Culpability and Willingness to Pay to Reduce Negative Externalities: A Contingent Valuation and Experimental Economics Study

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Selected Paper prepared for presentation at the Agricultural & Applied Economics Association 2010 AAEA, CAES, & WAEA Joint Annual Meeting, Denver, Colorado, July 25-27, 2010

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In parallel contingent valuation and laboratory experiments this paper demonstrates that culpability - defined as the amount of social damage resulting from an individual's actions – has a positive influence on willingness to pay to reduce negative externalities. The nation-wide, web-based CV study estimated a respondent's carbon footprint and provided information about the carbon footprints of peers. In the laboratory experiment student subject purchase "private commodities" (analogous to electricity) that generate a negative public externality (analogous to pollution) for a group in which they are a member. The subjects are subsequently given an opportunity to contribute to a fund that would reduce the negative harm created by the externality.

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I. Introduction:

In the last decade, economists have used stated preference surveys to elicit willingness to pay (WTP) values for policies that reduce the impact of greenhouse gasses (Layton and Brown, 2000; Berrens et al., 2004; Cameron, 2005; Viscusi and Zeckhauser, 2006; Cameron and Gerdes, 2007). Reflecting the substantial market for voluntary carbon offsets, estimated recently to be in excess of $236 million and doubling annually (World Bank 2008; New Carbon Finance 2009), other research has been directed toward assessing willingness to purchase voluntary carbon offsets (Brouwer et al., 2009; MacKerron et al., 2009).

With the exception of Brouwer et al. (2009), a notable omission in this body of research from a psychological/behavioral economics perspective has been the relationship between individual WTP and perceived culpability with respect to greenhouse gas emissions. By perceived culpability we mean the amount of social damage resulting from an individual's actions. In a test of the "passenger pays principle", Brouwer et al. (2009) found that air travelers' perceived responsibility for climate change, awareness of the environmental impact of flying, and the frequency of flying were all positively correlated with WTP for a per-flight carbon offset program. This notion of personal responsibility in creating public harm is an extension of what Kahneman et al. (1993) refer to as an "outrage effect", in which people are willing to pay more to avoid an environmental problem if they

think it is human-caused than if they think that it is an outcome of nature (Bulte et al., 2003). Kahneman et al. (1993) and Brown et al. (2002), amongst others, have demonstrated this "outrage effect" on CV responses.

Notions of personal responsibility have also played a role in psychological research on actual choices with respect to the environment. Building on the well known "Cialdini Effect", Schultz et al. (2007) and Ayers et al. (2009) have demonstrated that monitoring energy consumption and informing individuals of their personal levels of consumption relative to neighborhood norm could provide an incentive for above-average households to reduce energy consumption. This we refer to as a *within commodity* effect: impacts on purchases of good X are affected by information about peers' consumption of good X. Other recent research has explored a *cross commodity* effect of green purchases (X) on other behaviors (Y): for example, a study by Mazur and Zhong (2009) reports that allowing people to purchase green household goods instead of non-green household goods, makes them more likely to cheat on a test.

In this research we build upon and extend these ideas by exploring how WTP to prevent a public bad is affected by perceived personal culpability - defined as the amount of social damage resulting from an individual's actions - in a controlled set of experiments. We find that information about perceived personal culpability does affect individual WTP, however, only when the information is provided relative to the social damages caused by others. Specifically, telling a subject that they are more culpable than somebody else does increase WTP, whereas manipulating a subject's sense of culpability absent information about others has mixed effects across experiments. These culpability effects are not only

important from the perspective of better understanding psychological factors underlying actual contributions and contingent values, but also have practical policy import.

To explore the role of culpability in willingness to pay for prevent environmental harm, we use both web-based contingent valuation (CV) and real-money laboratory experiments. The contingent valuation study asks consumers to calculate their energy consumption and carbon dioxide emissions from energy consumption, and then elicits willingness to purchase green electricity as a means to offset carbon emissions. In an effort to parallel the field contingent valuation study, the laboratory experiment has student subject purchase "private commodities" (analogous to electricity) that generate a negative public externality (analogous to pollution) for a group in which they are a member. The subjects are subsequently given an opportunity to contribute to a fund that would reduce the negative harm created by the externality.

The remainder of the paper is organized as follows. In the following two sections we present the experimental design of the contingent valuation and the laboratory experiments, respectively. The results for both studies are presented in Section IV, and the final section concludes.

II. Culpability and Willingness to Pay For Carbon Offsets: The CV study.

The broad objective of the contingent valuation (CV) survey was to gather information from participants that allowed us to calculate a carbon footprint for each respondent and then elicit their willingness to pay for a green electricity program given information about their own carbon footprint and, in some treatments, their carbon footprint relative to those of another survey participant. Participants for the online hypothetical survey were recruited

through The StudyResponse Project, a nationwide panel of 95,574 people. Participants were chosen at random and emailed the URL for the survey. For completing the survey, participants received $5. 520 panelists were invited to participate, and we received 420 completed surveys for an 81% response rate.

There were four steps in the survey: I) Eliciting demographic questions to calculate the subject's carbon footprint; II) Providing information about International Panel on Climate Change (IPCC) predictions on the impacts of climate change; III) Showing Subjects their estimated annual carbon footprint based on the input they provided; and IV) Eliciting individual demand for green electricity. For the control treatment, subjects were not provided any information about the carbon footprint of others. All other subjects received information about the carbon footprint of "Others like you who took this survey".

In the spirit of Cameron (2005), Part I consisted of several web pages eliciting information about energy use, including housing characteristics (type, age, size of residence, and location), home energy use (monthly electric and gas bill expenditures, type of fuel used to heat house, whether the household generates or purchases electricity); automobiles (number, models, use of each vehicle) and transportation choices (use of public transportation, frequency of short and long domestic flights, frequency of international flights). Subjects were also asked about whether they purchased carbon offsets and if so, how many had they purchased. Only 31 subjects reported having purchased carbon offsets.

Subsequent to reporting the above information, subjects were provided with three IPCC climate policy scenarios (business as usual, small emissions reductions and high emissions reductions) and their anticipated consequences as presented below in Box 1.

The purpose of this screen was two-fold. First, we wanted to make respondents aware of current climate projections and relative policy options. To a certain extent, this information also served to induce an element of moral outrage for those concerned about climate change.

In Part III, respondents were provided with an estimate of the carbon generated from their use of utilities and transportation and, after accounting for offset purchases, their estimated carbon footprint ("the total amount of climate changing greenhouse gas emissions caused directly and indirectly by your household") in tons of carbon per year.

Box 1: IPCC Climate Options

The IPCC has presented several options for reducing climate change, each with different final levels of carbon and impacts on the global climate:

	Business as Usual	Small Emissions Reductions	Aggressive Emissions Reductions
Mean Percent change in Carbon Emissions from 2000 to 2050	115% Increase	55% Increase	70% Decrease
Global Average Temperatures Increases	8.8-11 degrees (4.9-6.1 degrees Celsius)	7.2-8.8 degrees Fahrenheit (4-4.9 degrees Celsius)	3.6-4.3 degrees Fahrenheit (2-2.4 degrees Celsius)
Sea Level Increases	12-24 inches (0.3 - 0.6 meters) Millions at risk of coastal flooding	10-24 inches (0.26 - 0.6 meters) Millions at risk of coastal flooding.	Less than 17 inches (0.45 meters)
Extinction Risk	More than 40% of species face some risk	More than 40% of species face some risk	30% of species face some risk
Crops and Famine	Crop productivity is expected to decrease. Global food production is expected to decrease, causing an increased risk of famine.	Crop productivity is expected to decrease. Global food production is expected to decrease, causing an increased risk of famine.	Crop productivity may increase in some regions and decrease in others. Increased risk of famine in some areas.
Other effects	Increase in intensity and frequency of heat waves. Increased range for tropical diseases. Together, these will cause death and sickness, placing a substantial burden on health services.	Increase in intensity and frequency of heat waves. Increased range for tropical diseases. Together, these will cause death and sickness, placing a substantial burden on health services.	Increase in intensity and frequency of heat waves.

Carbon footprints were calculated using two algorithms. If participants knew their electricity and heating expenditures, information about average electricity and fuel prices in each state were used to determine annual consumption of electricity and fuel. (If participants knew their fuel expenditures but not their fuel source for heating, a weighted average of all fuel sources for the state was used.) Annual consumption of electricity was then converted into CO2 emissions using the average CO2 intensity for each state. Fuel consumption was converted into CO2 emissions using information about CO2 intensity for each fuel type. If participants did not know their electricity and heating expenditures, we gathered information about their housing structure and compared it to information about average energy consumption for houses of similar age, type and size in their state, which was then used to calculate CO2 emissions as above. Information about fuel prices, generation mix and average household energy consumption was obtained from the Energy Information Administration of the Department of Energy.

Information about participants' cars and miles driven was directly computed based on combined city/highway fuel economy information from the EPA for every make, model and year of car from 1983 to 2009. For air travel, short flights were assumed to be 100 miles each way, long flights 750 miles, and international flights 4,250 miles. Carbon offsets reduced the carbon footprint by 168 pounds for every dollar spent, equivalent to prevailing rates at popular commercial carbon offset retailers.

Median estimated carbon emissions for the sample were 17.9 tons per household per year. For subjects in the control group, no other information was provided. Individuals in the treatment groups were informed that "Others like you who took this survey in the past had a carbon footprint of xx tons per year" and whether their contribution was MORE

or LESS than this individual. The "xx" value was randomly assigned to be high (26 tons) or low (11 tons), where 26 and 11 tons correspond to the 75^{th} and 25^{th} percentiles of the carbon footprint distribution in a pre-test. For example, a subject with an estimated carbon footprint of 18 tons and was assigned to the "See Low" group would be told that "Others like you who took this survey in the past had a carbon footprint of 11 tons per year" and that "Your contribution to global warming is MORE than this average." Similarly, a like individual who was assigned to the "See High" treatment was "Others like you who took this survey in the past had a carbon footprint of 26 tons per year" and that "Your contribution to global warming is LESS than this average." As will be discussed below, the difference between the subject's carbon footprint and the value associated with the reference individual provided a measure of relative culpability.

Given this information contingent values were elicited using a modification of a green electricity payment card used in Champ and Bishop (2001, 2006) in which individuals were given opportunities to buy blocks of energy measured in kilowatt hours. As shown in Box 2 each block had a corresponding monthly and annual cost and estimated annual tons of CO2 averted based on information available from the Energy Information Agency of the Department of Energy.

In Part IV, debriefing and demographic questions were asked, along with ten questions designed to measure environmental concern drawn from the New Environmental Paradigm (NEP) scale (Dunlap and Van Liere, 1978; Dunlap et al. 2000). This scale is widely used in the psychology and sociology literature to characterize an individual's environmental concern based on how the extent to which they agree or disagree with various statements of environmental concern:

> "limits to growth, anthropocentrism, the fragility of the balance of nature, rejection of the idea that humans are exempt from the constraints of nature, and the possibility of an eco-crisis or ecological catastrophe. The response categories range between 1 and 5 so that high scores correspond to a stronger pro-environmental attitude than low scores (with the ordering reversed for the statements that reject the NEP-paradigm)" (Ek and Söderholm, 2008, p. 175)

Past studies of willingness to pay for green electricity have found the aggregated values across a series of NEP questions to be a significant explanatory variable (Kotchen and Moore, 2007; Ek and Söderholm, 2008).

Box 2: The Green Electricity Contingent Valuation Question

Suppose your electric utility were to offer you renewable energy appropriate to your area. For example, wind, solar, geothermal, or tidal power could all be offered, depending on your geographical location. Choose the option that you would like to purchase from the table below. (Information from the Energy Information Agency of the Department of Energy)

	Size of Block	Extra Cost per Month	Extra Cost per Year	Tons of CO2 Averted per Year
◎	0 kilowatt hours	$0.00	$0.00	0 tons
◎	50 kilowatt hours	$2.80	$33.60	0.405 tons
◎	100 kilowatt hours	$5.60	$67.20	0.81 tons
◎	200 kilowatt hours	$11.20	$134.40	1.62 tons
◎	300 kilowatt hours	$16.80	$201.60	2.43 tons
◎	400 kilowatt hours	$22.40	$268.80	3.24 tons
◎	500 kilowatt hours	$28.00	$336.00	4.05 tons
◎	600 kilowatt hours	$33.60	$403.20	4.86 tons

Submit

II. Culpability and WTP to Reduce Negative Externalities: Lab Experiment

We endeavored to develop a parallel experimental economics laboratory in which subjects purchase "private commodities" (analogous to electricity) that generate a negative public externality (analogous to pollution) for a group in which they are a member. The subjects are subsequently given an opportunity to contribute to a fund that would reduce the negative harm created by the externality, akin, we believe to the opportunity to purchase green electricity. The added benefit of the lab design is that we can experimentally vary the level of consumer demand.

Subjects (n=240) were recruited from a variety of undergraduate business and economics courses at Cornell University. Pen and paper experimental sessions were conducted in the Laboratory for Experimental Economics and Decision Research in cohorts ranging in size from 10 to 20. A session lasted approximately 45 minutes and average earnings were $14.41.

Subjects were randomly assigned into groups of five anonymous participants including themselves. Adapting Plott's (1983) seminal externality experiments, each individual was given a balance of $9 at the beginning of each of five rounds and a per-unit value (demand) function for a commodity that could be purchased at a cost of $1 (experimental dollars were converted to real dollars at a rate of $15 experimental = $1 real.) Subjects in each group were randomly assigned into high, medium and low demands and the choices offered to individuals were presented as in Box 3 below.

In addition to private return for each commodity unit purchased, subjects were informed that each unit purchased would impose a negative externality on the entire group,

> *Your group also shares a GROUP FUND. This group fund began with 300 experimental dollars, and at the end of the experiment, any dollars in this*

group fund will be divided equally between all members of the group. Your actions and the actions of other people in your group in Round 1 may have reduced the total amount of dollars remaining in the group fund.

In Round 2, every unit of the commodity that you purchase decreases the number of experimental dollars in the group fund by 1.25. (Because there are five people in your group, every unit of the commodity that you purchase reduces the amount in the group fund by 0.25 dollars per person. Likewise, every unit of the commodity purchased by everyone else in the group reduces the amount in the group fund by 1.25 dollars and therefore costs everyone else 0.25 dollars.)

Hence, the optimal private decision would be to purchase only those commodities with a value of $1.25 or higher. After accounting for the "external" impact of their own consumption on themselves, subjects with low, medium and high demands were expected to buy 15, 25, and 35 commodity units respectively. Examples were worked through with the entire session on a whiteboard at the front of the lab, and after each decision, subjects were asked to calculate and report their own private returns and the impacts of their private decisions on other members of the group.

Box 3: Sample High Demand Function and Choice Setting

Units of Commodity	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Value of the unit	2.20	2.05	1.90	1.75	1.60	1.45	1.25	1.15	1.00
Cost of the unit	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Subjects were asked to sum their commodity purchases over the first five rounds and write this number down on a "passing sheet" which was submitted (sent) to the experimental moderator. Following a design in which "sending" subjects and "receiving" subjects were matched using a random number generator the experimental moderator passed these sheets to the assigned receiving subject. Each receiving subject was asked to record their own total purchases and the amount of total purchases that they saw on the sheet that was sent/passed to them. A total of 75 subjects were sent values higher than their own value, 75 received values lower than their own value, and 90 senders received their own passing sheet.

In the sixth round of the experiment, subjects were informed that "Based on the purchase decisions in the first 5 rounds made by you and others in your group, the total amount of dollars in the group fund has declined" (See instructions in the Appendix). Once again each subject was endowed with $9. However, in this round individuals participated in a standard public goods contributions game in which each dollar contributed was multiplied by 1.25 and distributed equally across all members of the group.

Following this last round individuals were asked a series of debriefing questions and the same NEP questions used in the CV field experiment.

IV. Econometric Modeling CV and Laboratory Responses.

In this section we provide preliminary regression results for parsimonious models of both the CV and laboratory experiments. As of the date of this conference draft, the robustness of these results have yet to be adequately evaluated.

In modeling the responses to the CV experiment, the dependent variable was kilowatt hours purchased. The sample was split into two groups: a "Treatment" group in which the subjects were informed about the carbon footprints of "Others like [them] who took this survey in the past" and a "Control" group in which no such relative information was provided. For the treatment group, we constructed a relative culpability variable (Own minus Saw) measuring the difference between the subject's carbon and the "other" carbon footprint he/she was shown. In the least squares regression we also included the subject's own carbon footprint, which we provide as a measure of absolute culpability, and the NEP scale response summed over the 10 Likert scale NEP questions. As shown in the regression resulting in Table 1, the coefficient for the absolute measure of culpability (Carbon Footprint) is not significant, but both the coefficients for Relative Culpability (Own minus Saw) and the NEP scale were significant and of the expected sign. The difference in significance between the absolute and relative culpability measures suggests that simply providing individuals about absolute measure of contributions does not lead to differential willingness to purchase green electricity offsets. However, contributions appear to be affected by how much of the negative externality individual's contribute relative to

others. This latter result is depicted in Figure 1, along with average green electricity purchases of the control group.

Response patterns differed somewhat in the laboratory experiment. Here contributions to reduce the public bad were initially modeled as a function of the subject's own total commodity purchases over the first five rounds (Own Purchases), the NEP scale and a measure of the difference between their expected purchases, given their value function, and the amount of purchases reported on the passing sheet that they received. In creating this later variable (E(Own) minus Saw) we used expected own purchases rather than actual own purchases to avoid endogeneity. In creating the data set used in Table 2, we excluded economics students (17% of sample), who have been shown in numerous other experiments to free ride and/or otherwise be unresponsive to framing effects, and those who were clearly irrational (20%), i.e. they chose consumption levels that had both negative private returns and negative social returns.

As shown in the second data column of Table 2, the coefficient on Own Purchases was significant and positive, suggesting that in the laboratory experiement the level of private purchase decisions raised culpability and willingness to pay. The E(own) minus Saw and NEP coefficients were, however, not significant. The latter result is not unexpected as the experiment was context-free, and environmental motives are not anticipated to be a strong, independent factor in willingness to contribute funds to a group investment fund. Hence, following on Rose et al. (2002) we added a motive (altruistic) variable from part 1b in the following Likert scale questions

> *On a scale from 1 to 7, where 1 is not important and 7 is extremely important, how important were the following in your decisions in this experiment?*
>
> *1a) I wanted to make as much money as I could for myself (Circle one number)*

1 2 3 4 5 6 7

Not Important Extremely Important

1b) I wanted the group to make as much money as possible (Circle one number)

1 2 3 4 5 6 7

Not Important Extremely Important

As reported in the last column of Table 2, with the addition of this covariate, the coefficients for both E(Own) minus Saw and NEP are significant, as is the coefficient for Altruism. Figure 2 depicts the responsiveness of contributions to E(own) minus Saw along with the average contributions of the control group)

Taken together these two experiments suggest that information about relative culpability does affect hypothetical and actual contributions to public goods. The impact of absolute culpability is mixed: it was not significant in the CV study but was a significant explanatory variable in the laboratory experiment.

Table 1: WTP Regressions CV Study

Variable	Mean Value (s.e.)	Estimated Coefficient (s.e.)
Constant		-110.07 (51.39)
Own Carbon Footprint [Absolute Culpability]	19.67 (0.96)	1.22 (0.85)
Own minus Saw [Relative Culpability]	0.13 (0.60)	2.68 (0.39)**
NEP	34.87 (0.45)	7.67 (0.67)***
n		270
R-squared		0.12

Notes: ** and *** indicate 5% and 1% levels of significance respectively. Robust standard errors grouped by treatment group (saw low, saw high)

Table 2: Contributions Regressions, Lab Experiment

Variable	Mean Value (s.e.)	Estimated Coefficient (s.e.)	Estimated Coefficient (s.e.)
Constant		3.73 (1.17)*	-0.43 (0.82)
Own Carbon Footprint [Absolute Culpability]	18.53 (0.82)	0.040 (0.010)*	0.115 (0.024)**
E(Own) minus Saw [Relative Culpability]	5.38 (1.46)	0.0099 (0.0064)	0.157 (0.004)*
NEP	23.51 (0.55)	-0.079 (0.039)	-0.117 (-3.09)*
Altruism	3.99 (0.17)		0.908 (0.123)**
n		100	100
R-squared		0.03	0.25

Notes: *, ** and *** indicate 10%, 5% and 1% levels of significance respectively. Robust standard errors grouped by demand category (low, medium, high)

Figure 1. Contingent Valuation Survey Green Electricity Purchased =f(Culpability: Est. CO2, NEP)

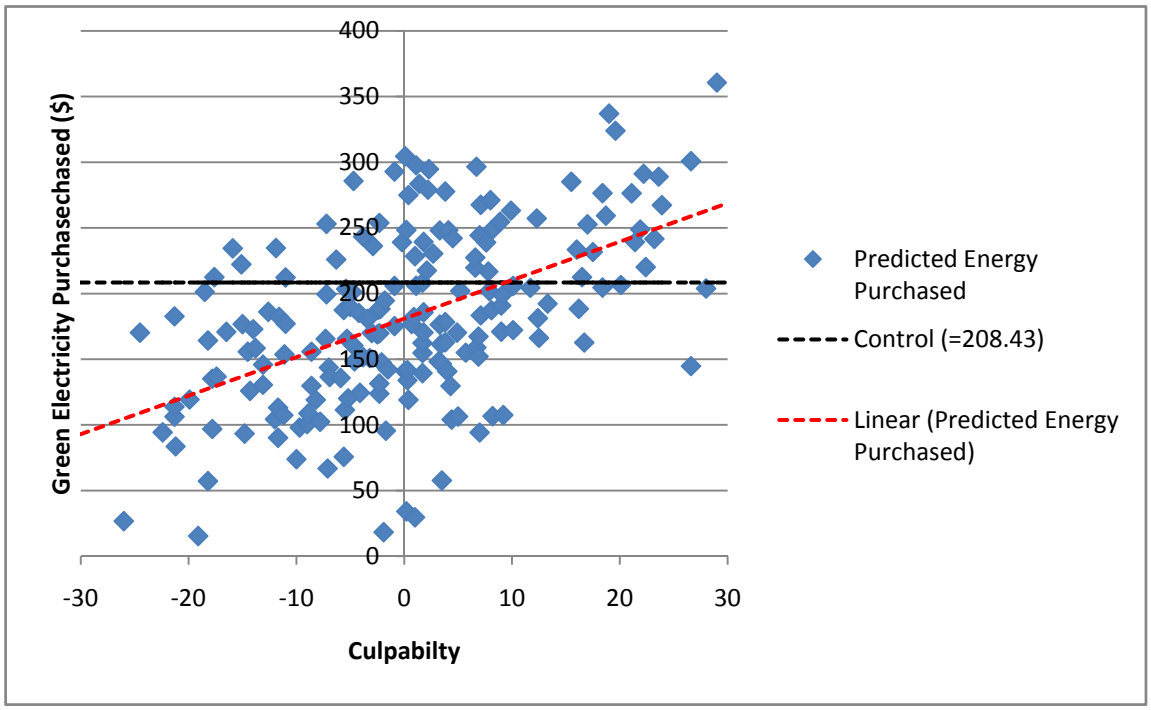
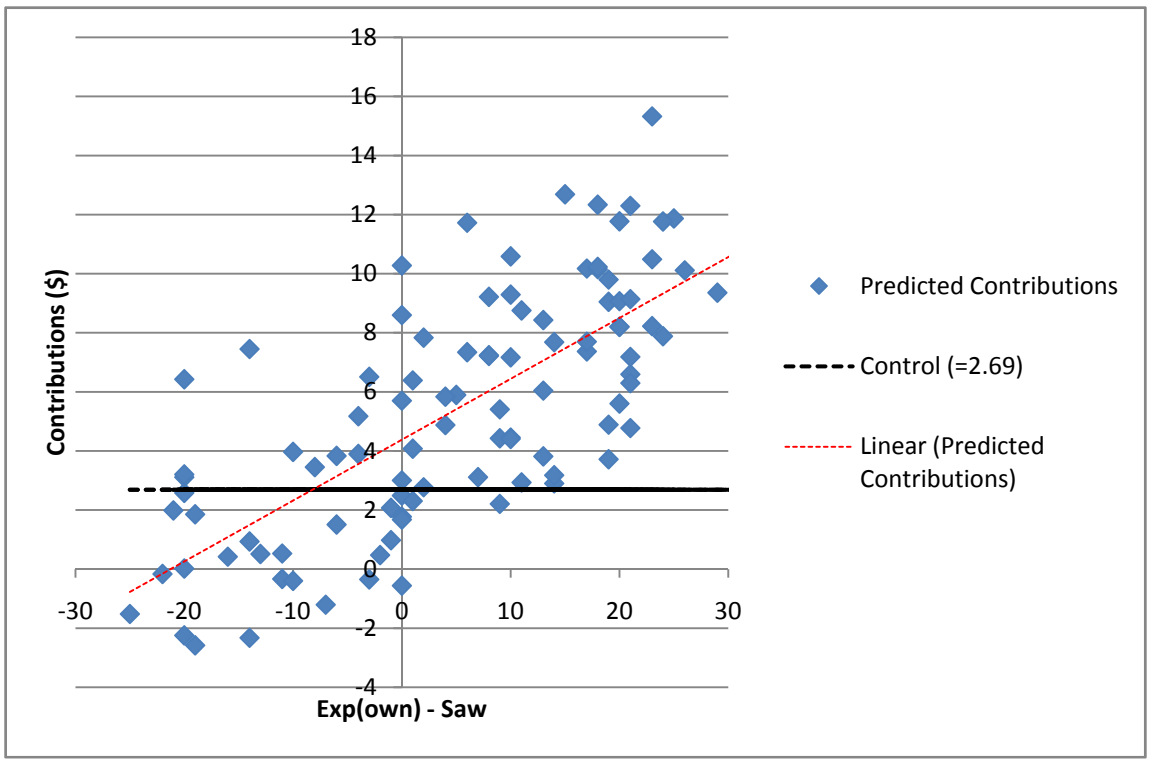


Figure 2: Experimental Laboratory Study: Contributions = f(Culpability: E(own)-Saw, Altruism, NEP)



References:

Ayers, I, S. Raseman, A. Shih. 2009. Evidence from Two Large Field Experiments that Peer Comparison Feedback Can Reduce Residential Energy Usage. *NBER Working Paper*

Berrens, R.P., A.K. Bohara, H.C. Jenkins-Smith, C.L. Silva, and D.L. Weimer, 2004. Information and Effort in Contingent Valuation Surveys: Application to Global Climate Change Using National Internet Samples. *Journal of Environmental Economics* 47:331-363.

Brouwer, R., L Brander, and P. Van Beukering., 2008. "A Convenient Truth": Air Travel Passengers' Willingness to Pay to Offset Their CO_2 Emissions. *Climatic Change* 90:299-313.

Brown, T.C. , D. Nannini, R.B. Gorter, P.A. Bell, and G.L. Peterson. 2002. Judged Seriousness of Environmental Losses: Reliability and Cause of Loss. *Ecological Economics* 42:479-491

Bulte, E. S. Gerking, J.A. List and A. deZeeuw, 2005. "The Effect of Varying the Causes of Environmental Problems on Stated WTP Values: Evidence from a Field Study. *Journal of Environmental Economics and Management* 330-342. 2003).

Cameron, T.A., 2005. Individual Option Price for Climate Change Mitigation. *Journal of Public Economics* 89:283-301.

Champ, P.A. and R.C. Bishop, 2001. Donation Payment Mechanisms and Contingent Valuation: An Empirical Study of Hypothetical Bias, *Environmental and Resource Economics* 19: 383–402.
Champ, P.A. and R.C. Bishop, 2006. Is Willingness to Pay for a Public Good Sensitive to the Elicitation Format? *Land Economics* 82:162-173

Dunlap, R.E. and K. Van Liere, K., 1978. The New Environmental Paradigm: A Proposed Measuring Instrument and Preliminary Results. *Journal of Environmental Education* 9:10–19.

Dunlap, R.E., K.D. van Liere, A.G. Mertig, and R.E. Jones, 2000. Measuring Endorsement of the New Ecological Paradigm: A Revised NEP Scale. *Journal of Social Issues* 56: 425 - 442

Ek, K. and P. Söderholm, 2008. Norms and Economic Motivation in the Swedish Green Electricity Market. *Ecological Economic*s 68:169-182.

Kahneman, D., I. Ritov, K.E. Jackowtz, and P. Grant, 1993. Stated Willingenss to Pay for Public Goods: A Psychological Perspective. *Psychological Science* 4:310-315.

Kotchen, M.J. and M.R. Moore, 2007. Private provision of environmental public goods: Household participation in green-electricity programs *Journal of Environmental Economics and Management* 53(1): 1-16.

Layton, D.F., and G. Brown, 2000. Heterogeneous Preferences Regarding Global Climate Change. *Review of Economcis and Statistics* 82:616-624.

Mazar, N. and C.B. Zhong, C. B. 2010. Do Green Products Make Us Better People? *Psychological Science*, 21: 494-498

MacKerron, G.J., C. Egerton, C. Gaskell, A. Parpia, and S. Mourato, 2009. Willingess to Pay for Carbon Offset Certification Among (High-)Flying Young Adults in the UK. *Energy Policy* 37:1372-1381.

New Carbon Finance: Hamilton, K, M. Sjardin, A Shaprio, and T Marvello. 2009. Fortifying the Foundation: State of the Voluntary Carbon Markets 2009. *New Carbon Finance*.

Plott, C.R., 1983. Externalities and Corrective Policies in Experimental Markets. *Economic Journal 93:*106-27.

Schultz, P. W., Nolan, J. M., Cialdini, R. B., Goldstein, N. J., and V. Griskevicius, 2007. The constructive, destructive, and reconstructive power of social norms. *Psychological Science*, 18,
429-434

Viscusi, W.K. and R.J. Zeckhauser, 2006. The Perception and Valuation of the Risks of Climate Change: A Rational and Behavioral Blend. *Climatic Change* 77:151-177.

World Bank: Capoor, K and P Ambrosi 2009. State and Trends in the Carbon Market: 2009. World Bank.
http://wbcarbonfinance.org/docs/State___Trends_of_the_Carbon_Market_2009-FINAL_26_May09.pdf

Appendix 1: Sample Experimental instructions

Consent Form for an Experimental Investigation of Decision Making

Background Information: You are invited to participate in a research study about how individuals and groups of individuals make decisions in a variety of economic contexts. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

Procedures and Compensation: You and the other participants will have the opportunity to earn cash through your decisions. The experiment will take approximately 1.0 hour to complete.

Voluntary Nature of Participation: Your participation is strictly voluntary. You may refuse to participate before the study begins or discontinue at any time. If you withdraw from the experiment, you will be paid the cash you earned before withdrawing.

Risks and Benefits of Participating in the Study: The risk for participating in this experiment is minimal. You have no greater physical, financial, or psychological risk from the experiment than you would from doing a similar amount of routine paperwork in any similar Cornell University classroom. There are no substantial benefits to you from this research. By learning more about people's decision-making, we hope that the research will benefit society by helping economic institutions understand people's behavior.

Confidentiality: Your decisions during the experiment will be kept confidential. All data will be recorded so that no individual participant can be identified with the results from the study. Please note that if you were recruited for this experiment via e-mail there is a chance that the information you communicated could be read by a third party.

Contacts and Questions: Please ask questions you have about the study before agreeing to participate. After the experiment, Professor Antonio Bento (amb396@cornell.edu), Professor Benjamin Ho (bth26@cornell.edu), or Professor Gregory L. Poe (glp2@cornell.edu) will be glad to answer any additional questions that you may have. You may contact the Cornell University Institutional Review Board for Human Participants (IRB) at 607-255-5138. The Cornell University web site is http://irb.cornell.edu.

You may request to receive a photocopy of your signed consent form after the experiment.

I understand the information above and agree to participate in this study:

Your Name (Please print): _____

Your Signature:_____ **Date:** _____

I am 18 years or older (circle): **Yes** **No**

Consent form approved by the IRB on November 16, 2009

This is an experiment in the economics of decision-making. If you follow these instructions closely and make careful decisions, you can earn money. Please do not communicate with any other student during the experiment.

This experiment consists of 6 rounds, and your final earnings will be determined by your decision in each of the rounds. Since your decisions will affect how much money you can earn, it is important to make a careful decision in every round. You will earn experimental dollars during the experiment, which will then be redeemed for real money at the end of the experiment, at a rate of 15 experimental dollars to $1 in real money. So, if you earn 300 experimental dollars, you would earn $20 of real money at the end of the experiment.

PLEASE DO NOT TURN TO THE NEXT PAGE UNTIL INSTRUCTED TO DO SO.

ROUND 1 INSTRUCTIONS:

For this experiment, you will be in a group composed of five anonymous people.

In Round 1 of the experiment, you will be endowed with 9 experimental dollars. You can keep these experimental dollars, or you can use some or all of them to purchase up to 9 units of the commodity. Assume that you are buying this commodity for the purpose of reselling it to the experimental facilitator at the end of the experiment. The value listed below each quantity in the table below is the value that you could sell that unit to the facilitator. Each unit of the commodity costs one experimental dollar to purchase.

The table below shows the value and costs for each unit that you may purchase in Round 1.

Units of Commodity	1st	2nd	3rd	4th	5th	6th	7th	8th	9th
Value of the unit	2.20	2.05	1.90	1.75	1.60	1.45	1.25	1.15	1.00
Cost of the unit	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Your group also shares a GROUP FUND. This group fund begins with 300 experimental dollars, and at the end of the experiment, any dollars in this group fund will be divided equally between all members of the group. Your actions and the actions of other people in your group may change the total amount of dollars remaining in the group fund.

In Round 1, every unit of the commodity that you purchase decreases the number of experimental dollars in the group fund by 1.25. (Because there are five people in your group, every unit of the commodity that you purchase reduces the amount in the group fund by 0.25 dollars per person. Likewise, every unit of the commodity purchased by everyone else in the group reduces the amount in the group fund by 1.25 dollars and therefore costs everyone else 0.25 dollars.)

Example: Suppose you choose to purchase zero units of the commodity, and the rest of the group buys a total of 20 units. Your total earnings in this round would be the 9 experimental dollars that you chose to keep from your endowment. The group fund would be reduced by 25 experimental dollars (20 units x 1.25 dollars/unit). 275 dollars would be left in the group fund (55 dollars per person).

Example: Suppose you choose to purchase 4 units of the commodity, and the rest of your group buys a total of 10 units. Your total earnings in this round would be 12.90 experimental dollars (2.20 + 2.05 + 1.90 + 1.75 dollars in value from buying four units, plus 5 dollars from the remaining portion of your initial endowment). The group fund would be reduced by 17.50 dollars (14 units x 1.25 dollars per unit). 282.50 dollars would be left in the group fund (56.50 dollars per person).

PLEASE DO NOT TURN TO THE NEXT PAGE UNTIL INSTRUCTED TO DO SO.

ROUND 6 INSTRUCTIONS:

Based on the purchase decisions in the first 5 rounds made by you and others in your group, the total amount of dollars in the group fund has declined.

In Round 6 of the experiment, you will again be endowed with 9 experimental dollars. You can keep these dollars, or you can put some or all of them into the group fund. Every dollar that you put into the group fund in this round of the experiment increases the number of dollars in the group fund by 1.25 dollars. Because there are five people in your group, every dollar you spend increases the amount in the group fund by 0.25 dollars per person, including yourself.

You will also be given information as to the total amount of the commodity that a random member of your group bought in the first 5 rounds. You may get your own information back.

Example: Suppose there were 50 experimental dollars left in the group fund at the end of Round 5. In Round 6, suppose you chose to spend 5 dollars to increase the size of the group fund, and the rest of the group chose to spend 15 more dollars to increase the size of the group fund. The group fund would increase by 25 dollars (1.25 dollars/unit x 20 units), to equal 75 dollars (15 dollars per person.) In addition, you would have 4 dollars left from your endowment, because you spent 5 dollars from your initial endowment of 9 tokens.

Example: Suppose there were 50 experimental dollars left in the group fund at the end of Round 5. In Round 6, suppose you chose to keep all of your endowment, and the rest of the group chose to spend 10 dollars to increase the size of the group fund. The group fund would increase by 12.5 dollars (1.25 dollars/unit x 10), and would total 62.5 dollars (12.5 dollars/person). In addition, you would have 9 experimental dollars left from your endowment, because you only spent 0 dollars from your initial endowment of 9 dollars.