which bet you would prefer to play or indicate that you are indifferent between them.

#### Instructions for P-N-NI (Play, Native Preferences, No Incentives)

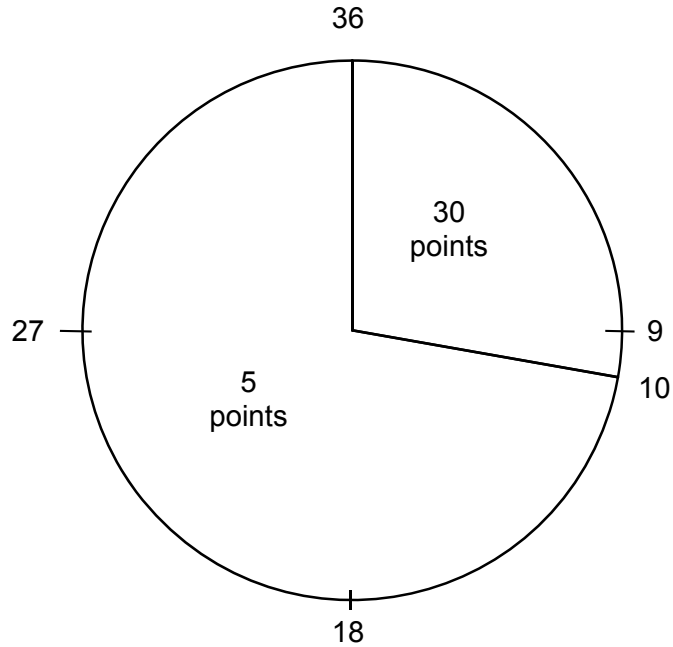
##### Instructions

This is an experiment in individual decision making. At the end of the experiment, you will receive your \$5 show up fee and a flat fee of an additional \$15 for participation in the experiment. These are the only payments you will receive for participating.

As a participant in this experiment, you will receive points for making decisions. There are 18 decision items in this experiment.

Each decision you make will involve one or more bets. These bets will be indicated by pie charts as shown below. When a bet is played, one ball will be drawn from a bingo cage that contains 36 red balls numbered 1, 2, ..., 36. The ball drawn determines the point outcome of the bet. For example, suppose you are playing the bet below. If the red ball drawn was less than or equal to 10, you would receive 30 points. If the red ball drawn was greater than 10, you would receive 5 points.

Now let's use the bet shown below as a practice item.



The number that the experimenter drew from the cage of red balls is \_\_\_\_\_.

This means that I would receive \_\_\_\_\_ points as a result of this bet.

Part 1:

In this part you will be asked to consider several pairs of bets. For each pair you should indicate which bet you prefer to play or indicate that you are indifferent between them. After each decision, you will have an opportunity to using the following procedure:

1. The bet you indicate as preferred will be played and you will receive the points indicated by its outcome. If you check "Indifferent" the bet you play will be determined by a coin toss.

Part 2:

In this part you are given several opportunities to play bets to obtain points. For each bet you must indicate the smallest number of points for which you would give up the opportunity to play the bet.

After each decision, you will have an opportunity to receive points using the following procedure:

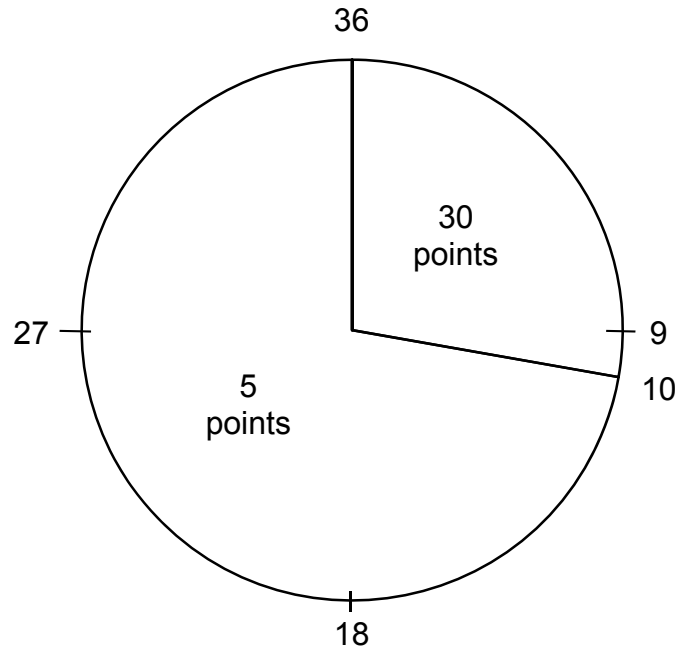


1. A ball will be drawn from a bingo cage containing 41 green balls numbered 0,1,2,...,40. If the number on this green ball is less than or equal to the number you have specified, you will keep the bet and play it. You will receive the points indicated by the outcome of the bet. If the number on the green ball is greater than the number you have specified, you will give up the bet and in exchange receive the points equal to the number on the ball.

It is in your best interest to be accurate; that is, the best thing you can do is be honest. If the number of points you state is too high or too low, then you are passing up opportunities that you prefer. For example, suppose you would be willing to give up the bet for 20 points but instead you say that the lowest amount for which you would give it up is 30 points. If the green ball drawn at random is between the two (for example 25) you would be forced to play the bet even though you would rather have given it up for 25 points.

On the other hand, suppose that you would give it up for 20 points but not for less, but instead you state your amount as 10 points. If the green ball drawn at random is between the two (for example 15) you would be forced to give up the bet for 15 points even though at that amount you would prefer to play it.

Practice Item 1: Suppose you have the opportunity to play the bet shown below. What is the smallest number of points for which you would give up this opportunity?



Decision \_\_\_\_\_ .

In order which results from this decision, you need to know two things:

- (1) The ball drawn from the cage of green balls.
- (2) The ball drawn from the cage of red balls.

The two examples in this practice item fix these draws so that you can concentrate on how your decision and the results of the draws will determine your points.

Example 1: Use your decision in the Practice Item 1 and suppose the green ball drawn at random is 2.

The number on the green ball is

- a) greater than my indicated amount.
- b) less than or equal to my indicated amount.

Therefore, I would

- a) receive points equal to the number on the ball and not play the bet.
- b) play the bet and receive points according to its outcome.

Will you be playing the bet? \_\_\_\_\_ (yes/no) If your answer is YES, you will need to know the outcome of the bet before you can determine the points you receive. If your answer is

NO, you do not need to know the outcome of the bet to determine the points received.

Suppose the red ball drawn to determine the outcome of the bet was 18.

Based on my point decision above, and the results of the draws from the bingo cages, the number of points I would have is \_\_\_\_\_.

Complete the next part only if you would have been playing the bet to receive points.

Suppose the red ball drawn to determine the outcome of the bet was 10 instead of 18.

Based on my point decision above, and the results of the draws from the bingo cages, the number of points I would have is \_\_\_\_\_.

Stop here and wait for the experimenter to tell you to go on to Example 2.

Example 2: Now use your decision in the Practice Item 1 and suppose instead that the green ball drawn at random is 38.

The number on the green ball is a) greater than my indicated amount.

b) less than or equal to my indicated amount.

Therefore, I would a) receive points equal to the number on the ball and not play the bet.

b) play the bet and receive points according to its outcome.

Will you be playing the bet? \_\_\_\_ (yes/no) If your answer is YES, you will need to know the outcome of the bet before you can determine the points you receive. If your answer is NO, you do not need to know the outcome of the bet to determine the points received.

Suppose the red ball drawn to determine the outcome of the bet was 18.

Based on my point decision above, and the results of the draws from the bingo cages, the number of points I would have is \_\_\_\_\_.

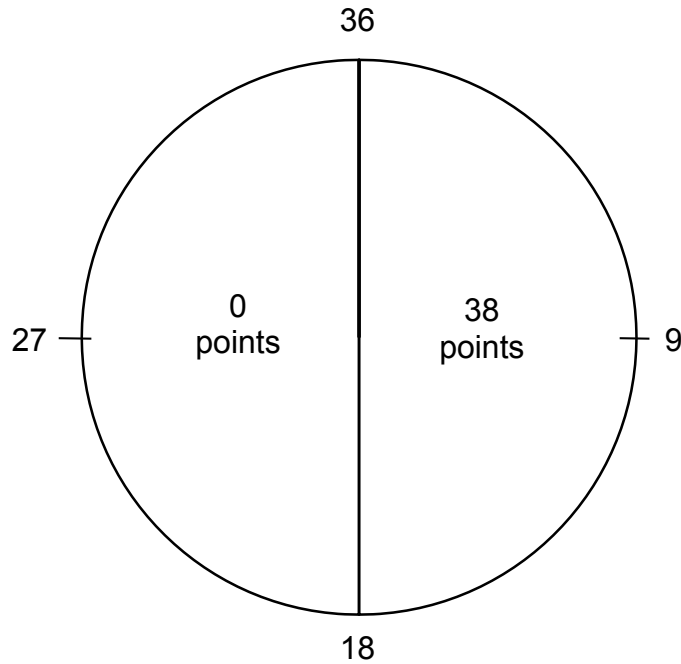
Complete the next part only if you would have been playing the bet to receive points.

Suppose the red ball drawn to determine the outcome of the bet was 10 instead of 18.

Based on my point decision above, and the results of the draws from the bingo cages, the number of points I would have is \_\_\_\_\_.

Stop here and wait for the experimenter to tell you to go on to the next practice item.

Practice Item 2: Suppose you have the opportunity to play the bet shown below. What is the smallest number of points for which you would give up this opportunity?



Decision \_\_\_\_\_.

The green ball drawn at random is \_\_\_\_\_ .

The number on this green ball is

- a) greater than my indicated amount.
- b) less than or equal to my indicated amount.

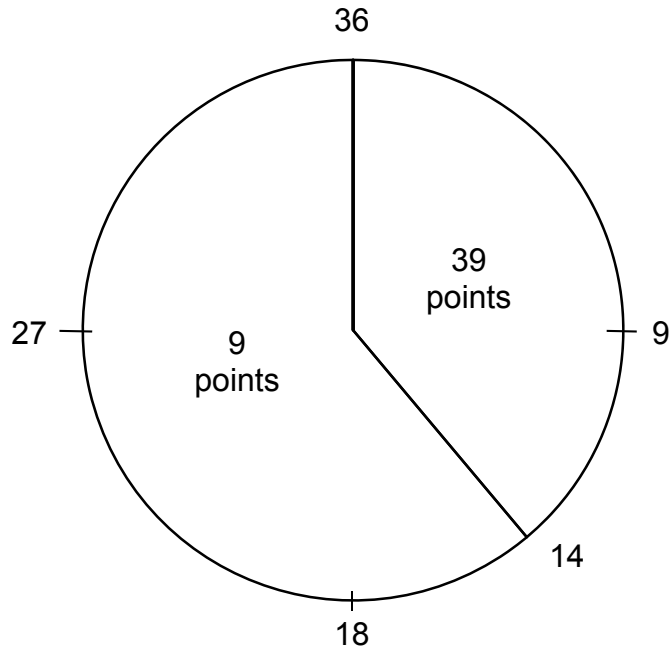
Therefore, I would

- a) receive points equal to the number on the ball and not play the bet.
- b) play the bet and receive points according to the outcome.

The red ball drawn to determine the outcome of the bet was \_\_\_\_\_.

Based on my decision above, and the results of the draws from the bingo cages, the number of points I would have is \_\_\_\_\_.

Practice Item 3: Suppose you have the opportunity to play the bet shown below. What is the smallest number of points for which you would give up this opportunity?



Decision \_\_\_\_\_.

The green ball drawn at random is \_\_\_\_\_ .

The number on this green ball is

- a) greater than my indicated amount.
- b) less than or equal to my indicated amount.

Therefore, I would

- a) receive points equal to the number on the ball and not play the bet.
- b) play the bet and receive points according to the outcome.

The red ball drawn to determine the outcome of the bet was \_\_\_\_\_.

Part 3:

This part is exactly like Part 1. You will be asked to consider several pairs of bets, and for each pair you should indicate which bet you prefer to play or indicate that you are indifferent between them. After each decision, you will then have an opportunity receive points using the following procedure:

1. The bet you indicate as preferred will be played and you will receive the points indicated by its outcome. If you check "Indifferent" the bet you play will be determined by a coin toss.

## Instructions for P-RA/RN/RS-NI (Play, Induced Preferences, No Incentives)

### Instructions

This is an experiment in individual decision making. At the end of the experiment, you will receive your \$5 show up fee and a flat fee of an additional \$15 for participation in the experiment. These are the only payments you will receive for participating.

As a participant in this experiment, you will have opportunities to play for eighteen “prizes.” “Prizes” in this experiment have no value, however your objective in this experiment is to win as many prizes as possible. Whether or not you receive a particular prize will be determined by spinning the spinner on your prize wheel. If the spinner stops in the area designated as the WIN area on your prize wheel, then you will receive the prize. If the spinner stops in the area outside the WIN area, then you will receive nothing.

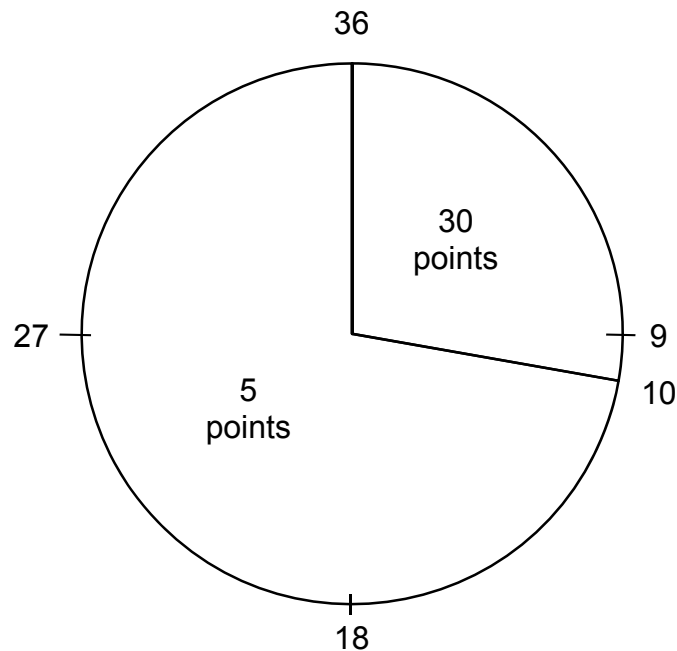
For example, suppose the WIN area of your prize wheel is designated as 0 through 5. Then, if the spinner stops on a number less than or equal to 5, you will receive the prize. If the spinner stops on a number greater than 5, you will receive nothing. Although the WIN area on your prize wheel will vary, it will always be determined by starting at zero and moving clockwise.

Now suppose that the WIN area on your prize wheel is designated as 0 through 30. Please spin the spinner to determine whether you would have received the prize or not.

So far, you have discovered that a spin on your prize wheel will determine whether or not you receive a prize. However, you need to know how the WIN area on your prize wheel is determined before you can complete the experiment. The markings on the circumference of your prize wheel denote points, and you will receive points for making decisions. There are 18 decision items in this experiment. When a decision is made, the WIN area on your prize wheel will be designated as the area between 0 and the number of points you receive as a result of the decision. Then the spinner on your prize wheel will be spun to determine whether you receive the prize. Points do not accumulate from decision to decision.

Each decision you make will involve one or more bets. These bets will be indicated by pie charts as shown below. When a bet is played, one ball will be drawn from a bingo cage that contains 36 red balls numbered 1, 2, ..., 36. The ball drawn determines the point outcome of the bet. This point outcome will designate the upper boundary of the WIN area on your prize wheel. For example, suppose you are playing the bet below. If the red ball drawn was less than or equal to 10, you would receive 30 points. If the red ball drawn was greater than 10, you would receive 5 points.

Now let's use the bet shown below as a practice item.



The number that the experimenter drew from the cage of red balls is \_\_\_\_\_.

This means that I would receive \_\_\_\_\_ points as a result of this bet.

Therefore the WIN area on my prize wheel is designated as 0 through \_\_\_\_\_.

Now, spin the spinner. As a result of my spin I would have received

PRIZE / NOTHING (circle the correct word).

### Part 1:

In this part you will be asked to consider several pairs of bets. For each pair you should indicate which bet you prefer to play or indicate that you are indifferent between them. After each decision, you will have an opportunity to play for a prize using the following procedure:

1. The bet you indicate as preferred will be played and you will receive the points indicated by its outcome. If you check "Indifferent" the bet you play will be determined by a coin toss.
2. The WIN area of your prize wheel will be designated as the area from 0 through the number of points which you have received. You will spin the spinner to determine whether you win the prize.

### Part 2:

In this part you are given several opportunities to play bets to obtain points. For each bet you must indicate the smallest number of points for which you would give up the opportunity to play the bet.

After each decision, you will have an opportunity to play for a prize using the following procedure:

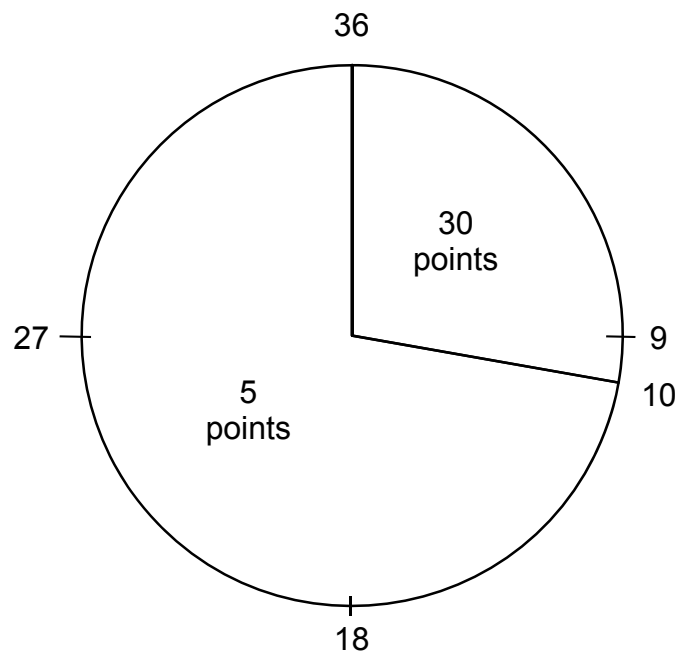
1. A ball will be drawn from a bingo cage containing 41 green balls numbered 0,1,2,...,40. If the number on this green ball is less than or equal to the number you have specified, you will keep the bet and play it. You will receive the points indicated by the outcome of the bet. If the number on the green ball is greater than the number you have specified, you will give up the bet and in exchange receive the points equal to the number on the ball.
2. The WIN area of your prize wheel will be designated as the area from 0 through the number of points which you have received. You will spin the spinner to determine whether you win the prize.



It is in your best interest to be accurate; that is, the best thing you can do is be honest. If the number of points you state is too high or too low, then you are passing up opportunities that you prefer. For example, suppose you would be willing to give up the bet for 20 points but instead you say that the lowest amount for which you would give it up is 30 points. If the green ball drawn at random is between the two (for example 25) you would be forced to play the bet even though you would rather have given it up for 25 points.

On the other hand, suppose that you would give it up for 20 points but not for less, but instead you state your amount as 10 points. If the green ball drawn at random is between the two (for example 15) you would be forced to give up the bet for 15 points even though at that amount you would prefer to play it.

Practice Item 1: Suppose you have the opportunity to play the bet shown below. What is the smallest number of points for which you would give up this opportunity? Remember that the WIN area on your prize wheel will be designated as the area from 0 through the number of points you receive as a result of your decision.



Decision \_\_\_\_\_ .



Based on my point decision above, and the results of the draws from the bingo cages, the number of points I would have is \_\_\_\_\_.

This means that the WIN area of my prize wheel would cover the numbers 0 through \_\_\_\_\_.

If the spinner stopped on the number 5, I would (circle the correct words) win / not win the prize.

If the spinner stopped on the number 40, I would (circle the correct words) win / not win the prize.

Stop here and wait for the experimenter to tell you to go on to Example 2.

Example 2: Now use your decision in the Practice Item 1 and suppose instead that the green ball drawn at random is 38.

The number on the green ball is a) greater than my indicated amount.

b) less than or equal to my indicated amount.

Therefore, I would a) receive points equal to the number on the ball and not play the bet.

b) play the bet and receive points according to its outcome.

Will you be playing the bet? \_\_\_\_\_ (yes/no) If your answer is YES, you will need to know the outcome of the bet before you can determine the WIN area of your prize wheel. If your answer is NO, you do not need to know the outcome of the bet to determine the WIN area. Suppose the red ball drawn to determine the outcome of the bet was 18.

Based on my point decision above, and the results of the draws from the bingo cages, the number of points I would have is \_\_\_\_\_.

This means that the WIN area of my prize wheel would cover the numbers 0 through \_\_\_\_\_.

If the spinner stopped on the number 5, I would (circle the correct words) win / not win the prize.

If the spinner stopped on the number 40, I would (circle the correct words) win / not win the prize.

Complete this page only if you would have been playing the bet to receive points.

Suppose the red ball drawn to determine the outcome of the bet was 10 instead of 18.

Based on my point decision above, and the results of the draws from the bingo cages, the number of points I would have is \_\_\_\_\_.

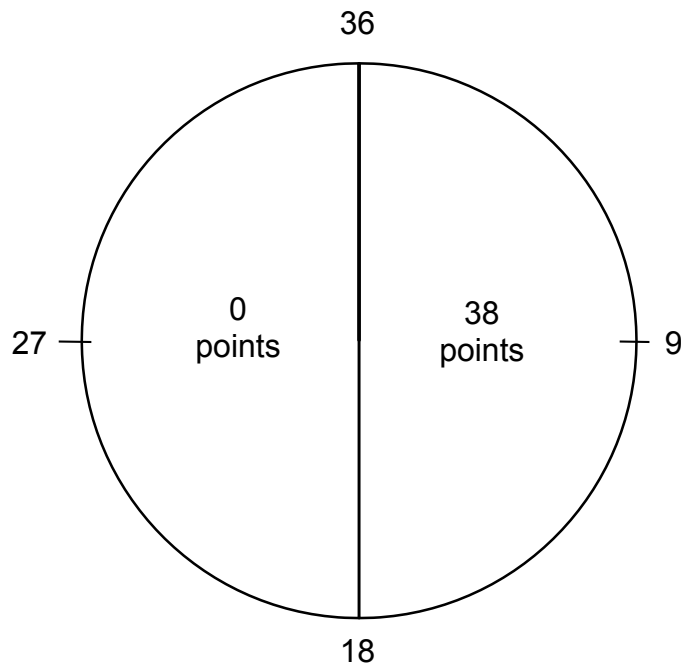
This means that the WIN area of my prize wheel would cover the numbers 0 through \_\_\_\_\_.

If the spinner stopped on the number 5, I would (circle the correct words) win / not win the prize.

If the spinner stopped on the number 40, I would (circle the correct words) win / not win the prize.

Stop here and wait for the experimenter to tell you to go on to the next practice item.

Practice Item 2: Suppose you have the opportunity to play the bet shown below. What is the smallest number of points for which you would give up this opportunity? Remember that the WIN area on your prize wheel will be designated as the area from 0 through the number of points you receive as a result of your decision.



Decision \_\_\_\_\_.

The green ball drawn at random is \_\_\_\_\_.

- The number on this green ball is
- a) greater than my indicated amount.
  - b) less than or equal to my indicated amount.

Therefore, I would

a) receive points equal to the number on the ball and not play the bet.

b) play the bet and receive points according to the outcome.

The red ball drawn to determine the outcome of the bet was \_\_\_\_\_.

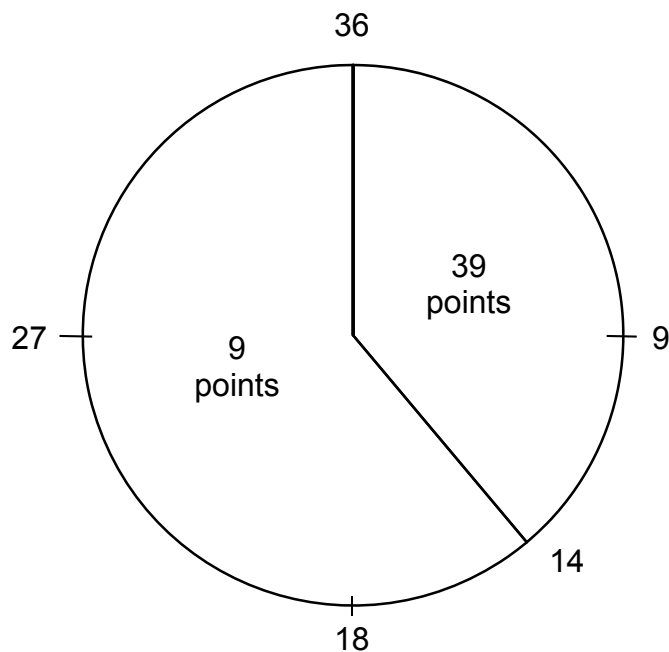
Based on my decision above, and the results of the draws from the bingo cages, the number of points I would have is \_\_\_\_\_.

This means that the WIN area of my prize wheel would cover the numbers 0 through \_\_\_\_\_,

My spinner stopped on the number \_\_\_\_\_.

Therefore I would have (circle the correct words) won / not won the prize.

Practice Item 3: Suppose you have the opportunity to play the bet shown below. What is the smallest number of points for which you would give up this opportunity? Remember that the WIN area on your prize wheel will be designated as the area from 0 through the number of points you receive as a result of your decision.



Decision \_\_\_\_\_.

The green ball drawn at random is \_\_\_\_\_.

The number on this green ball is

a) greater than my indicated amount.

b) less than or equal to my indicated amount.

Therefore, I would

a) receive points equal to the number on the ball and not play the bet.

b) play the bet and receive points according to the outcome.

The red ball drawn to determine the outcome of the bet was \_\_\_\_\_.

Based on my decision above, and the results of the draws from the bingo cages, the number of points I would have is \_\_\_\_\_.

This means that the WIN area of my prize wheel would cover the numbers 0 through \_\_\_\_\_, My spinner stopped on the number \_\_\_\_\_.

Therefore I would have (circle the correct words) won / not won the prize.

### Part 3:

This part is exactly like Part 1. You will be asked to consider several pairs of bets, and for each pair you should indicate which bet you prefer to play or indicate that you are indifferent between them. After each decision, you will then have an opportunity to play for a prize using the following procedure:

1. The bet you indicate as preferred will be played and you will receive the points indicated by its outcome. If you check "Indifferent" the bet you play will be determined by a coin toss.
2. The WIN area of your prize wheel will be designated as the area from 0 through the number of points which you have received. You will spin the spinner to determine whether you win the prize.