Uncertainty and Taxpayer Aggressiveness:
Experimental Evidence

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SYNOPSIS

This paper presents the results of three experiments designed to determine the impact of changing taxpayer uncertainty (through information provided by tax practioners or others) on tax reporting decisions in an economic laboratory setting. In particular, the study provides direct experimental tests of two taxpayer reporting models under a proportional tax rate structure with tax liability uncertainty due to tax law complexity. In our characterization of the tax setting, taxpayers were uncertain about their taxable income and whether or not they would be audited. Incentives were provided to subjects by making their post-experimental remuneration a function of disposable income (net of taxes and penalties). In the first two experiments, subjects' risk taking preferences were controlled experimentally by means of the remuneration scheme, while in the third experiment subjects' risk preferences were measured ex post.

The experimental results provide substantial support for risk neutral predictions. First, risk neutral subjects were found to report higher levels of income when penalty rates and audit probabilities were high. Second, as predicted by the model, the tax rate was not observed to impact on the reporting behavior of risk neutral subjects. In addition, reports were affected by audit probability by uncertainty and penalty rate by uncertainty interactions. Specifically, increasing uncertainty led to lower (higher) levels of reported taxable income when penalty rates or audit probabilities were low (high). Finally, the deviation of mean observed reports from predicted levels was small. Support for risk averse model-based predictions, however, was much weaker. While predicted tax rate and tax rate by uncertainty interactions were observed, they were only marginally significant and accounted for only 7% of the variance in subjects' reports.
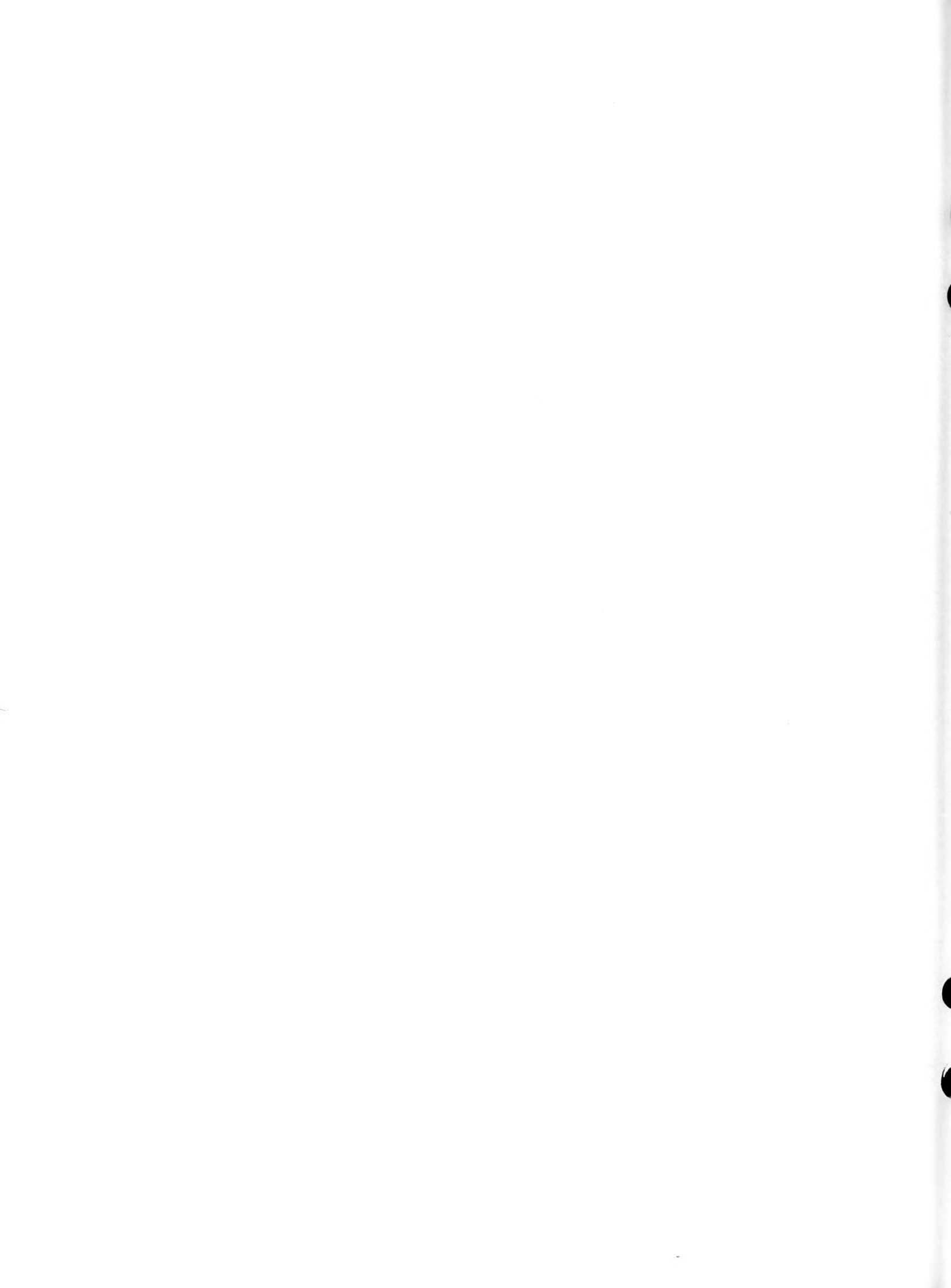
Uncertainty and Taxpayer
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I. INTRODUCTION

Complexity and ambiguity are inherent in the tax law and lead to substantial

uncertainty on behalf of some taxpayers regarding their reporting obligations to the tax

authority. In some instances, taxpayers attempt to reduce this uncertainty by seeking out

tax practitioners. In other cases, taxpayers may obtain information from other sources (such

as the tax authority itself) or may make no attempts to reduce or eliminate their

uncertainty. Due to the potentially important impact of uncertainty on taxpayer reporting,

the role of tax practitioners in reducing uncertainty, and the subsequent effect on tax

revenue collections, this topic recently has been examined at length in the accounting and

economics literature (see Alm [1988], Shavell [1988], Beck and Jung [1989a, 1989b], Beck,

Davis and Jung [1989], Scotchmer [1989a, 1989b], and Scotchmer and Slemrod [1989]). In

general, these studies modelled the effect of changing tax liability uncertainty in

conjunction with other factors (such as penalty rates, audit probability, taxpayer risk

preferences, etc.) on taxpayer reporting.[1]

Despite the significant recent growth of modelling research in this area, empirical

research has not kept pace.[2] To address the paucity of empirical evidence regarding the

impact of changes in uncertainty on taxpayer behavior, this paper reports the results of

three experiments performed in an economic laboratory setting representative of an

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[1]These studies do **not** address tax evasion because they assume that taxpayers do not lie (due to
extremely high penalties such as jail terms). Rather taxpayers are uncertain about taxable income (e.g., due to
complexity and ambiguity inherent in the tax law) and must decide what positions to adopt. An aggressive
position is defined as reporting a relatively low amount of taxable income while a conservative position is
defined as reporting a relatively high income. Neither type of position is illegal.

[2]One notable exception is the work by Klepper, Mazur and Nagin [1988] who attempted to test
whether taxpayers having "questionable income sources" and who use tax advisors report a smaller percentage
of "actual" income (determined by TCMP audit) than those taxpayers who do not use advisors. Their analysis,
however, relies on the tenuous use of the number of Revenue Rulings issued for a particular income source as a
proxy for taxpayers' uncertainty level.

uncertain tax environment. Addressing this topic is important for at least two reasons. First, the reduction of taxpayer uncertainty is one function provided by tax practitioners and understanding the impact of uncertainty reduction on taxpayer reporting could have important policy implications. Second, the experiments provide a test of the descriptive validity of the modelling research that has been recently developed.

Among the results of the research, we found that reducing the level of tax liability uncertainty induced more aggressive reporting behavior (i.e., lower reported income) when subjects are risk neutral and the audit probabilities and penalties are high. However, for low audit probability and penalty conditions, reduction in tax liability uncertainty was observed to result in less aggressive reporting for risk neutral subjects. Furthermore, for risk neutral subjects, tax rate changes were found to have no effect upon reporting. In contrast, tax rates interacted weakly with the uncertainty level when taxpayers were risk averse. Specifically, with a low (high) tax rate, increased uncertainty was observed to lead to more (less) aggressive reporting.

The remainder of the paper begins with a description of the experimental setting, the associated modelling assumptions, and the administration of the experiments. Next, theory and hypotheses are presented for both risk neutral and risk averse taxpayers. This is followed by a presentation of the designs of and results from three experiments. The implications of this research for tax policy, the limitations of the study and conclusions are discussed in the final section.

II. METHODS

The Experimental Setting

Each session had seven participants, acting as taxpayers. Every subject was given an endowment (representing pre-tax income), y, of 1000 units of an experimental currency (called "Francs") at the beginning of each of 60 trials. The participants' task was to determine how much of the endowment to report as taxable income, R, where there was

uncertainty about the "correct" (or post-audit) taxable income, x.[3] After making their reports, subjects faced the possibility of being audited and paying additional penalties if their post-audit taxable incomes were found to exceed the amounts reported on their tax returns. Consistent with the United States environment, a proportional penalty rate, q, was applied to the tax deficiencies: $t(x-R)$, where t is the proportional tax rate. Realistic economic incentives were provided by making subjects' post-experimental cash payments dependent upon their (after-tax and penalty) disposable income.

Two sources of uncertainty could affect experimental earnings and ultimately cash payoffs in our operationalization of the tax setting. The first was whether or not an audit occurred, while the second was the specific audit outcome (i.e., post-audit tax liability). Since taxpayer reporting behavior is the phenomenon of interest in the study, we simplified by adopting a partial equilibrium framework in which the tax agency's audit decisions were exogenous.[4] Accordingly, subjects in the experiments were told that audits occurred randomly and with a known probability, p. The audit selection rule was operationalized by defining outcomes in terms of the number rolled on a ten-sided die. For each trial in the

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[3]Role playing by subjects was discouraged by not mentioning taxes, audits, etc., in the experimental instructions (see Appendix B) or during the administration of the experiment (see Davis and Swenson [1988, 20] for a discussion of neutrality as a desirable characteristic in instructions) . Attempts to mask the purpose of the experiment were only partially successful. Approximately 14 percent of subjects raised the issue of tax compliance when responding to the open ended question "In a few words, describe the issue that you think this experiment was trying to address." While a possibility for bias was introduced in the experiment, we do not expect a serious effect given the small proportion of subjects professing this belief.

[4]An alternative would have been to make the tax agency's audit decisions strategically based. However, we believe that random (non-strategic) auditing is consistent with the beliefs of a significant class of taxpayers. Empirical evidence suggests that taxpayers are not homogeneous with respect to their beliefs about the tax agency's approach to selecting returns for audit. One IRS survey [Aitken and Bonneville, 1980] reports that 29.3% of respondents indicate that they believe the IRS randomly selects returns for audit. An additional 30.4% of respondents believe that attributes of their tax return provide the basis for audit selection. Remaining respondents stated either that they did not know how returns are selected (17.4%) or indicated that some other audit selection rule was used (21.7%). This data suggests that almost half of the respondents (46.7%) would act (in accordance with our model) as if the IRS audits randomly (combining those who stated this belief and those who are naive with respect to the audit decision). In any event, the evidence gathered from these experiments provides a benchmark for comparisons with future studies in which the tax agency operates strategically.

experiments, a die was rolled, and an audit occurred if the die's outcome was an element of a pre-specified set of numbers.

Uncertainty regarding the post-audit tax liability could arise either due to tax law complexity or ambiguity. Since taxpayers' reports typically include numerous items of income, deductions, credits, etc., there could be uncertainty about the reported amount for any number of items on the return. As a simplification, however, we focused on the summation of items, taxable income. Given a proportional tax rate structure, tax liability uncertainty was represented by a uniform probability distribution for the post-audit taxable income (x) denoted by $f(x)$[5] in our models. Theoretical predictions regarding the effects of changes in the uncertainty level were obtained by varying the range of possible taxable income values, $[L,H]$, while holding the mean, μ, constant. In order to make the uncertainty as salient as possible for the subjects in our experiments, the uniform taxable income distribution subsequently was operationalized through the use of a bingo cage containing sequentially numbered balls. Since subjects knew that each ball corresponded to a particular taxable income level, changes in uncertainty were achieved experimentally by varying the number of balls in the bingo cage. We employed one bingo cage containing 11 balls to represent a low level of uncertainty (taxable income from 700 to 800 Francs, in 10 Franc intervals) and a second bingo cage containing 51 balls to represent a high level of uncertainty (taxable income from 500 to 1000 Francs, in 10 Franc intervals).

Given the two sources of uncertainty discussed above, and assuming that each subject reports a taxable income of R, there were three possible uncertain events in our operationalization of the tax setting. First, subjects faced the possibility of being audited. In the event of an audit, their tax liability was proportional to post-audit taxable income (i.e., tx), so that their liability would be revised downward if $tx < tR$. However, when $tx >$

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[5]While a uniform probability distribution is assumed as an operational simplification, in the experimental setting such a distribution is not essential to the analysis (see Beck and Jung [1989a]). The hypotheses derived require only that the cumulative distributions cross at a single point, x_c (i.e., $G(x) > F(x)$ for $x < x_c$, with the inequality reversed for $x > x_c$).

tR, taxpayers were required to pay a penalty rate of q on the difference between the reported and post-audit tax liabilities. Finally, when tx = tR or subjects' tax reports were not selected for audit, then their tax liability remained tR. Table 1 illustrates the disposable income levels of a subject having a pretax income of y corresponding to the three events described above:

Insert Table 1 Here

Another potentially important factor in the tax compliance setting is the taxpayer's risk-taking attitude. For an environment similar to the operationalized setting in the present study, the Beck and Jung [1989a] model suggests that increasing the tax rate will have no effect on risk-neutral taxpayers' reporting decisions, but will create incentives for risk-averse taxpayers to report higher levels of income (see Yitzhaki [1974]). A further difference between risk-averse and risk-neutral taxpayers concerns the effects of changes in the level of tax liability uncertainty. Specifically, the analysis performed by Beck and Jung [1989a] suggests that, when the initial report, $R > \mu$, increasing the uncertainty level creates incentives for both risk-averse and risk-neutral taxpayers to increase their reported income. However, when $R < \mu$, risk neutral taxpayers should reduce reported income while the effect on risk averse taxpayers depends upon the magnitude of the tax rate.

Since our tests were, by necessity, a joint test of subjects' risk preferences and our model, and given the potential importance of subjects' risk-taking attitudes for the theoretical predictions, two different approaches were employed in our experiments. First, for two experiments, we attempted to control subjects' risk taking attitudes experimentally by means of the utility induction procedure described in Berg, et al. [1986]. As described in greater detail below, the central feature of this approach was to map subjects' end-of-trial wealth in Francs onto the probability of winning a cash prize in a lottery. In concept, any desired risk preference can be induced through the choice of mapping functions. Two mapping functions were used in our experiments. The first was a linear mapping designed

to induce subject risk neutrality over (net of tax) Francs. The second mapping function was designed to induce preferences consistent with a negative exponential utility function. This particular preference structure was chosen for several reasons. Most importantly, the negative exponential utility function exhibits constant absolute risk aversion, thereby avoiding the potential confounding that would occur if risk aversion were to covary with other manipulated variables due to income effects. Another reason for adoption is that a closed-form solution can be obtained for the optimal income reporting level, thereby facilitating a comparison between taxpayers' actual income reports and the model-based point predictions.

The actual procedure to induce risk preferences made use of three ten-sided dice and "win range sheets" such as the one displayed in Figure 1. Win range sheets were provided to subjects to make salient the mapping of all possible values of after-tax (and penalty) Francs onto numbers in the interval [0,999] which represented the probability (to three digits) of winning a 75 cent prize in a lottery. The win-range sheet in Figure 1 illustrates a linear mapping of possible ending Francs onto probabilities, thereby inducing risk neutrality.

Insert Figure 1 Here

To participate in the lottery to win a cash prize, subjects first determined their after-tax Francs and the associated win range points. Then the experimenter rolled three ten-sided dice. The outcome of each die represented one digit of a three digit number (the "prize number"). The order of the digits in the number was determined by the color of each die. If the prize number was less than or equal to the win-range points, then the subject won a cash prize. If the prize number was greater than the win-range points, the subject won nothing.

In addition to the Berg et al. [1986] mechanism for utility induction, in a third experiment we attempted to estimate subjects' risk preferences using a refinement of the

Becker, Degroot and Marschak [1964] technique suggested by Kachelmeier [1989]. This approach first required assessment of subjects' certainty equivalents for a series of simple lotteries. Subsequently, the certainty equivalents were employed to estimate a quadratic OLS regression of the form:

$$\text{Prob}_i = \alpha + \beta_1(\text{Price}_i) + \beta_2(\text{Price}_i)^2 + \epsilon$$

where Prob_i was the exogenous probability of winning lottery i, Price_i was the subject's minimum selling price for lottery i, and α, β_1, β_2, and ϵ were the regression coefficients and residual, respectively. Subjects were then classified into risk averse, risk neutral and risk seeking categories using the 2-tailed t-statistic for the test of the null hypothesis $\beta_2 = 0$. Specifically, subjects whose β_2 coefficients were significantly negative (at $p \leq .05$), were classified as risk averse. Likewise significantly positive (insignificant) coefficients led to risk seeking (risk neutral) classification.

Administration

Subjects. The subjects were 112 undergraduate and graduate students from a large state university. Subjects were recruited from numerous classes at the university and, within each of three experiments (induced risk neutrality, induced risk aversion, and risk preference measurement), were randomly assigned to treatments.[6] Responses to a query in the post-experimental questionnaire suggest that subjects had not discussed the experiment with others prior to participation.[7]

Procedures. For all experiments, subjects were given written instructions upon arriving for the experimental session (see Appendix B). The first part of the instructions

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[6]Kruskal-Wallis one-way ANOVA using demographic data obtained in a post experimental questionnaire suggests that random assignment to experimental treatments was successful.

[7]In a two-part question on the post-experimental questionnaire, 11% of subjects responded "yes" to the question: "Did you have any advance knowledge or discussions with anyone regarding this experiment?" However, when asked about the nature of this advance knowledge, all subjects indicated that they had heard either about the cash rewards available or about the general nature of the task to be performed. None of the information obtained by subjects ex ante was deemed to be insightful enough to contaminate the experiment.

described a probability training exercise similar to that used by Plott and Sunder [1982]. The objective of this exercise was to provide subjects with knowledge of the outcome generating properties of the bingo cages and ten-sided dice used in the experiment. Subjects had an opportunity to observe the operation of the bingo cages and the dice for 40 trials. Prior to each draw from the bingo cage (or roll of the dice), subjects were asked to predict the outcome (either X or Y, defined on partitions of the outcome space). Subjects were rewarded (penalized) for correct (incorrect) predictions as described in the instructions in Appendix B.

Following completion of the probability training session, subjects read the remainder of the instructions and were required to complete successfully a quiz which tested comprehension of the tax and penalty computations and the cash lottery procedure (for the utility induction experiments). Upon completion of the quiz, subjects were informed of the initial parameter values for their experiment.

Subjects began each experimental trial by choosing and recording a reported income level within the specified interval (either 700 to 800 Francs or 500 to 1000 Francs, depending upon the experimental condition). After recording their report, subjects proceeded to an "investigation table" where a ten-sided die was rolled to determine whether an audit was to take place. When subjects were audited, the experimenter drew a ball from the bingo cage which determined the post-audit taxable income. This information was recorded next to the subject's report. Next, subjects computed their after-tax Francs and win-range points (when applicable) and proceeded to a "lottery table" where their computations were reviewed, the prize number determined, and possibly, a cash prize awarded.[8] After completing all experimental trials, total cash payments to subjects were

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[8]For the experiment in which risk preferences were measured rather than induced, the cash earned by subjects was a fixed proportion of their ending Francs for each trial.

tallied and paid[9] while subjects completed a post-experimental questionnaire designed to gather demographic information and evidence regarding the validity of the experiment.[10]

III. THEORY AND HYPOTHESES

Taxpayer reporting behavior can be modelled for the above experimental setting. Letting $U(\cdot)$ denote the taxpayer's preference function for after-tax (disposable) income, the expected utility is given by:

$$EU = (1-p)U(y-tR)+p\{\int_{L}^{R} U(y-tx)f(x)dx+ \int_{R}^{H} U(y-tx-qt(x-R))f(x)dx\}. \qquad (1)$$

Beck and Jung [1989a] obtained the following implicit characterization of the optimal reporting decision from the first order condition:

$$(1-p)/pq = \int_{R^*}^{H} [U'(y-xt-qt(x-R^*))/U'(y-R^*t)]f(x)dx, \qquad (2)$$

where $U'(\cdot)$ denotes the derivative of the utility function with respect to its argument and R^* denotes the implicit solution.

By making specific assumptions about taxpayers' utility functions, the optimality condition in (2) can be simplified to obtain point predictions and facilitate the ensuing comparative statics analysis. Two specific utility functions are employed herein. The first is $U(w)=w$ and the second is $U(w) = -e^{-\lambda w}$, where w denotes disposable income and $\lambda > 0$ is a positive constant denoting subjects' risk aversion. These utility functions were selected to represent different risk-taking attitudes. In particular, the former reflects risk neutrality, while the latter represents constant absolute risk aversion. Hypotheses for each of these utility functions are now developed.

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[9]Cash payments to subjects ranged from $29.25 to $47.73 with an average payment of $39.52 per subject or approximately $4425 in total payments for the experiments.

[10]The post-experimental questionnaire was divided topically into five sections. The first section contained questions concerning subjects' beliefs regarding the presence of interference by the experimenter with the bingo cages, dice or the decisions of subjects. The remaining four sections dealt with Wilde's [1981] (see also Smith [1982]) four precepts necessary for successfully controlling preferences over an experimental commodity: salience, nonsatiation, privacy, and dominance. The results of the questionnaire suggest that subjects did not believe the experimenter interfered in any way, and that the four precepts were satisfied.

Risk neutral hypotheses. Assuming that taxpayers have utility functions of the form $U(w)=w$, the marginal utility ratio in the first-order condition is unity, so (2) simplifies to:

$$(1-p)/pq = F(H) - F(R_N),\qquad(3)$$

where R_N denotes the optimal amount of taxable income to be reported under risk neutrality. As $F(H) = 1.0$ due to the property of cumulative probability distributions, (3) is equivalent to:

$$F(R_N) = 1 - [(1-p)/pq],\qquad(4)$$

where $F(R_N)$ represents the fractile of the cumulative probability distribution corresponding to R_N. Given the monotonicity of $F(\cdot)$, it is apparent that R_N is an increasing function of the audit probability (p) and the monetary penalty rate (q) for underpayment of taxes. This gives rise to the first hypothesis:

H1:   Ceteris paribus, the amount of reported income (R_N) is an increasing function of the audit probability (p) and the penalty rate (q).

Two other hypotheses are apparent from the above analysis. First, since the tax rate, t, does not appear in the first order condition, changes in t should have no effect on taxpayer reporting. This gives rise to:

H2:   The level of income reported by risk neutral taxpayers (R_N) will be unaffected by the applicable tax rate (t).

The last hypothesis concerns the effect of uncertainty on taxpayers' reporting decisions. Specifically, given our assumption of risk neutrality, changes in the uncertainty level should influence reporting incentives through the expected penalty. In particular, an increase in the range of the income distribution increases the marginal penalty when the initial level of reporting, R, is above the mean of the taxable income distribution. Such a penalty increase creates incentives for taxpayers to report a higher income level to maintain the optimal tradeoff between tax savings and penalties. Similarly, when the initial level of reporting is below (at) the mean of the taxable income distribution, increased

uncertainty will reduce (have no effect on) expected marginal penalties, thereby resulting in a lower reported income (no change in reported income). This reasoning gives rise to the following hypothesis:[11]

H3: Increased uncertainty has no effect on the level of taxable income reported (R_N) by risk neutral taxpayers if $p/(1-p) = 2/q$, but will decrease (increase) the level of taxable income reported (R_N) when $p/(1-p) < (>) 2/q$.

A noteworthy feature of H3 is that, under the assumption of taxpayer risk-neutrality, changes in the level of tax liability uncertainty can have differing effects on taxpayers' reporting decisions. More specifically, H3 predicts that taxpayer reports are affected by uncertainty by audit probability and uncertainty by penalty rate interactions.

Risk averse hypotheses. Given the assumption of a negative exponential utility function, one can verify that $U'(y-xt-qt(x-r)) = \lambda e^{-\lambda[y-xt-qt(x-R)]}$ and $U'(y-Rt) = \lambda e^{-\lambda[y-Rt]}$. Substituting these expressions into the first-order condition in (2), we obtain:

$$(1-p)/pq = [1/(H-L)] \int_{R_A}^{H} e^{-\lambda[(1+q)t(R_A-x)]} dx \tag{5}$$

where R_A denotes the optimal reporting level (i.e., the solution to (5)). After some tedious manipulations (see Appendix A), one can show that:

$$R_A = H-[(1+q)t\lambda]^{-1} \bullet \ln\{1 + [(1-p)\lambda(1+q)t(H-L)]/pq\}. \tag{6}$$

The partial differentiation of (6) with respect to t (see Appendix A) shows that R_A is an increasing function of the tax rate. This prediction contrasts with H2, regarding risk neutral taxpayers, wherein no effect for tax rate is predicted. Nevertheless, the tax rate effect is consistent with previous models and is explained by the presence of an income effect under taxpayer risk aversion (see Yitzhaki [1974] and Beck and Jung [1989a]). Based upon this result, we can now state:

H4: Ceteris paribus, the amount of income reported, R_A, is an increasing function of the tax rate, t.

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[11]See Beck and Jung [1989a] for a formal proof..

In addition to economic factors, uncertainty about taxable income is also expected to affect tax reporting decisions for risk averse taxpayers. By perturbing the range [L,H] of possible post-audit taxable income values, while holding the mean constant, it is possible to determine the effects of tax liability uncertainty. Based on this analysis (see Appendix A), the following hypothesis is developed:

H5: Provided that the taxpayer's absolute risk aversion parameter, λ > (<) $2/[(1+q)t(H-L)]$, the amount of reported taxable income, R_A, will be an increasing (decreasing) function of the uncertainty level (range of possible post-audit taxable incomes).

Holding a taxpayer's risk aversion constant, an interaction between the tax (or penalty) rate and changes in the taxpayer's uncertainty is predicted by H5 since an increase in uncertainty is predicted to result in less (more) aggressive reporting by the taxpayer when the tax rate is high (low).

IV. EXPERIMENTAL DESIGN AND RESULTS

This section begins by presenting the results from a sequence of three experiments designed to test the seven hypotheses developed in the previous section.[12] In the first two sets of experiments, utility functions were induced using the Berg et al. [1986] technique. The first experiment examined hypotheses H1 to H3 (risk neutral behavior), while the second experiment was designed to test hypotheses H4 and H5 (risk averse behavior). The results from a third experiment, which measured risk preferences using the Kachelmeier [1989] method, are reported here in an attempt to overcome the limitations of using a single approach to dealing with risk preferences. Finally, the overall predictive ability of the taxpayer reporting model is evaluated.

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[12]The data from the experiments are available on 3 and 1/2 inch diskette (MS DOS format) from the authors upon written request.

Experiment 1: Risk Neutral Taxpayers

Design. The first experiment employed the Berg et al. lottery procedure to induce risk neutral preferences to permit testing of hypotheses H1 to H3. The tax rate and uncertainty were manipulated at two levels within subjects, in a fully crossed design between experiments within each cell. Each of the four sets of manipulation combinations was implemented for 15 trials. Audit probability and the penalty rate were manipulated at three and two levels respectively, between subjects, with the penalty rate manipulation nested within the audit probability. Table 2 presents the design and parameters employed in Experiment 1.

Insert Table 2 Here

Hypotheses. The hypotheses regarding risk neutral taxpayer reporting were tested via a repeated measures ANOVA, with seven subjects in each treatment condition. The relevant results from the ANOVA, presented in Table 3, are supportive of both hypotheses H1 and H2. Note that, consistent with H1, the penalty and audit probability main effects are both significant ($p < .000$) and together these two effects explain approximately 52% of the variance in the ANOVA (using the Ω^2 statistic). Furthermore, mean reports increase with the audit probability (721.5 for 0.4, 729.5 for 0.5, and 875.1 for 0.9) and with the penalty rate (642.3 for 0.2, and 775.3 for 2.0), as predicted. Likewise, consistent with the theoretical prediction made by H2, the tax rate effect is not significant ($p = .655$) and the percent of explained variance provided by the tax rate factor is extremely small (.002).[13]

Insert Table 3 Here

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[13]Note that the ANOVA indicates that the null hypothesis of no effect for tax rate cannot be rejected. While we cannot state with confidence that the analysis suggests that the null should be accepted, the extremely small percentage of variation accounted for by the tax rate effect suggests that tax rate had little impact upon behavior.

The results of the ANOVA in Table 3 are also supportive of our hypothesis regarding the uncertainty by audit probability and uncertainty by penalty rate interactions (H3). Specifically, both interactions are significant ($p < .000$) and they account for 19% and 3% of the explained variance, respectively. Furthermore, the direction of the interactions is consistent with the hypothesis. Figure 2A illustrates graphically the mean reports under the two uncertainty levels for each audit probability level. Note that, at the 0.9 probability level, the mean report is significantly greater ($p < .000$) under high uncertainty than under low uncertainty. However, at the 0.4 audit probability level, the relationship between high uncertainty and low uncertainty mean reports is reversed although the difference between the means is not significant.

Insert Figure 2A Here

Similarly, the penalty rate by uncertainty interaction is consistent with our prediction (see Figure 2B). That is, with a 0.2 penalty rate, the mean report under high uncertainty is significantly less ($p < .000$) than the mean report under low uncertainty, while the relationship is reversed when the penalty rate is 2.0, although the difference between means is no longer significant.

Insert Figure 2B Here

Experiment 2: Risk Averse Taxpayers

Design. The second experiment used the Berg et al. lottery procedure to induce risk averse preferences consistent with a negative exponential utility function where $\lambda = 0.023$. The presence of risk aversion permitted tests of hypotheses H4 and H5, using the experimental design and parameters in Table 4. In this experiment, the uncertainty level was manipulated at two levels, each for 30 trials, within subjects. The tax rate also was

manipulated between subjects in a fully crossed design while penalty rate and audit probability were held constant throughout the experiment.

Insert Table 4 Here

Hypotheses. Tests of hypotheses H4 and H5 were performed using a repeated measures ANOVA. Only two effects in the analysis approached significance. These were the (H4) predicted main effect for tax rate (p = .077; $F_{1,24}$ = 3.42; MS_e = 142343) and the (H5) predicted tax rate by uncertainty interaction (p = 0.069; $F_{1,24}$ = 3.62; MS_e = 133090). In addition, the two significant effects together accounted for only 7% of the total variance (Ω^2 = .035 for each effect). The means for tax rate are in the predicted direction--a low mean report in the low tax rate condition (703.1) and a high mean report in the high tax rate condition (737.1). Likewise, the form of the interaction effect is as predicted by H5 (see Figure 3)--more (less) income is reported as uncertainty increases when the tax rate is low (high). However, given the marginal significance of the two predicted effects and the very small proportion of variance explained, strong support for H4 and H5 is not provided.

Insert Figure 3 Here

Experiment 3: Measured Risk Preferences

Risk preferences and design. In contrast with the previous experiments, no attempt was made to induce risk preferences in Experiment 3. Instead we employed the Kachelmeier [1989] risk preference measure. Based upon our analysis, 20 of the 22 subjects who completed the measurement instrument were classified as risk neutral, while the remaining two subjects were classified as risk averse.[14] In addition, consistent with the

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[14]Six subjects who participated in the third experiment did not complete the risk preference measurement task, which was administered in a separate session.

results reported by Kachelmeier [1989], the average fit of regression was excellent; the mean R^2 across regressions was .89.

Given the large proportion of risk neutral subjects in the third experiment (and the small number of risk averse subjects), the remainder of the analysis is based on predictions of the risk neutral model. The design and parameters employed in present experiment were identical to those used in Experiment 2 (see Table 4). For this design, H2 predicts that no tax effect will be observed, while H3 predicts a main effect for uncertainty (since penalty rate and audit probability were constant at 0.2 and 0.5, respectively). In addition, the predicted reports are 500 in the high uncertainty treatment and 700 in the low uncertainty in the low uncertainty treatment.

Hypotheses. The results of a repeated measures ANOVA are displayed in Table 5. Consistent with hypothesis H2, we found that the tax rate effect was not significant with an Ω^2 of 0 (but see footnote 13). Furthermore, the main effect for uncertainty was significant (p < .000) as predicted by H3. However, the trial main effect and uncertainty by trial interaction effect were also significant. A visual examination of the mean reports (see Figures 4A and 4B) suggests that these effects could be attributed to the presence of a learning effect during the first half of each treatment condition.

Insert Table 5 Here

Insert Figure 4A Here

Insert Figure 4B Here

In an attempt to remove learning effects from the analysis, a second ANOVA was performed using the last 15 trials in each treatment condition. As can be seen from the results of the second ANOVA in Table 6, the trial main effect and the interaction effect were no longer significant and explained none of the variance. Likewise, the uncertainty

effect predicted by H4 explained approximately 36% of the variance and became even more significant. Furthermore, tax rate remained insignificant and explained none of the variance, as predicted. Thus, support is provided for the risk neutral hypotheses.

Insert Table 6 Here

Overall Predictive Ability

The overall predictive ability of the model was evaluated by calculating the mean deviations between observed reports and the corresponding theoretical predictions. The effects of scale differences across experimental conditions were removed by expressing the actual reports and predictions as fractiles before calculating the deviations.[15] Descriptive statistics for the distribution of deviations of the mean observed fractile from the predicted fractile for each of the three experiments and on an overall basis are presented below in Table 7.

Insert Table 7 Here

The mean of the overall distribution of deviations indicates that subjects' actual reporting fractiles were 13% higher on average than predicted. However, within each of the three experiments, the mean deviation from the predicted fractile was highly variable. In Experiment 1, the mean deviation was only 5.2%, while in the remaining two experiments, there was a tendency for subjects to report incomes substantially higher than the predicted level (mean deviations of 19.4% and 22.3%, respectively). One possible explanation for the difference in results across experiments is provided by referring to the experimental parameters. First, recall that, in the first experiment (see Table 2), a variety

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[15]Since the range of possible income values that could be reported by subjects is varied experimentally, the maximum possible absolute reporting deviations also vary. By expressing all reports and theoretical predictions as fractiles, we ensure that performance across each experimental condition is weighted equally.

of reporting fractiles were examined, while in the third experiment (see Table 4) where most subjects were risk neutral, 0 was the predicted reporting fractile in all conditions, thereby producing a floor effect. Thus, one might expect the observed reports in Experiment 3 to be skewed upwards. Likewise, in the second experiment, we induced risk aversion with a negative exponential function, which provided asymmetric incentives to subjects. That is, due to the shape of the utility function, a subject would have more to lose by reporting too low than by reporting too high. This suggests that subjects would tend to be less sensitive to over-reporting, leading to the high positive observed deviation. Given the expectation that subjects would over-report in the second and third experiments, the small observed deviation in Experiment 1 is perhaps the best measure of the model's predictive ability.

V. CONCLUSIONS

This paper provides initial tests of the recently developed body of economic theory concerning taxpayer reporting under conditions of uncertainty. A series of three experiments using a laboratory representation of the tax reporting setting were performed. In the experimental setting, subjects were required to select a report from a prespecified range and faced an audit with known probability. Based upon the results reported herein, one can conclude that substantial support is provided for the risk neutral model of taxpayer reporting under uncertainty. All hypotheses were supported and the predictive ability of the model is generally good (.052 mean fractile deviation in Experiment 1). In Experiment 2, subjects' mean reports were generally in the hypothesized directions predicted by the risk averse model. However, the results are only marginally significant. The very weak effect observed may be due to 1) a theoretical failure, 2) an unsuccessful attempt to induce risk averse preferences, or 3) some other unknown reason. Within Experiment 3, almost the entire subject pool appeared to be risk neutral and subjects' tax reporting decisions were consistent with the hypothesized effects for risk-neutral taxpayers, thereby providing

additional support for the model. Given the limited data, additional experiments would appear to be warranted. For example, Experiment 3 could be replicated, using subjects pre-screened for risk aversion.

In addition to further tests of the risk averse model of reporting, future work could extend the current tests to a setting where the tax agency's audit strategy is endogenous [Beck and Jung, 1989b]. Future research could also incorporate additional facets of the tax practitioner's role in the taxpayer reporting process under conditions of uncertainty (e.g., the signalling benefit provided when a practitioner signs a return [Beck, Davis and Jung, 1989]).

WIN RANGE SHEET   SN_____

Ending Total in Francs	Win Range	Increase in Win Range
795	0	0
796	33	33
797	67	34
798	100	33
799	133	33
800	167	34
801	200	33
802	233	33
803	267	34
804	300	33
805	333	33
806	367	34
807	400	33
808	433	33
809	467	34
810	500	33
811	533	33
812	567	34
813	600	33
814	633	33
815	667	34
816	700	33
817	733	33
818	767	34
819	800	33
820	833	33
821	867	34
822	900	33
823	933	33
824	967	34
825	999	32

Figure 1: Sample Win Range Sheet for a .25 tax rate, a .20 penalty rate and low uncertainty (i.e., taxable income $\in$ [700,800]).
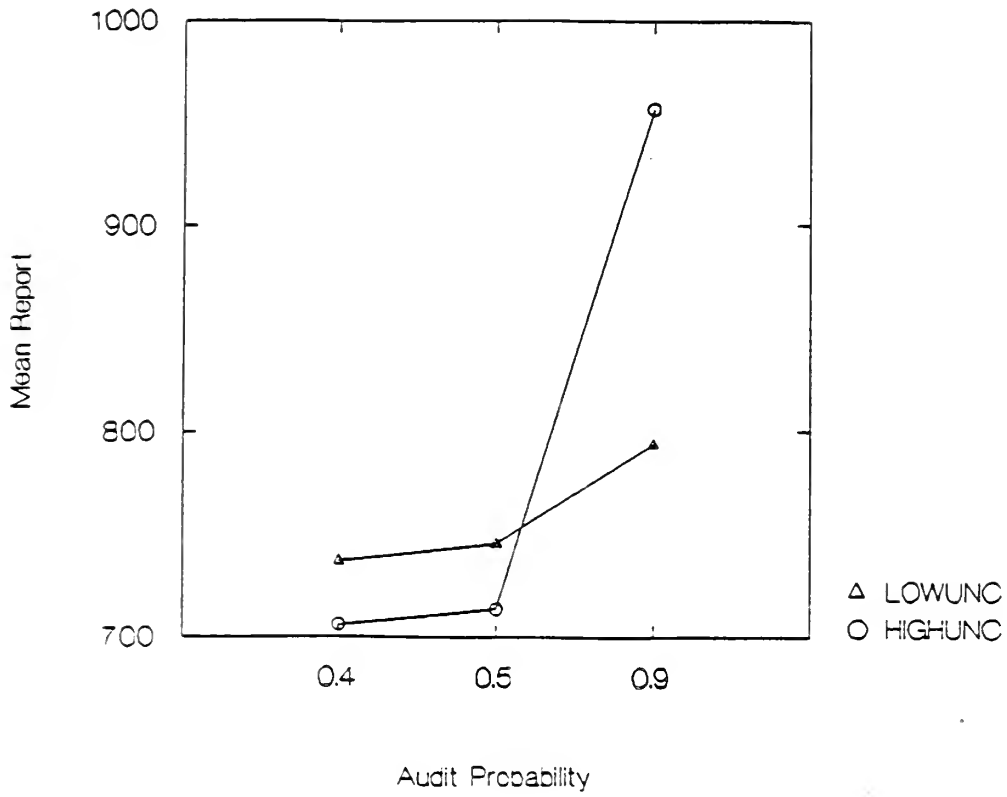
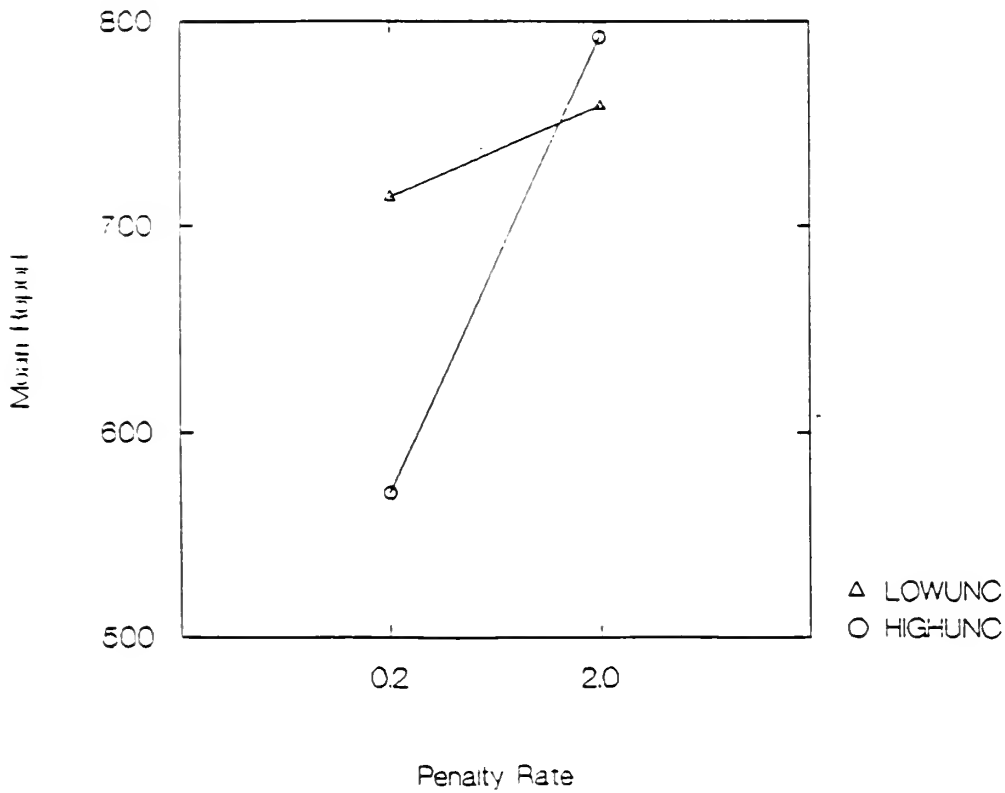Figure 2A: Audit Probability by Uncertainty Interaction Effect in Experiment 1.

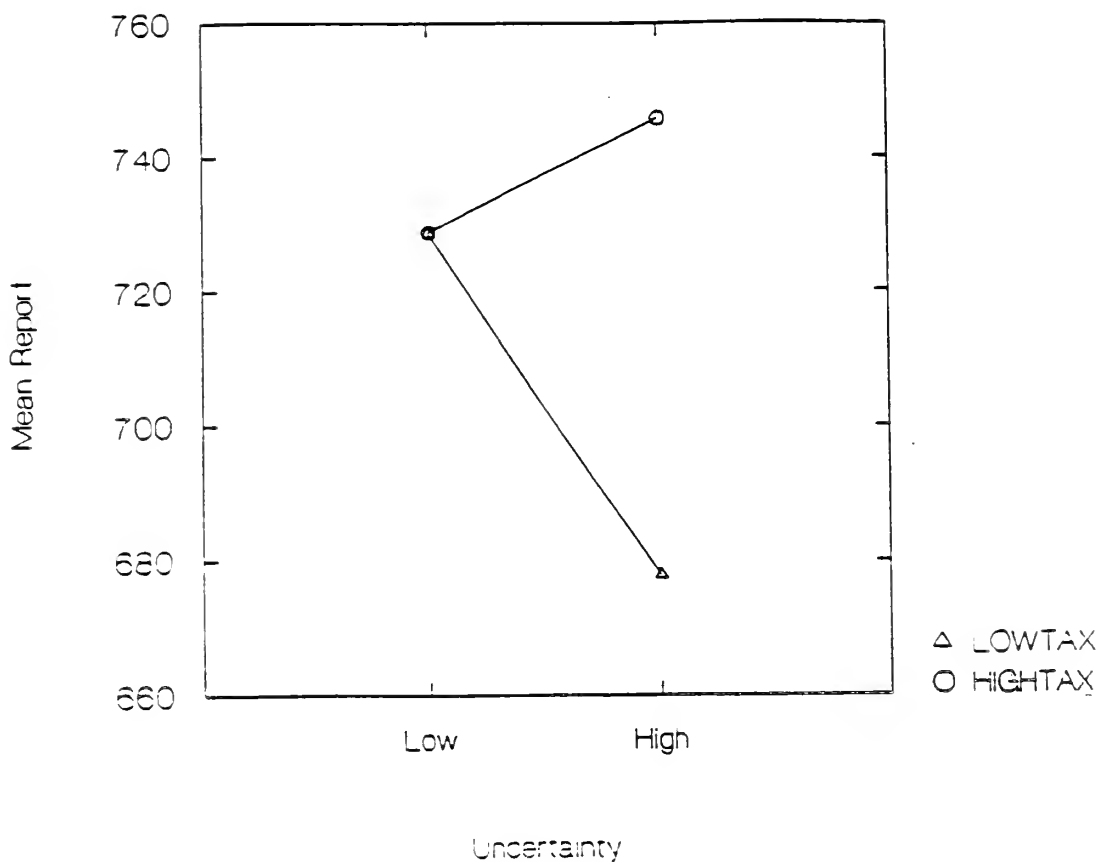Figure 2B: Penalty Rate by Uncertainty Interaction Effect in Experiment 1.

Figure 3: Tax by Uncertainty Interaction Effect in Experiment 2.
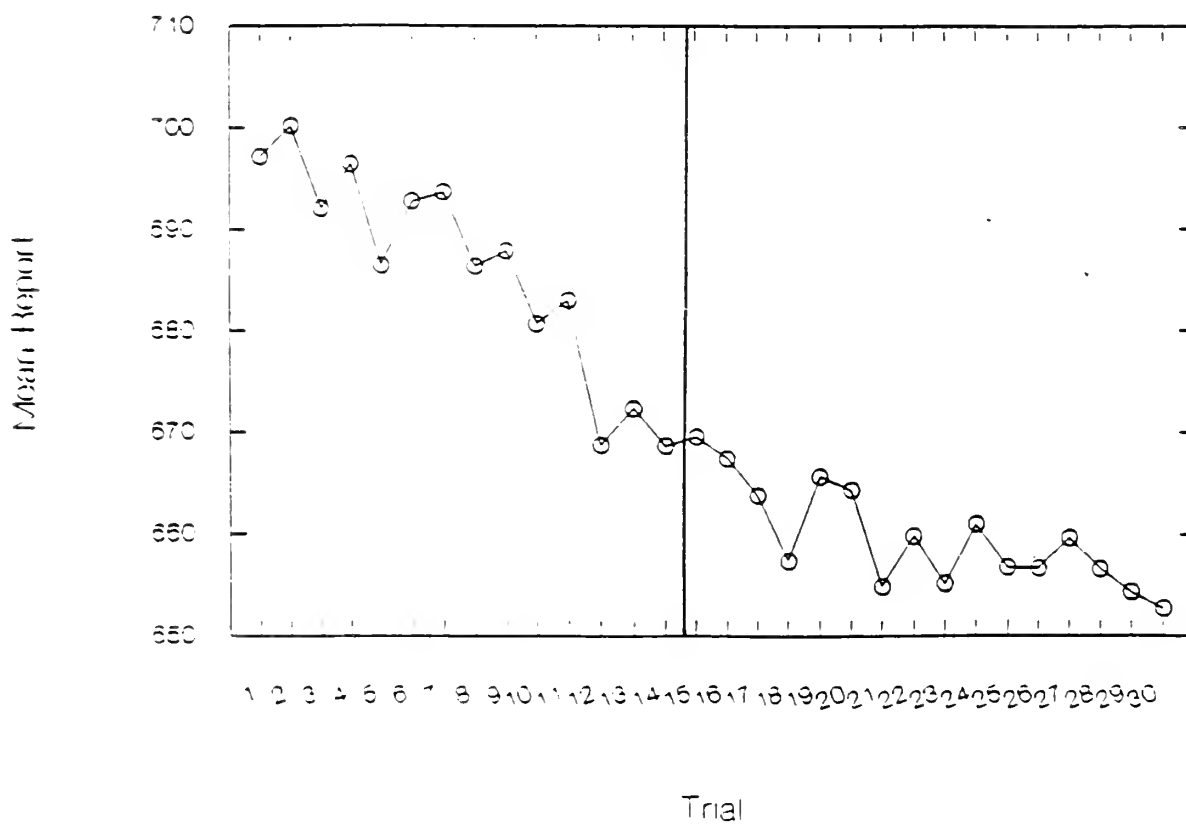
Figure 4A: Trial Main Effect in Experiment 3.
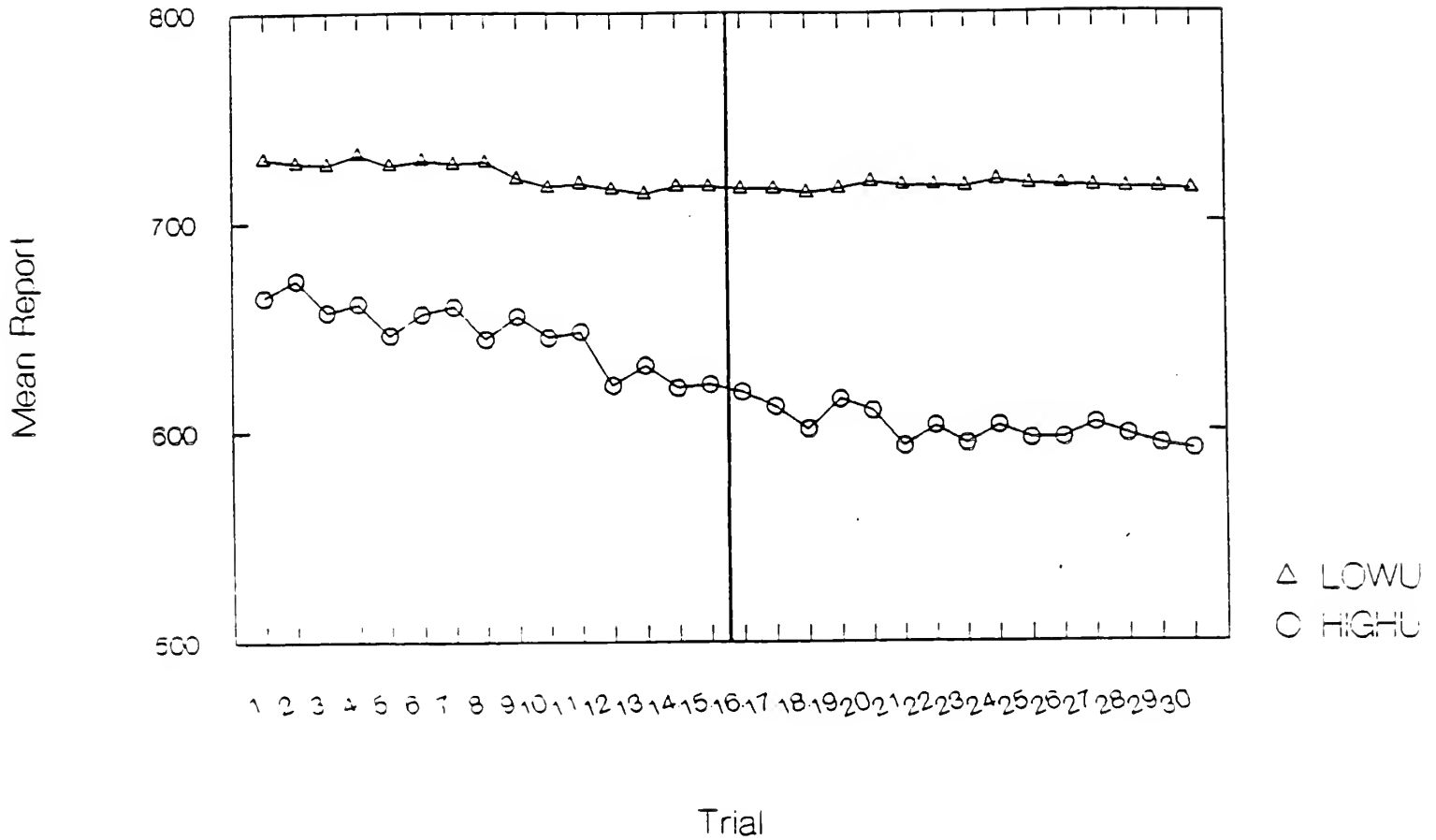
Figure 4B: Uncertainty by Trial Interaction Effect in Experiment 3.

Event	Net Payoff	Probability
1. No Audit	$y - tR$	$(1 - p)$
2. Audit / No Deficiency	$y - tx$	$p \int_L^R f(x)dx$
3. Audit / Tax Deficiency	$y - tx$ $\quad - qt(x-R)$	$p \int_R^H f(x)dx$

Table 1: Disposable Income of a Taxpayer Under Three Possible Events.

Cell	Tax Rate	Uncertainty	Probability of Audit	Penalty Rate	Optimal Fractile	R^H	R^L
1	.25/.5	High/Low	.50	0.20	0.0	500	700
2	.25/.5	High/Low	.40	2.0	0.25	625	725
3	.25/.5	High/Low	.50	2.0	0.50	750	750
4	.25/.5	High/Low	.90	2.0	0.94	970	794

where High = [500,1000], Low = [700,800], R^H and R^L = Optimal report for high and low levels of uncertainty respectively. Tax rate was changed every 15 trials and uncertainty was changed halfway through the experiment, at trial number 31, so that the design is fully crossed. The order of tax rate and uncertainty manipulations were changed between experimental sessions to permit measurement of order effects.

Table 2: Experimental Design for Experiment 1 (Induced Risk Neutrality).

Source of Variation	df	SS	MS	F	Prob.	Ω^2
BETWEEN SUBJECTS						
Audit Probability	2	20527018.72	10263509.36	110.52	.000	.437
Penalty Rate Nested within Probability	1	3187511.72	3187511.72	34.32	.000	.088
WITHIN SUBJECTS						
Tax Rate	1	2438.65	2438.65	0.20	.655	.002
Audit Probability by Uncertainty	2	8892576.80	4446288.40	75.79	.000	.189
Penalty Rate by Uncertainty	1	1315216.69	1315216.69	22.42	.000	.028

Note: Some higher order interactions not reported here were statistically significant. However, none of these effects were intuitive nor were they theoretically predicted, and the percent of variance explained by these effects (Ω^2 statistics) were less than one percent for any individual factor and in sum, less than three percent of total variance. In contrast, the significant effects reported in this table explain almost 75 percent of the variance. The complete ANOVA table is available from the authors.

Table 3: Results of Repeated Measures ANOVA for Experiment 1 (Induced Risk Neutrality).

Cell	Tax Rate	Uncertainty	Probability of Audit	Penalty Rate	Optimal Fractile	R
1	.25	High / Low	0.50	0.20	.15821 0	579 (High) 700 (Low)
2	.50	High / Low	0.50	0.20	.48268 0	741 (High) 700 (Low)

where λ = .023, High = [500,1000], and Low = [700,800]. Tax rate is manipulated between subjects and uncertainty level is manipulated within subjects, after 30 trials, changing the order of the manipulation between sessions to permit measurement of order effects.

Table 4: Experimental Design for Experiments 2 and 3 (Induced Risk Aversion and Measurement of Risk Preference Experiments).

Source of Variation	df	SS	MS	F	Prob.	Ω^2
BETWEEN SUBJECTS						
Tax	1	17043.57	17043.57	0.09	.771	0
WITHIN SUBJECTS						
Uncertainty	1	3828690.71	3828690.71	40.86	.000	.232
Trial *Greenhouse-Geisser*	29 4.26	393728.27	13576.84	5.01	.001	.020
Uncertainty by Trial *Greenhouse-Geisser*	29 3.84	195187.34	6730.60	2.62	.042	.008

Note: For the data in experiment 3, analysis using the Mauchly [1940] sphericity index suggests that the compound symmetric covariance matrix assumption is seriously violated. Accordingly, we report univariate average F statistics, corrected for the violation using the Greenhouse and Geisser [1959] degrees of freedom adjustment. Resulting probability values are approximate.

Table 5: Results of Repeated Measures ANOVA for Experiment 3 (Measured Risk Preferences), All Trials.

Source of Variation	df	SS	MS	F	Prob.	Ω^2
BETWEEN SUBJECTS						
Tax	1	1728.60	1728.60	0.02	.896	0
WITHIN SUBJECTS						
Uncertainty	1	2757161.46	2757161.46	55.87	.000	.359
Trial	14	15683.45	1120.25			
Greenhouse-Geisser	2.94			0.77	.513	0
Uncertainty by Trial	14	14441.67	1031.55			
Greenhouse-Geisser	2.70			0.78	.495	0

Table 6: Results of Repeated Measures ANOVA for Experiment 3 (Measured Risk Preferences); Last 15 Trials in each Treatment Condition.

Statistic	Total	Induced Risk Neutrality	Induced Risk Aversion	Measured Risk Preferences
Minimum	-0.369	-0.369	-0.119	0.000
Maximum	0.714	0.471	0.537	0.714
Mean	0.130	0.052	0.194	0.223
Standard Deviation	0.147	0.116	0.009	0.122
Skewness	0.382	0.227	-0.012	1.386
Kurtosis	0.617	0.479	-0.510	3.493

Table 7: Mean Deviations from Predicted Fractile--Descriptive Statistics.

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APPENDIX A:
NEGATIVE EXPONENTIAL UTILITY MODEL

The first-order condition characterizing the optimal reporting decision for a taxpayer having a negative exponential utility function is:

$$(1-p)/(pq) = [1/(H-L)] \int_{R^{**}}^{H} e^{-\lambda[(1+q)t(R^{**}-x)]} dx. \tag{1A}$$

Recognizing that $e^{-\lambda[(1+q)t(R^{**}-x)]} = e^{-\lambda(1+q)tR^{**}} \cdot e^{\lambda(1+q)tx}$, (1A) can be rewritten as:

$$(H-L)(1-p)/(pq) = e^{-\lambda(1+q)tR^{**}} \int_{R^{**}}^{H} e^{\lambda(1+q)tx} dx \tag{2A}$$

$$= e^{-\lambda(1+q)tR^{**}} (e^{\lambda(1+q)tH} - e^{\lambda(1+q)tR^{**}})/(\lambda(1+q)t) \tag{3A}$$

$$= (e^{-\lambda(1+q)tR^{**}} e^{\lambda(1+q)tH} - 1) / (\lambda(1+q)t). \tag{4A}$$

Rearranging (4A), we obtain the following expression:

$$[(H-L)(1-p)\lambda(1+q)t/(pq) + 1]/e^{\lambda(1+q)tH} = e^{-\lambda(1+q)tR^{**}}. \tag{5A}$$

Taking the natural logarithm of both sides of (5A) and simplifying, we obtain:

$$\lambda(1+q)tR^{**} = \ln\{e^{\lambda(1+q)tH}/[(H-L)(1-p)\lambda(1+q)t/(pq) + 1]\}. \tag{6A}$$

Solving (6A) for R^{**} and simplifying, one can verify that:

$$R^{**} = H - [(1+q)t\lambda]^{-1} \cdot \ln(1 + [(1-p)(1+q)t(H-L)\lambda]/(pq)). \tag{7A}$$

The comparative statics properties of R^{**} are now investigated. Note that (7A) can be rewritten as:

$$R^{**} = H - [(1+q)t\lambda]^{-1} \cdot \ln(1 + (1/p-1)(1/q + 1)t(H-L)\lambda). \tag{8A}$$

The effect of an increase in the audit probability (p) is obtained by differentiating (8A) using the chain rule:

$$\partial R^{**}/\partial p = -[(1+q)t\lambda]^{-1} \cdot [1+(1/p-1)(1/q+1)t(H-L)\lambda]^{-1}$$

$$\cdot (-1/p^2 (1/q+1)t(H-L)\lambda) > 0. \tag{9A}$$

Similarly, (8A) can be differentiated with respect to q to determine the effect of increasing the penalty rate:

$$\partial R^{**}/\partial q - 1/((1+q)^2 t\lambda) \cdot \ln\{1 + (1/p-1)(1/q+1)t(H-L)\lambda\}$$

$$- [(1+q)t\lambda]^{-1} \cdot [1+(1/p-1)(1/q+1)t(H-L)\lambda]^{-1} \cdot$$

$$\{-(1/p-1)(1/q^2)t(H-L)\lambda\} > 0. \tag{10A}$$

The tax rate effect can be obtained by differentiating (8A) with respect to t:

$$\partial R^{**}/\partial t - 1/[(1+q)\lambda t^2] \cdot \ln\{1+(1/p-1)(1/q+1)t(H-L)\lambda\}$$

$$- [(1+q)t\lambda]^{-1} \cdot \{1/[1+(1/p-1)(1/q+1)t(H-L)\lambda]\} \cdot$$

$$\{(1/p-1)(1/q+1)(H-L)\lambda\}. \tag{11A}$$

Letting $\beta \equiv \{1+(1/p-1)(1/q+1)t(H-L)\lambda\}$, (11A) is rewritten as

$$\partial R^{**}/\partial t - 1/[(1+q)\lambda t^2] \cdot [\ln\beta - (1-1/\beta)] \tag{12A}$$

Denoting the bracketed terms by T,

$$\frac{\partial T}{\partial t} - (\beta-1)/\beta^2 \cdot \frac{\partial \beta}{\partial t} > 0, \tag{13A}$$

since $\beta > 1$ and $\partial\beta/\partial t - (1/p-1)(1/q+1)(H-L)\lambda > 0$.

Note also that T=0 when t=o.

It thus follows from the latter and (13A) that

$$T>0 \text{ for all } t>o. \tag{14A}$$

Since $T>0$ and $(1+q)\lambda t^2>0$, it must be that $\partial R^{**}/\partial t>0$.

The effects of taxpayer uncertainty about the tax liability can be modelled by perturbing the support of the taxable income distribution so that x is uniformly distributed over the interval $[L-\Delta, H+\Delta]$, where Δ denotes the perturbation parameter. Substituting $L-\Delta$ for L and $H+\Delta$ for H into (8A) we obtain the following first-order condition corresponding to the perturbed income distribution:

$$R^{***} - (H+\Delta) - [(1+q)t\lambda]^{-1} \ln\{1+(1/p-1)(1/q+1)t(H-L+2\Delta)\lambda\}. \tag{15A}$$

The effects of increases in the level of uncertainty (range of taxable income values) can be determined by differentiating (15A) partially with respect to Δ:

$$\partial R^{***}/\partial\Delta = 1 - [(1+q)t\lambda]^{-1} \{1/[1+(1/p)(1/q+1)t(H-L+2\Delta)\lambda]\} \cdot$$

$$\{2(1/p)(1/q+1)t\lambda\}. \tag{16A}$$

$$= 1 - 2(1-p)/[pq+(1-p)\lambda(1+q)t(H-L)]. \tag{17A}$$

$$= \frac{pq + (1-p)[\lambda(1+q)t(H-L) - 2]}{pq + (1-p)\lambda(1+q)t(H-L)}. \tag{18A}$$

Note that a sufficient condition for the right hand side of (18A) and $\partial R^{***}/\partial\Delta > 0$ is that:

$$\lambda > 1/(1+q)t(H-L). \tag{19A}$$

APPENDIX B:
INSTRUCTIONS TO SUBJECTS

This is an experiment in the economics of decision making. Various research
foundations have provided funds for this experiment. The instructions are
simple, and if you follow them carefully and make good decisions you may earn
a CONSIDERABLE AMOUNT OF MONEY which will be distributed to you in cash at the
end of the experiment.

Introduction to Outcomes

Before we introduce you to the task you will be asked to perform in the
experiment, we will spend some time describing certain tools that will be used
during the experiment. Specifically, you will need to become familiar with
the operation of bingo cages and dice.

       To demonstrate how the bingo cage is operated, we will begin with a cage
with 50 balls in it, numbered one through fifty-one. Based on the number of
the ball drawn from the cage, one of two results will occur: either outcome X
or outcome Y. Your task is to correctly predict the result of each draw
before we announce it. If your prediction is correct, you win $.20; if wrong,
you lose $.15. Before the first draw, record your prediction by circling
either X or Y in the first row of the Outcome Prediction Form. After you have
circled one letter, the outcome will be announced and you should record the
announced outcome in the blank space in the same row of the prediction sheet.
If your prediction is correct, circle the amount shown in the Win column.
Otherwise circle the amount shown in the Lose column.

       Once you have recorded your prediction, no changes will be permitted;
any erasure will invalidate your prediction. At the end, add up your total
winnings and losses and record the difference (net winnings or losses) at the
bottom right corner of the sheet. Your winnings will be paid to you IN CASH
at the end of the experiment. If you lose money, the losses will reduce the
CASH you are paid at the end of the experiment.

       The chances of state X and Y occurring will change from time to time
throughout this part of the experiment. We will tell you each time the X and
Y states are to change. The various definitions of X and Y are described
below:

1) If the ball drawn is numbered one through twenty, the outcome of the draw
is called X; if a ball numbered twenty-one through fifty-one is drawn, the
outcome of the draw is called Y.

2) If the ball drawn is numbered one through ten, the outcome of the draw is
called X; if a ball numbered eleven through fifty-one is drawn, the outcome of
the draw is called Y.

3) If the ball drawn is numbered one through thirty, the outcome of the draw is called X; if a ball numbered thirty-one through fifty-one is drawn, the outcome of the draw is called Y.

4) If the ball drawn is numbered one through forty, the outcome of the draw is called X; if a ball numbered forty-one through fifty-one is drawn, the outcome of the draw is called Y.

STOP READING NOW AND RAISE YOUR HAND TO INDICATE THAT YOU ARE READY TO BEGIN THE PREDICTION TASK.

Now that we have gone through the four possible definitions of X and Y outcomes using the bingo cage, described above, we will switch from the bingo cage to using dice. In the dice cup at the front of the room, there are three ten-sided dice. The first die is white, the second is red, and the third is black. We will use these dice to determine outcome X and Y in the same way we used the bingo cage. That is, the occurrence of outcome X and Y depend on what number comes up. When we throw the dice, the white die will represent the first digit of the number, the red die will represent the second digit, and the black die will represent the third digit. These three numbers together make up a single number from 000 to 999. So, for example, if on one throw, the white die is 4, the red die is 9, and the black die is 1, the resulting number is 491. You are required to circle predictions, enter outcomes, etc., just like you did when we used the bingo cage. The various definitions of outcome X and Y are shown below:

1) If the number rolled is 000 through 300, the outcome of the draw is called X; if the number rolled is 301 through 999, the outcome of the draw is called Y.

2) If the number rolled is 000 through 600, the outcome of the draw is called X; if the number rolled is 601 through 999, the outcome of the draw is called Y.

STOP READING NOW AND RAISE YOUR HAND TO INDICATE THAT YOU ARE READY TO CONTINUE WITH THE PREDICTION TASK.

Now that you are familiar with the operation of the bingo cage and the dice, we will move on to a discussion of the actual experimental task that you will be asked to perform and, most important, how you can earn CASH during the remainder of the experiment.

Winning Money:

As a participant in this study, you will have MANY opportunities to win $1.00 prizes. Whether or not you win a particular $1.00 prize is decided by a roll of the dice and your earnings during each trial in the experiment. If the number rolled is LESS THAN OR EQUAL TO your earnings, then you will receive $1.00. If the number rolled is GREATER THAN your earnings, then you will receive nothing. Note that the more experimental currency (called "FRANCS") you earn in each trial of the experiment, the better your chances for winning a cash prize.

For example, suppose you earned 250 Francs. Then, if any number between 000 and 250 were rolled with the dice, you will win $1. If the number rolled is between 251 and 999, then you win nothing. Likewise, if you were to earn more Francs, say 990, you could win $1 with any roll between 0 and 990. You would receive nothing only if the number rolled was between 990 and 999.

How Francs are earned:

At the beginning of each trial in the experiment, you will be given an endowment of 1000 Francs (1000F). During each trial, you will be required to pay some portion of the endowment to the Supervisor. The amount you are required to pay will depend on the decisions you make during the trial. Remember, the Francs you have at the end of each trial are determine your chances of winning a cash prize as described above. Thus, the more Francs you have at the end of a trial (i.e., the less you pay to the Supervisor), the better your chances of winning CASH rewards.

The amount of Francs that you are required to pay to the Supervisor during each trial depends upon several factors. First, a portion of the 1000F endowment will be subject to a surcharge. You will not know the exact amount subject to the surcharge. Instead, you will be provided with a range of earnings on which the surcharge may be assessed.

For example, let's assume that you are told that the exact amount (called Z) subject to the surcharge lies within the range 100F to 200F. Your task will be to decide how many Francs to report (called R). This amount must be within the range specified (100 to 200 Francs). Suppose you decided to report 150F (for R). You would enter 150F on the Report Form (several of these are in your folder) and give the Report Form to the Supervisor. Further assume for illustration that the surcharge rate is 20% and the penalty rate (discussed later) is 50%. This information is summarized below:

Range of Francs subject to surcharge: 100F to 200F
Surcharge Rate: 20%
Penalty Rate: 50%
Francs that You have Reported (R):   150F
Bingo Cage (True) Earnings subject
            to Surcharge (Z):   Not Yet Known

Once you have given your report of 150F to the Supervisor, you will go to the investigation area (behind the screen) where a grey die is used to determine whether or not your report will be examined. Depending on the outcome of the investigation, one of three events can occur. Each event has a different effect on the number of Francs you have left to use in the roll for a cash prize.

Event 1: Your report is not selected for investigation. Then, you would pay a surcharge to the monitor of 20% on the 150F that you reported, or 30F. This would leave you with a net profit of 1000F less a 30F surcharge or 970F to be used on the prize wheel.

In events 2 and 3, your report is selected for investigation. When your report is selected for investigation, the exact value subject to surcharge (Z) is determined by drawing a ball out of a bingo cage. The number on the ball will be used to determine the exact value subject to surcharge. Each of the balls in the bingo cage represents a value in the range of possible values, in 10F intervals. Thus, in our example, there would be 11 balls, Ball #1 for 100F, Ball #2 for 110F, Ball #3 for 120F, etc., all the way to Ball #11, representing 200F. Note that, in the investigation, each value has an equal chance of occurring.

Event 2: Your report is selected for investigation and your reported value (R) is greater than or equal to the exact value drawn from the bingo cage (Z). Let's assume for illustration that the exact value determined by the bingo cage is 100F. Then you would pay a surcharge to the monitor of 20% of the exact value of 100F or 20F. Note that the reported value that you chose (R = 150F) has no effect on the surcharge in this case. This would leave you with a net profit of 1000F less a 20F surcharge or 980 Francs to·be used in the roll for a cash prize. Summarizing, when your reported value, R, is greater than or equal to the bingo cage value, Z, you pay a surcharge on exact bingo cage value (Z), determined by the bingo cage, instead of your reported value (R).

Event 3: Your report is selected for investigation and your reported value (R) is less than the exact value drawn from the bingo cage (Z). Let's assume for illustration that the exact value determined by the bingo cage is 200F. Then you would pay a surcharge of 20% of the outcome Z (200F) or 40F. In addition, since you understated your earnings subject to the surcharge (i.e., your reported earnings were less than the exact earnings subject to surcharge), you would be required to pay a penalty computed as follows:

Surcharge on Z (200F):	.20 x 200F = 40F	
Less: Surcharge on R (150F):	.20 x 150F = 30F	
Additional surcharge due to		
investigation		10F
Times: penalty rate (assume 50%)		x.5
PENALTY		5F

Thus, you would pay a 40F surcharge plus a 5F penalty, or 45F. Subtracting this from the 1000F that you earned, you would be left with 955F to be used on the prize wheel.

Take special note that a penalty is assessed in addition to the regular surcharge when the earnings that you report (R) is less than the exact earnings determined by the bingo cage (Z). The penalty is a fixed percentage of the difference in surcharges due using R and Z as bases.

STOP HERE AND RAISE YOUR HAND TO INDICATE TO THE EXPERIMENTER THAT YOU ARE READY FOR A DEMONSTRATION OF THE Investigation PROCESS. DO NOT CONTINUE READING UNTIL INSTRUCTED TO DO SO.

Step by Step Instructions:

At the beginning of each trial in the experiment, you will be given a 1000F endowment. Next, you will be asked to report the endowment subject to a surcharge (R) by preparing a Report Form. After completing your report, you will go to the investigation area where the investigation die is thrown to determine whether or not your report is to be examined. If your report is examined, a ball will be drawn from the bingo cage to determine the exact value subject to a surcharge (Z). The experimenter will enter this information on your report form. After the investigation procedure, you will be required to complete the computation on the Report Form. If no investigation is made, you will pay a surcharge based on your report (R). If there is an investigation, you will pay a surcharge on the bingo cage value (Z). In addition, you will pay a penalty if the bingo cage value (Z) is greater than your report (R). Note that the larger the difference between your report and the bingo cage value, the greater the penalty. After the investigation, you must complete the computations required on the Report Form. When the computations are complete, you will proceed to the prize area where your computations will be checked by computer. Next, dice will be thrown to determine your CASH payoff. Any number thrown that is less than or equal to your final earnings will provide a $1 prize. The prize monitor will then make note of the outcome on your earnings record. At the end of the experiment, your winnings will be paid to you in CASH.

Note that during the experiment the range of possible values subject to the surcharge will be changed from time to time. In addition, the surcharge rate will also be subject to change during the experiment.

This is the end of the instructions. Please reread any part of the instructions again if you feel it is necessary. Make certain that you understand the instructions and are prepared to proceed with the actual experiment. If you do not thoroughly understand the instructions, your cash earnings may suffer. When you have finished the instructions, complete the attached quiz and give it to the monitor for grading. After everyone has successfully completed the quiz, the experiment will begin. If you have a question that you feel was not adequately answered by the instructions or if you are confused about the task that you will be asked to perform, please ask the experimenter before proceeding with the quiz! AGAIN, YOUR EARNINGS MAY SUFFER IF YOU PROCEED WITH THE EXPERIMENT WITHOUT COMPLETELY UNDERSTANDING THE INSTRUCTIONS!!!

IMPORTANT!!!: WHEN THE EXPERIMENT BEGINS, YOU MUST NOT DISCUSS ANYTHING ABOUT THE EXPERIMENT WITH OTHER SUBJECTS IN THE ROOM! IT IS ESSENTIAL THAT ALL INFORMATION ABOUT YOUR EARNINGS, YOUR REPORTED INCOME, AND THE STRATEGIES THAT YOU HAVE SELECTED ARE NOT SHARED WITH OTHER SUBJECTS. ALL INFORMATION IS PRIVATE! IF IT IS DISCOVERED THAT SUBJECTS ARE SHARING THIS INFORMATION, THE EXPERIMENT WILL BE CANCELLED, AND YOU WILL LOSE THE CHANCE TO MAKE SUBSTANTIAL AMOUNTS OF MONEY.