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Experimental Economics: A Revolution in Understanding Behaviour

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Jim Engle-Warnick is a Professor in the Department of Economics at McGill University. He holds a PhD in economics from the University of Pittsburgh. Mr. Engle-Warnick's field of research is in experimental economics, and he uses the laboratory to explore issues such as pay for performance, peoples' willingness to pay to reduce future risk, and the effect of risk and ambiguity preferences on decision making.

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Sonia Laszlo is a professor in the Department of Economics at McGill University. She holds a PhD from the University of Toronto. Ms. Laszlo's field of research is in development economics, where she seeks to better understand the challenges faced by the poor in improving their living standards. She uses the laboratory as well as survey data to investigate whether decision making under uncertainty can explain behaviors among the poor, such as subsistence farmers' production decisions.

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Executive Summary

What is the best compensation

What is the best compensation package to offer employees? How should choice among investments in pension plans be structured? Should a government use auctions to sell natural resources? Is it possible to design a market to reduce non-point source pollution in Quebec's watersheds? What holds people back from trying technologies that are completely new to them?

Over the last two decades a revolution has occurred in the advancement of our ability to answer questions such as these. This revolution is called experimental economics. Experimental economics is the use of a controlled laboratory environment to understand decisions people make. In an economics experiment, people make decisions in a laboratory. They are paid according to the outcome of their decisions, and their decisions are analyzed to determine the effect of an institutional or environmental change that is being tested.

Through the analysis of behaviour in controlled economics experiments, much has been learned about behaviour when outcomes are uncertain: for example, new notions about preferences toward risk and consumption over time have been developed. Much has also been learned about how people behave in strategic environments: for example, bidding behaviour in auctions is better understood, and the strategies people use as they learn how to trust each other have been observed.

The purpose of this report is to describe the methodology of experimental economics and to detail its major uses. We will focus on the ability to measure behaviours in a wide variety of situations important to organizations. We will show, with examples from our own work, how feedback between the laboratory and the field can result in new understanding of decisions in an effort to affect the cycle of poverty in a developing country in fundamentally new ways.

The Effects of Change

What is the best compensation package to offer employees? How should choice among investments in pension plans be structured? Should a government use auctions to sell natural resources? Is it possible to design a market to reduce non-point source pollution in Quebec's watersheds? What holds people back from trying technologies that are completely new to them?

Answering questions such as these is important to businesses, governments, and organizations of all kinds. Answering them is difficult because of the complexities and confounds that make understanding peoples' behaviours in institutions difficult. For example, a change in a compensation package rarely occurs in a vacuum. Often such a change occurs during an upheaval in business conditions, such as a change in the overall economy, the marketing mix, or the management. This makes it difficult if not impossible to identify the effect of the policy change on the performance of employees.

Imagine that a manager had the ability to switch from a flat-rate compensation policy, in which employees are paid a fixed salary, to a piece-rate payment system, in which employees are paid according to the output they produce. Imagine that everything else about the business could be held constant while making the switch. This might allow her to detect a change in the performance of the employees, but what if she could do better than that? What if she could observe the counterfactual, i.e., what if she could observe what would have happened had she not changed the compensation policy? Then she could measure the effect of the policy change.

This is precisely what economics experiments make possible. In an economics experiment, people make decisions in a controlled situation, which is designed to measure the effect of a specific change in the decision-making environment. To fix their incentives, they are paid according to the results of the decisions. And their decisions and the results of their decisions are then analyzed against a theory or a standard

In an economics experiment, people make decisions in a controlled situation, which is designed to measure the effect of a specific change in the decision-making environment.

of behaviour. For example, in pay-for-performance experiments, people perform a task and are paid according to an actual compensation scheme. The experimenter can test different types of compensation, or test the effect of changing from one type to another.

Now let us take the example of the manager who is interested the effect of compensation methods a step further. Imagine she works for a company with operations in both Canada and China. It is possible that, due to cultural or other reasons, different compensation packages should be implemented in the different locations. Increasingly, economics experiments are conducted with this type of question in mind. Through either portable laboratories or multiple laboratories, experiments can be used to understand and predict differences in behaviour between different groups of people.

The rest of this report is organized as follows. Section 1 introduces the experimental economics methodology, and details the types of behaviours that can be measured with it. Section 2 shows how constant feedback of knowledge can be attained between the laboratory and the field, using an example of a cycle of poverty in a developing economy. Section 3 provides concluding comments.

FIRST PART

Analyzing Behaviour in a Petri Dish

1.1 Improving Foundations

Experimental economics has its roots in the need to improve theories of behaviour. Theories are the foundation of the discipline. They are used, for example, to form public policy, to design institutions, and to construct contracts common between businesses and private people. From expected utility theory, which describes how people should make decisions in uncertain environments, to game theory, which details what people should do in strategic situations, the question has long been whether the theory describes the way people actually make decisions. The problem is how to determine the empirical relevance of the theory. Experiments provide a method to do just that.

Experimental economics is a part of a broader field called behavioural economics. Behavioural economists use principles from psychology, as well as field and laboratory observation, to test and modify economic theory. The purpose is to improve its ability to describe and predict behaviour (Camerer, 2003). In an economics experiment, volunteers make decisions in a laboratory and are paid according to the results of their decisions (Kagel and Roth, 1995; Davis and Holt, 1993). Their decisions are then typically compared with theoretical predictions or standards of behaviour. For example, experimental economists showed for the first time in a controlled way that supply and demand curves really can predict the price and quantity of goods sold (Holt, 1995), that people will punish others for treating them unfairly even at cost to themselves (Fehr and Gaechter, 2006), and that information is conveyed in prices in stock markets (Sunder, 1995).

In an economics experiment, volunteers make decisions in a laboratory and are paid according to the results of their decisions.

Economics experiments provide a feedback between economics and observed behaviour. Once a theory is tested in the laboratory and found to be deficient, work is done to improve the theory. The modified theory is tested again, resulting in a refinement that was not possible before the development of the experimental methodology.

One strength of experimental economics is its widely accepted standard methodology. First, economics experiments always compensate subjects in cash according to the results of their decisions. The reason that economics experiments are incentivized are that (1) it is an easy way to universalize the consequence of an action with money because everyone understands what money is, and (2) it provides a standard methodology across experiments conducted by different experimenters, allowing us to compare results from a series of studies. Second, there is no deception in an economics experiment. This is primarily because our theories require beliefs to be correct, which requires us to avoid deception. It is also important that our laboratories do not develop a reputation for deception since the word can travel between subjects.

Why do people overbid on auctions?

1.2 Whispering in the Ears of Princes

A tremendous variety of social and strategic issues have been studied in the experimental laboratory. Most studies can be broken down into three categories (Roth, 1995).

First, economics experiments test theories. For example, it has long been thought that people overbid in auctions, resulting in a situation in which the winner has bid too much, and is sorry that she won. Overpaying at auction can be a shareholder issue during a hostile takeover. It can also be an issue when governments auction hugely valuable public resources, such as frequencies for mobile phones, or rights for timber or oil.

The winner's curse is difficult to identify in normal bidding because we cannot observe the bidder's true valuation of the item for which they are bidding. Thus we cannot know if she is actually overbidding. In the

laboratory, by contrast, we can set a bidder's valuation of an item ourselves, and pay her the difference between her valuation and the amount of money she pays for the item at auction. With this type of a controlled experiment, new evidence for overbidding has added much to our knowledge of overbidding in auctions (Kagel, 1995). The controlled experiments added new evidence for the existence and causes of the winner's curse.

Second, economics experiments suggest new theories. For example, standard theory has traditionally not been able to describe addiction or procrastination. This is because economists have long assumed that people discount the future at a rate that does not depend on time, much like a compound interest rate. In other words, $10 that I expect to receive in 30 days is worth less to me than $10 I expect to receive today. And the rate at which I discount these two payoffs is the same at which I discount the expectation of $10 in 31 days vs. $10 in 1 day.

Experiments have shown, however, that patience is likely to be a function of time in a special way (Fredereick, Loewenstein, and O'Donohugh, 2002). In laboratory experiments, people tend to value future days against the present at a lower rate than they do between any two other days. In other words, there is an extra discount whenever I compare today with any other day: today is special. If today is special, then my time preferences can change in the following way: I prefer $10 today to $11 tomorrow, but I prefer $11 in 31 to $10 in 30 days. But when 30 days passes, I again prefer the $10 today to $11 tomorrow, i.e., after time passes my preferences reverse. Think of trying to quit smoking: I'll do it later, but when later arrives, well, I'll do it later. One way of describing this type of time preference is with "hyperbolic discounting," and much experimentation is being done to find a preference model to best fit observed behaviour.

Third, economics experiments are used for policy recommendations and the design of economic markets. Issues such as education, social welfare, and the environment can be addressed. For example, experiments have

been conducted to test the effect of school voucher programs in the United States (Bettinger and Slonim, 2006), and the savings decisions of working poor in Quebec (Eckel, Johnson and Montmarquette, 2006). Economics experiments have been conducted in developing economies to study such issues and peoples' predisposition to contribute to public goods (Carpenter, Daniere and Takahashi, 2004). School admissions procedures, multiple kidney exchange markets, electricity markets, and markets for trading carbon emissions permits are being designed with the aid of this tool as well (see Alvin Roth'spage at Harvard University for a list of references for market design: http://kuznets.fas.harvard.edu/~aroth/alroth.html).

1.3 On the Road

Real life problems involve a hugely heterogeneous group of people with regard to age, ethnicity, gender, and a host of other things that make us all different from each other. Traditional economics experiments are conducted in laboratories, often located at universities, using a pool of subjects that consists largely of university undergraduates. Such a pool of subjects is called a "convenience pool", because these subjects are readily available for studies. Increasingly, portable laboratories and laboratories across the world are used to study different subject populations.

Examples of specific groups of people that have been the subject of interest are men, women, children, representative voters, working poor, factory workers, expert bidders at auctions, and students. The explosion of field experiments is currently being documented at the web site www.fieldexperiments.com.

1.4 Our Petri Dish

At CIRANO we have a tremendous and well-used facility to conduct economics experiments. Our laboratory, which is funded by Bell Laboratories, the Canadian Foundation for Innovation, and the FQRSC sports 20 workstations, 20 laptop computers, and 60 hand-held devices for use as a portable laboratory in the field.

Activity in our laboratory over a 6-month period in 2007 is listed in Table 1. The table reveals that our laboratory is used for a wide variety of purposes by many people from many institutions across the world. Fifteen researchers and four graduate students conducted studies in both French and English in this period. The table shows twelve projects ranging in topics from corruption to emotions. In this brief period over $40,000 in cash was paid to almost 1,500 subjects.

Table 1
CIRANO Laboratory Statistics, January – July 2007
Experimental Projects

A total of 11 research projects were carried from January to July 2007 (of those, 6 are new ones):

Name of the Experiment	Experiment Language	Money spent on Participant Compensation	Funding Source
Aliments fonctionnels	fr	$3,730.00	FQRNT
Analysts, Incentives and Cooperation	en	$1,672.50	University of Minnesota
Assurances	fr	$4,609.50	Bell University Laboratories and TEAM
Centre d'appel	fr	$3,615.00	CRSH
Contagion émotionnelle	fr	$788.50	CRSH
Corruption	fr	$9,933.71	CRSH and FQRSC
Endogenous Emergence of Voluntary Disclosure	en	$4,676.25	University of Minnesota
Gestion de la qualité du service par les utilisateurs	fr	$2,720.00	Bell University Laboratories and CRSNG
Incitation à la protection de terres privées	fr	$6,562.00	Environment Canada in partnership with Agriculture Canada
Satisfaction	fr	$755.50	Bell University Laboratories
Subject-Based Modelling	en	$1,805.00	FQRSC and SSHRC

- **1,476** participants took part in 110 sessions (average of 13 participants per session)
- **$40,867.96** was given out in cash payments for an average of $27.69 per participant
- Laboratory was used 62 days out of 125 potential days for a **50%** utilisation rate

Subject Pool

- Number of subjects (active): **3,802** (1,997 English speaking and 3,025 French speaking)
- Number of participants who have participated in a study since January 2007: **644** (435 English speaking, 529 French speaking)

Researchers

- Number of researchers and graduate students involved: 15/4
- Number of programmers and research assistants involved: 3/6

Their affiliations: HEC Montréal, INRS, McGill University, Université de Montréal, Université Laval, Université Paris 1, University of Minnesota, UQÀM.

SECOND PART

Measuring Behaviour in a Petri Dish

2.1 Uncertainty and Strategy

Banks need to know clients' preferences about risk in order to provide investment advice. Companies need to know their employees' attitudes about consumption over time to provide appropriate pension benefits. Companies need to know the effect of new marketing strategies. Managers need to know how much cooperation or trust exists between their employees.

Economics experiments can be used to measure behavioural characteristic that occur within two types of situations. The first type of choice occurs under uncertainty. This is a situation with multiple alternatives for a decision maker, where the result of each alternative is uncertain. An example of an individual choice problem is the choice of an investment fund. The guiding theory for individual choice is expected utility theory. The second type of choice occurs in strategic games, where the results of a person's decision depend on their own decision and the decisions of others. An example of a strategic game is the production choice of firms. For strategic choice the guiding theory is game theory.

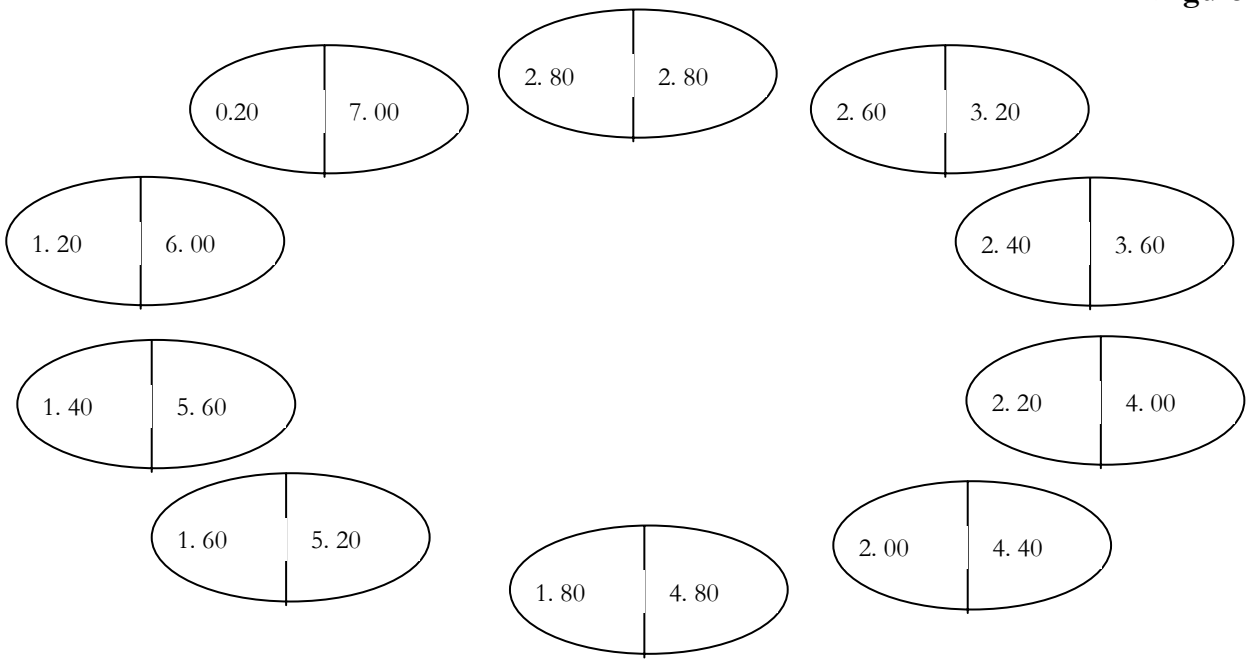
There are many behaviours that can be measured in each of these two categories, and all of these behaviours are important to the functioning of businesses, organizations, and institutions. The following is a summary of the most commonly measured behaviours.

2.1 Uncertainty in Life

Risk Preferences: Risk preferences in part guide a person's investment decisions, migration decisions, and employment decisions. In a typical experiment to measure risk preferences, subjects are given a choice

between several lotteries (Eckel, Montmarquette and Johnson (2006) provide an example). Figure 1 illustrates such a setup. In the figure, there are ten lotteries, each represented by a circle with a vertical line down the middle. Each circle represents a lottery with a 50/50 chance of winning either of the amount of money listed on the left of the circle or the amount on the right. For example, the lottery at the very bottom of the figure (at the six-o'clock position) represents a 50/50 lottery between the outcomes $1.80 and $4.80. The lottery at the top (at the twelve-o'clock position) in which both prizes are $2.80 is a lottery that pays $2.80 for sure.

Figure 1



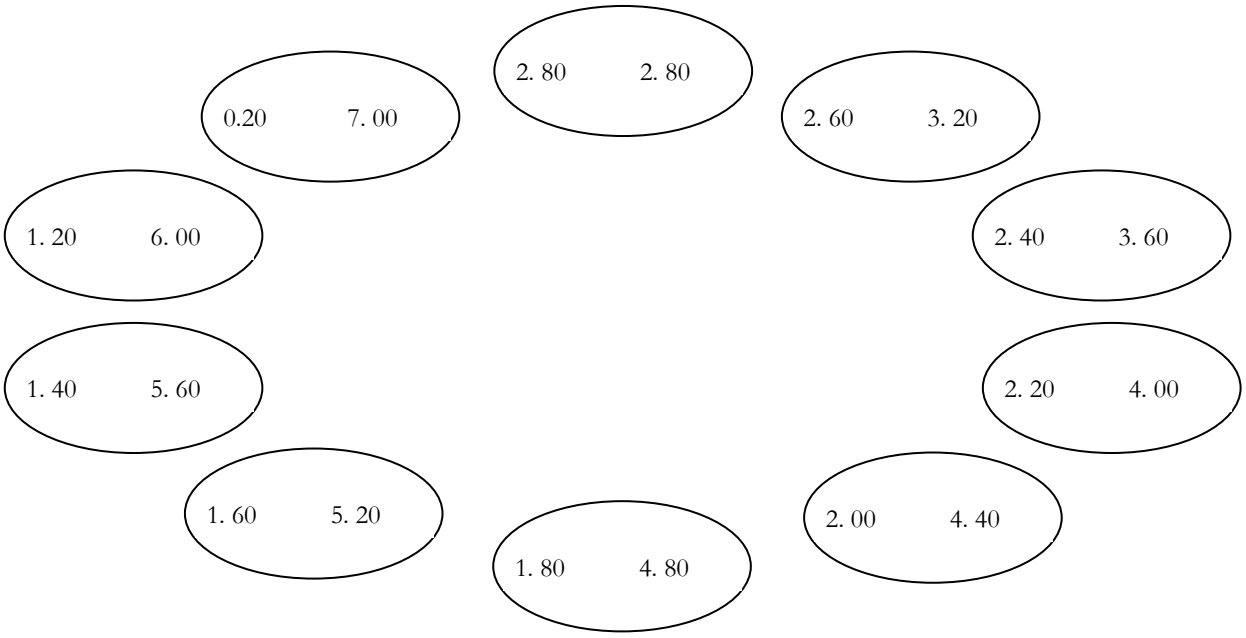
Each of these ten circles represents a lottery with two possible prizes. The lotteries are played by drawing a chip out of a bag. In the bag, there are 10 chips: 5 chips are yellow and 5 chips are blue. You state which colour, blue or yellow, represents the larger of the two lottery payoffs and then draw a chip out of the bag without looking. If the colour of the chip is the colour you chose, then you earn the larger amount. If the colour of the chip is not the colour you chose, then you earn the lower amount. Please choose the lottery you most prefer by placing an X over it. You will play the lottery you choose for cash.

The subject's task is to choose her most preferred gamble, which she will then play for cash. The instrument is designed so that aversion to risk is increasing as one moves counter-clockwise around the circle. The way this instrument works is that as the expected value decreases, so does the

variance, as one moves counter-clockwise among the alternatives. The dollar amount of the prizes can be varied to measure subjects' responsiveness to the size of the stakes.

Ambiguity preferences: Ambiguity preferences guide a person's choice to try new things. A company full of ambiguity averse employees is unlikely to be a source of innovation. Figure 2 shows an example of an instrument to measure subjects' preferences over ambiguity (Engle-Warnick, Escobal and Laszlo (2008) provide an example of the use of this instrument). Ambiguity is typically characterized by unknown probabilities over outcomes. Thus the difference between this instrument and the previous one is that the chances of winning either prize in each lottery are unknown to the subject. As before, the subject chooses the lottery she most prefers and then plays it for cash.

Figure 2



Each of these ten circles represents a lottery with two possible prizes. The lotteries are played by drawing a chip out of a bag. In the bag, there are 10 chips: each chip is either blue or yellow, and you do not know how many chips are blue nor how many chips are yellow. You state which colour, blue or yellow, represents the larger of the two lottery payoffs and then draw a chip out of the bag without looking. If the colour of the chip is the colour you chose, then you earn the larger amount. If the colour of the chip is not the colour you chose, then you earn the lower amount. Please choose the lottery you most prefer by placing an X over it. You will play the lottery you choose for cash.

The formal measure of ambiguity preference involves the difference in decisions between the risk instrument (Figure 1) and the ambiguity instrument (Figure 2): a subject who is averse to ambiguity will make a choice that lies in a more counter-clockwise direction in the ambiguity instrument than she does in the risk instrument. For example, a subject who chooses the lottery with the outcomes $1.60 and $5.20 in the risk instrument, and then the lottery with the outcomes $2.00 and $4.40 in the ambiguity instrument, reveals an aversion to ambiguity. The larger the distance between the two choices, the stronger is the ambiguity preference.

Time preference: Time preferences guide the way a person chooses between consuming and saving. Investments such as schooling and health are two examples. The typical style of an instrument to elicit time preferences has subjects responding to a question of the type, "How much money would you require in ten days to be equivalent to $10 today". Both the amounts and the time lag are varied to obtain an estimate of the subject's time preferences. In these experiments, subjects are paid in the future according to the time lag specified in the question. Fredereick, Loewenstein, and O'Donohugh (2002) provide a survey of many of the elicitation of time preferences.

2.2 Strategy in Life

Trust is essential for the economic system to work. Trust can be measured in the laboratory.

Trust: Trust has been called a lubricant of a social system, and is an extremely important behaviour in a world with incomplete contracts. If people or organizations had to enforce more than a fraction of their agreements formally, legal costs would increase, costly delays would ensue, and opportunities would be missed. It is a fact that we must trust other people, in general, to fulfill their obligations to us. Thus it is often important to be able to measure the amount of trust that exists between people.

A simple way to do this is with the following game, due to Berg, Dickhaut and McCabe (1995). In this two player game, a Trustor decides whether or not to send an amount of money, $0 - $10, to a Trustee. If she sends

something, it is tripled (as a return on an investment), and then the Trustee decides whether or not to return any money to the Trustor. The measure of trust is simply the amount of money that is sent to the Trustee. The measure of reciprocity, trustworthiness, or trust responsiveness, is the amount of money returned to the Trustor, conditional on the amount that was sent to her. A bank official might recognize this game as a model of a borrower and a lender.

This simple game, which reduces trust and reciprocity to simple actions in a way that can only be done in the laboratory, has suggested that people trust others, even when playing the game with strangers, and with no chance of building a reputation for trustworthiness. In repeated games, it has been found that subjects learn to trust each other after punishments are delivered for untrustworthy behaviour.

How do we as a society agree to pay for health care?

Cooperation: Cooperation (or the lack of cooperation, which is called free-riding) is an issue when a group, not an individual, is responsible for providing a good or a service. Should a manager arrange her workforce into teams? How do we as a society agree to pay for health care? These types of issues can be better addressed if we could understand the foundations of cooperation.

Cooperation is measured with public goods games. A public good is something that no one can be excluded from using, such as a park, health care, or national defense. The degree to which people willingly contribute to a public good is a measure of cooperation. In a typical laboratory game, each member of a group of, say, five subjects begins with an amount of money, say, $10. They then decide simultaneously and anonymously how much of their $10 to contribute to the public good. Each contribution is multiplied by two and then distributed evenly amongst all five subjects.

Notice that the maximum amount of total money earned occurs when everyone contributes all $10. Notice also that for every $1 contribution of her own, a subject receives back only $0.40. Despite this fact it is normal for many subjects to contribute to the public good, and for these

contributions to decline if the game is repeated. If punishment is available to direct at a non-contributor, then contributions increase. Fehr and Gaechter (2004) provide a summary of some important findings in this area. Engle-Warnick (2007) provides results about cooperation in several different repeated games.

Bargaining: Bargaining is an extremely important mechanism for allocating goods in markets, for reaching agreements within and between companies, and for taking legislative decisions. The ultimatum game is used to model the last stage of a bargaining process, and can reveal subjects' preferences for fairness in outcomes. In this game, a proposer proposes a split of an amount of money with a responder, and then the responder accepts or rejects the split. Acceptance means the split is implemented, and rejection means that both players go home with nothing. Results from this game indicate the modal proposal is a 50/50 split, and that the further away from a 50/50 split a proposal is, the higher the chances are that it will be rejected. This was the first game to illuminate the fact that people will punish others for unkind behaviour even at a cost to themselves. This is because when a 70/30 split is rejected, for example, the responder is giving up 30% of the available pie.

Hundreds of variants of this game have been run to refine knowledge regarding what triggers costly punishment. One such variant is the dictator game, in which the proposal is automatically implemented, with no chance for the responder to reject. This game was in response to the question of whether 50/50 splits were the result of preferences for even splits, or fear of a rejected proposal. Results indicate that the answer is a little of both. This game is an example of the level of control achievable in the laboratory: the dictator game is a pure test of revealed preference of how to split a pie with another person. It abstracts away from anything else that could influence behaviour or confound inference regarding decisions the subjects make. One can only achieve this level of control in a laboratory. Forsythe, Horowitz, Savin and Sefton (1994) provide a classic example of the study of fairness in bargaining.

Airlines, banks, and transport companies obviously require a great deal of coordination between people doing very different jobs to function properly.

Coordination: Every organization or institution requires coordination among people to function. Large companies such as airlines, banks, and transport companies obviously require a great deal of coordination between people doing very different jobs to function properly. But coordination is also used to explain the existence of social norms, which are things we do to escape sanctions from others, such as helping others in distress, driving on the right (or left) side of the road, or avoid making noise in our flats late at night.

A coordination game is one in which the players, more than anything else, wish to match their respective actions. Coordination games require people to answer questions such as, "I accidentally erased a file from my computer so I contacted _____", or "I discovered a violation of a work procedure so I spoke with _____". Subjects' responses are compared with each other and if they match, the subjects earn money. This provides the incentive to think about not only how one would respond to the question oneself, but also how one expects others to respond.

Coordination thus requires a kind of mind-reading. It requires the formation of common beliefs of the type that "I know that you know that I know…to take a particular action", and "You know that I know that you know…to take a particular action". One can use such a game to measure the ability of employees to coordinate on matters important to a business. Mehta, Starmer and Sugden (1992) provide the classic implementation of this type of experiment.

THIRD PART

From the Petri Dish to Real Life and Back

3.1 The Art of Refinement

One particular powerful method of inquiry using this methodology is the exploration of a phenomenon that is suspected in the field. The problem is that one cannot be sure about it because of the confounding multiple explanations that can exist for observed behaviour. In this case one can test such a conjecture using the control of the experimental laboratory.

An example of this occurred when Kagel and Roth (2000) studied the unraveling of the system for assigning new medical residents to hospitals. Upon graduation, students submitted a list of their most preferred hospitals in order, and the hospitals ranked the students. A computer program used the lists to generate matches. Over time, more and more hospitals and students began making side agreements on employment contracts outside of the matching algorithm, and these agreements were being reached earlier and earlier. The earlier the matches, the less education had been completed, and presumably, the less information was available upon which to make judgments regarding employment. Thus a question of efficiency resulted from the unraveling of the allocation process.

The algorithm was suspected to be the culprit, but in the field, it was impossible to isolate it as the cause. It could simply have been the case that local culture would create an unraveling regardless of the algorithm, for example. Thus Kagel and Roth (2000) took the matching algorithm into the lab, where they observed similar unraveling. This was a powerful result because in the laboratory, the existence of unraveling could only be explained by the algorithm. In the same experiment, they transitioned to a

new matching algorithm and observed subjects returning to the central matching algorithm. With this evidence in hand, they recommended implementing their algorithm in the field, and this was in fact done.

The following is an example of how we have found that feedback between the laboratory and the field can answer questions, and formulate new questions that we had not thought of in the first place. The example is in the context of measuring behaviours to explain the persistence of poverty in a developing country.

From the laboratory to Peru helping farmers.

3.1 Too Many Choices in Peru

In Peru, subsistence farmers are slow to adopt new technologies. The primary technology choice available to these farmers is the choice between modern and traditional varieties of seeds to plant. This is a possible contributing factor to generation after generation of families remaining poor. Recently, it has been suggested that having too many alternatives can make people worse off (Schwartz, 2003). In Escobal, Engle-Warnick and Laszlo (2008), we asked the question whether the existence of additional alternatives affect subsistence farmers' decision making in Peru.

We designed an experiment, based on the risk preference instrument in Figure 1, which allowed us to measure whether risk preferences are affected by the addition of an alternative. We tested this design in our laboratory at CIRANO before taking it to the field. We found that when an additional lottery was added to a choice set of two lotteries, farmers in Peru appeared to be more risk loving than they were when that additional lottery was not present in the choice set.

However, this effect was not seen with student subjects in our laboratory at CIRANO. Our explanation for these results comes from the psychological notion of "risk as feelings". As we added an alternative to the choice set, the Peruvian farmers were more pleased with the choices they had, which caused them to behave in a less risk averse manner. In Montreal, the more experienced subjects were not emotionally affected by

the additional alternative, thus they exhibited no change in measured risk preferences.

This is an important finding for policy makers. We normally think of adding alternatives as a way of increasing the opportunities for the farmers. But if adding alternative changes the farmers' attitudes toward risk, this should be taken into account when making decisions such as subsidizing or providing technical assistance for new technologies.

3.2 Ambiguous Alternatives in Peru

Escobal, Engle-Warnick and Laszlo (2008) returned to the CIRANO laboratory from Peru with a new idea. Imagine that farmers view innovation as an ambiguous, as opposed to a risky, proposition? If new seeds are risky, then presumably both the expected yield and the variance of the yield is higher. If they are ambiguous, then the probability distribution of the yield is not known to the farmers. Could we disentangle these two notions, for the first time, with farmers in Peru?

We tested a new experimental design in our CIRANO laboratory, and then we returned to Peru with a new instrument, like the one in Figure 2, to measure ambiguity preferences. Our goal was to determine whether the measure of risk or ambiguity preferences helped to predict technology choices on the farm. Our method was to combine an experiment with a socio-economic survey.

We found that ambiguity aversion did predict some aspects of technology adoption. We also found evidence for learning-by-doing by asking the farmers how much experience they had with their technologies. Learning-by-doing is the notion that as a farmer uses a technology, she is learning in a noisy way about a more productive technology. At some point in the learning curve, she should switch over to the new technology. With these new results in hand, we then designed a more precise test of some aspects of our findings back in our laboratory at CIRANO.

The findings in Escobal, Engle-Warnick and Laszlo (2007) are exciting because until now, it has been assumed that risk preferences affect technology choices. Our finding, that ambiguity aversion is involved, suggests a different policy prescription. If risk preferences matter, then we have no evidence against the conjecture that farmers are choosing according to their preferences, and we have no policy recommendations to make. If ambiguity preferences matter, then we can suggest that technical assistance be designed to reduce the ambiguity to help farmers make more informed choices.

3.3 Validating a Finding from Peru at CIRANO

Managers could identify best training methods for employees.

The findings in Escobal, Engle-Warnick and Laszlo (2007) are important to many business and organizational problems, where a question is how much job-specific training to provide. If a manager could identify ambiguity averse employees from the beginning, then she could more quickly identify the best training methods for the employee. An owner of a company that wishes to be a leader in innovation may want to know about a job candidate's preferences toward ambiguity before making an employment decision.

To validate to our findings we repeated the ambiguity and risk preference instruments in our CIRANO laboratory, and followed them with a learning-by-doing game. In the game, the subjects' sole decision was when to switch from one technology to the other, as they learned from using the current technology. However, we let subjects pay to practice the game, i.e., to explore the results from their decision when to switch, before they played the game for pay. We did this to mimic the real technology choice on the farm, using the accepted precise model for doing so.

In Engle-Warnick and Laszlo (2007) we found that ambiguity preferences predicted the number of times subjects paid to play the game, i.e., they predicted the amount of people were willing to pay to reduce ambiguity. But we also found a surprise: overall profit earned in the game was correlated with risk preferences. This is something we would have never

tested in the field. Thus we validated our ambiguity measure, adding strength to our findings in Peru, and we formed a new hypothesis, which we plan to go back to the field to test with a new experiment and survey.

3.4 What the Future Holds

We are conducting several studies in the category of feedback between the laboratory and the field, we are currently conducting pay-for-performance experiments with businesses in China. Using the portable capability of our CIRANO laboratory, we will shortly conduct experiments in a Quebec watershed to test mechanisms for auctioning management practice changes on farms to reduce non-point source pollution. And we will shortly conduct experiments with electricity producers to test mechanisms for trading carbon permits. We have recently conducted experiments to measure the received tone of media communications by a representative sample of voters in Montreal.

From Montreal to China.

CONCLUSION

Economics experiments provide a controlled method for understanding and measuring behaviour important to the functioning of economic markets, organizations, and institutions. As we have seen, the control that is possible to achieve in the laboratory helps us to measure both individual behaviour, and behaviour in strategic environments. Both traditional subject pools at universities and diverse subject pools in businesses, schools, and developing countries have refined our knowledge of how people behave in important situations.

Our results inform policy makers who are involved with the reduction of poverty.

A particularly compelling line of inquiry available to the experimentalist involves refining knowledge regarding a real-life phenomenon in the laboratory. In the end, we obtained more detailed information about individual choices by farmers who's very existence depends on those choices than we ever could have without the methodology of economics experiments. Our results inform policy makers who are involved with the reduction of poverty.

We showed, using our example of a field experiment in Peru, how the laboratory made it possible to design a tool to answer a question in the field. We subsequently showed how additional questions were raised in the field, which we attempted to answer with more detailed experimental designs, which we first tested in the laboratory. Finally, a laboratory experiment designed to validate our field results gave us a new hypothesis to return with to the field.

It is a wonderful time to conduct economics experiments. Although the field is still young, experimental economics is now accepted, and our laboratory is well-equipped for both traditional and field experimentation. The methodology is well-developed. And those of us who do this work

stand on the shoulders of researchers from our own and other disciplines: a few years ago the Nobel Prize in economics was awarded to an economist (Vernon Smith) and a psychologist (Daniel Kahneman) for pioneering work in experimental methods. Thomas Schelling, another recent recipient of the prize, is an original contributor to behavioural economics.

Bibliography

Berg, J., J. Dickhaut, and K. McCabe (1995): "Trust, Reciprocity and Social History", *Games and Economic Behavior*, 10:122-142.

Bettinger, E. and R. Slonim (2006), "Using Experimental Economics to Measure the Effects of a Natural Educational Experiment on Altruism," *Journal of Public Economics*, 90, 1625-1648.

Camerer, C., (2003): *Behavioural Game Theory*, Princeton University Press, Princeton.

Carpenter, J. A. Daniere and L. Takahashi (2004): "Cooperation, Trust and Social Capital in Southeast Asian Urban Slums"*, Journal of Economic Behavior and Organization*, 55(4):533-551.

Davis, D. and C. Holt (1993): *Experimental Economics*, Princeton University Press, Princeton.

Eckel, C, Johnson C, & C. Montmarquette "Saving decisions of the working poor: short and long-term horizons", *Field Experiments in Economics*, J. Carpenter, G.W. Harrison and J.A. List (eds.), Greenwich, CT: JAI Press, Research in Experimental Economics, 2005, Volume 10.

Engle-Warnick, J., J. Escobal, and S. Laszlo (2008): "How do additional alternatives affect individual choice under uncertainty?" Forthcoming at the *Canadian Journal of Economics*.

Engle-Warnick, J. (2007): "Five Indefinitely Repeated Games in the Laboratory", CIRANO working paper 2007s-11.

Engle-Warnick, J., J. Escobal and S. Laszlo (2007): "Ambiguity Aversion as a Predictor of Technology Choice", CIRANO working paper 2007s-01.

Engle-Warnick, J. and S. Laszlo (2006): "Learning by Doing in an Ambiguous Environment", CIRANO working paper 2006s-29.

Ferh, E. and S. Gaechter (2000): "Fairness and Retaliation: The Economics of Reciprocity" , *Journal of Economic Perspectives* 14, (2000), 159-181.

Frederick, S., Loewenstein, G. and O'Donoghue, T. (2002). Time Discounting and Time Preference A Critical Review. *Journal of Economic Literature*. 40(2), 351-401.

Holt, C. (1995): "Industrial Organization: A Survey of Experimental Research", in *The Handbook of Experimental Economics*, J. Kagel and A. Roth eds., Princeton University Press, Princeton.

Kagel, John H. and A.E. Roth, "The dynamics of reorganization in matching markets: A laboratory experiment motivated by a natural experiment," *Quarterly Journal of Economics*, February 2000, 201-235.

Kagel, J. and A. Roth (1995): *The Handbook of Experimental Economics*, Princeton University Press, Princeton.

Kagel, J. (1995): "Auctions: A Survey of Experimental Research", in *The Handbook of Experimental Economics*, J. Kagel and A. Roth eds., Princeton University Press, Princeton.

Mehta, J., C. Starmer and R. Sugden (1994): "The Nature of Salience: An Experimental Investigation of Pure Coordination Games", *American Economic Review*, 84:658-673.

Roth, A. (1995): "Introduction" in *The Handbook of Experimental Economics*, J. Kagel and A. Roth eds., Princeton University Press, Princeton.

Schwartz, B. (2003): *The Paradox of Choice: Why More is Less*, Ecco.

Sunder, S. (1995): "Experimental Asset Markets: A Survey", in *The Handbook of Experimental Economics*, J. Kagel and A. Roth eds., Princeton University Press, Princeton.

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