



Is Reciprocity Necessary for Co-opetition? Some Experimental Evidence

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ABSTRACT

Cooperative strategy is increasingly being accepted as a legitimate construct in strategic management. In this paper we argue that in order to use cooperative strategy in concert with competitive strategy, what some have called *co-opetition*, an environment of reciprocity is required. This paper reviews the theoretical roots of co-opetitive behavior and reciprocity, describes a two-stage game designed to test competing hypotheses of co-opetitive behavior, then reports the results of two experiments where subjects played the co-opetition game under differing conditions. Our results show that game-theoretic predictions of co-opetitive behavior are not supported. Most subjects elect to cooperate in the first stage of the game, thereby increasing the size of the “pie” but potentially weakening their role in the second stage of the game. Further, subjects do not make large demands in the ultimatum bargaining (second) stage of the game and frequently reject positive offers. The results show that giving subjects an opportunity for reciprocal interaction improves overall rates of cooperation and lowers the likelihood of rejected demands.

Introduction

Cooperative strategy is receiving increased attention in strategic management research. While much of the recent work has been in the area of interorganizational relationships, such as joint ventures and strategic alliances (Kogut, 1988; Dyer & Singh, 1998), a broader concept, dubbed “co-opetition”, has recently surfaced in the strategy literature. Brandenburg and Nalebuff (1996) argue that the essence of co-opetition is in the search for complements. A complement is a product or service that makes another more attractive. Examples include hardware and software, automobiles and car loans, televisions and videocassette recorders, even hot dogs and mustard. Firms with complementary products are advised to first *cooperate* with each other to expand the size and attractiveness of the market, and then *compete* with one another to get the largest possible share of profits from the expanded market.

Evidence of the quick acceptance of co-opetition in mainstream thinking abounds. Kessler (1998) used co-opetition to explain the continually shifting partnerships and co-dependencies prevalent in the computer industry. Bill Gates, CEO of Microsoft, is quoted as saying, “I come from a business where everybody is a competitor with everybody else, and everybody cooperates with everybody else” (Editor and Publisher, 1998). One healthcare



consultant advises that his industry "... is poised and ready for the concept of co-opetition ..." and believes the concept could "... usher in a new era for the nation's largest service sector" (Gee, 2000). Wheatley (1998) contends that competitors who ship goods on the same trucks are using co-opetition in their supply chains. Similarly, competing newspaper groups that are jointly selling advertising insert packages are said to have found co-opetition (Editor and Publisher, 1998). Ghemawat (2001) endorses Brandenburg and Nalebuff's "Value Net" analysis -- a tool of strategic management that explicitly considers complementors. He advocates this tool as an accompaniment to Porter's Five Forces Model, thus adding an important cooperative dimension to the standard competitive forces analysis.

Co-opetition is seemingly a smart and clever construct to add to the strategist's handbook. However, it is difficult to implement because it requires participants, who operate predominantly in competitive business environments, to know when and how to cooperate. While there is an abundance of theory informing competitive strategy, much less is known on how or when firms should cooperate. Although co-opetition is a recent addition to the strategic management jargon, the idea that a single actor should both cooperate and compete in situations of strategic interdependence has a long history in economics and behavioral research. Given the growing acceptance and potential value of cooperative strategy, further research from multiple perspectives is warranted.

In this paper, we examine co-opetitive behavior from a game-theoretic perspective, beginning with the premise that the addition of cooperative strategy is a positive development in strategic management. The rest of the paper is organized as follows. We briefly review select theoretical and experimental evidence relevant to co-opetitive behavior. We then present and discuss the results of a new experiment specifically designed to elicit co-opetitive behavior. However, as our laboratory will results show, even in simplified environments, co-opetitive behavior is not easily mastered or maintained. The paper concludes with some basic advice on how to manage the duality of co-opetition.

The Roots Of Co-Opetive Behavior

When should a person cooperate or defect in an ongoing interaction with another is the question Robert Axelrod (1984) posed several decades ago in his investigation into the evolution of cooperation. Although his question was certainly not novel, Axelrod's method of research was. A repeated play Prisoner's Dilemma (PD) round-robin tournament was conducted. Participants from around the world submitted computerized strategies with algorithms for playing the repeated PD. Each singular strategy was matched against each other strategy for 200 repetitions of the game, with scoring determined by cumulative payoffs. Tit-for-Tat (TFT) a surprisingly simple strategy submitted by Anatol Rapoport won the tournament. TFT begins play with cooperation, and then simply does whatever its opponent did in the prior round. This simple yet highly effective strategy, whose unbending rules for when to defect and when to cooperate, performed remarkably well against a wide range of opponents.

TFT is clearly a simplistic forerunner to inter-firm co-opetition. In order to frame and understand the success of TFT, it is necessary to understand the nature of the PD. The game



presents the player with a basic choice between cooperative and competitive behavior. The standard non-cooperative game theoretic solution to the one-shot prisoner's dilemma game is to always defect (compete). The reasoning is that the individual payoff for defection is greater than the individual payoff for cooperation, regardless of the opponent's choice. The dilemma exists because both players could earn greater payoffs through mutual cooperation. When the PD game is repeated for a number of periods, a strategy that sustains mutual cooperation is more effective in maximizing long-term payoff than a strategy that does not. The success of TFT lies in its ability to promote and maintain long periods of cooperation. As Axelrod's tournament showed, cooperation among egoists can only be maintained when a strategy determines when and how to both cooperate and defect.

Axelrod argued that the success of TFT was attributable to the strategy being: (1) nice -- not being the first to defect; (2) retaliatory -- repaying defection with defection; (3) forgiving -- willing to restore mutual cooperation; and (4) clear -- easily understood by its opponents. TFT engages in reciprocity by repaying cooperation with cooperation, and defection with defection. Reciprocity, in the context of a repeated PD, allows TFT to maintain long periods of cooperation by denying another strategy the ability to exploit it. TFT is always willing to cooperate, but is quick to retaliate defection as a punishment in order to deter continued defections. To externally validate the power of reciprocity, Axelrod offered several real world examples of TFT promoting cooperation in competitive environments where friendship or foresight did not exist.

Subsequent research by Axelrod (1997) and others (Smith, 1998; Hoffman, McCabe & Smith, 1994; Fehr & Gächter, 2000) has proposed that reciprocity is a key element in the development and maintenance of cooperative behavior in many different economic and social environments. Evolutionary biologists have suggested that reciprocity is an important factor in the success of the human species because it allows cooperative behavior to emerge in a community of competitors (Cosmides, L. & Tooby, J., 1992). If reciprocity is a necessary condition for realizing cooperation in competitive environments, one may argue it is also a necessary condition for co-opetition, which requires both cooperative and competitive behavior.

Reciprocity

The notion of reciprocal, give-and-take behavior is one of man's oldest conceptions and is found throughout the literature. Consider the following excerpts:

"There is no duty more indispensable than that of returning a kindness...all men distrust one forgetful of a benefit." (Cicero, as quoted in Gouldner, 1960).

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"A man ought to be a friend to his friend and repay a gift with a gift. People should meet smiles with smiles and lies with treachery." (Edda, a 13th century collection of Nordic verses, as quoted in Fehr & Gächter, 2000).



“A new commandment I give unto you, That ye love one another; As I have loved you, that ye also love one another. By this shall all men know that ye are my disciples, if ye have love one to another.” (Gospel of John, King James Bible version)

Each passage describes an obligation of mankind in rather strong terms, such as “duty”, “ought” and “commandment.” Modern-day notions of reciprocal behavior have changed little from these early views. Gouldner (1960) argued that the norm of reciprocity makes two demands: 1) people should help those who have helped them, and 2) people should not injure those who have helped them. Fehr & Gächter (2000) make a distinction between *positive reciprocity*, in which people tend to repay gifts, and *negative reciprocity*, in which people may take revenge, even against complete strangers and even if it is costly for them to do so. Reciprocity has also been defined as a form of altruism. Adam Smith (1759) proposed that: “How selfish soever man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him, though he derives nothing from it except the pleasure of seeing it” (The Theory of Moral Sentiment, pg. 159). Smith’s definition is considered *pure altruism*. Pure altruism occurs when a person gives something to another without the expectation of anything in return. *Reciprocal altruism* (Trivers, 1971) takes place when an altruistic act is given at one point in time on the expectation or possibility that it will be reciprocated in the future.

How prevalent and widespread reciprocity is in the human species is much debated. Gouldner (1960) argues that the norm of reciprocity is most likely universal and found in nearly all value systems and known cultures. He suggests we are generically hard-wired for reciprocal behavior, and that reciprocity is one of several “Principal Components”, which are commonly present in codes of moral behavior. Trivers (1971) offered one of the first models to account for the natural selection of reciprocal altruism in the population. He showed that even though there is a cost associated with the altruistic act, as long as there is the possibility of the act being reciprocated with sufficient enough benefits the characteristic of reciprocal altruism will evolve into the population. The view that the human mind has cognitively adapted for reciprocal social exchange (cooperation) was investigated by Cosmides and Tooby (1992). Their argument is that in response to the myriad problems in the social world, the human mind has evolved and adapted into a collection of dedicated, functionally specialized, and interrelated modules employed to handle specific problems. One of these modules has specialized to handle instances of social exchange. Summarizing their findings they write:

“From the child who gets dessert if her plate is cleaned, to the devout Christian who views the Old and New Testaments as covenants arrived at between humans and the supernatural, to the ubiquitous exchange of women between descent groups among tribal peoples, to trading partners in the Kula Ring of the Pacific—all of these phenomenon require, from the participants, the recognition and comprehension of a complex set of implicit assumptions that apply to social contract situations. Our social exchange psychology supplies a set of inference procedures that fill in all these necessary steps, mapping the elements in each exchange situation to their representational equivalents within the social contract algorithms, specifying who in the situation counts as an agent in the exchange, which items are costs and



benefits and to whom, who is entitled to what, under what conditions the contract is fulfilled or broken, and so on” (pg. 206-207, Cosmides & Tooby, 1992)

The arguments made by sociologists and psychologists on the importance of reciprocity in social interactions have prompted many economists to use reciprocity to explain subject behavior in various economic experiments (Berg, Dickhaut & McCabe, 1995; Smith, 1998; Hoffman, McCabe & Smith, 1998; Hirshleifer, 1999; Fehr & Gächter, 2000; Ortmann, Fitzgerald & Boeing, 2000). What distinguishes economic theories from those of other disciplines is the guiding presumption that behavior can be explained by notions of individual rationality; that people attempt to maximize their self-interests, without consideration for the collective welfare of the group. This is an important canon of economists’ noncooperative models, widely used to predict behavior in both natural market and experimental settings. However, noncooperative models have often been poor predictors of behavior (in games such as PD, ultimatum and dictator), and results that have long puzzled economists are now being explained using reciprocity.

In making the case for the use of reciprocity in economic markets Vernon Smith (1998) writes:

“All humans, in all cultures, engage in the trading of favors. Although the cultural forms of reciprocity are endlessly variable, functionally, reciprocity is universal. We do beneficial things for our friends, and implicitly we expect beneficial acts in kind from them. In fact, this condition essentially defines the difference between friends and foes. We avoid close relationships with those who do not reciprocate. You invite me to dinner and two months later I invite you to dinner.”

A key issue raised by V. Smith (1998) concerns the existence and form of reciprocity in an impersonal market exchange economy. Adam Smith (1776) in the *Wealth of Nations* proposed that: “It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own self-interest.” V. Smith (1998) reiterates that noncooperative behavior in impersonal markets “maximize the gains from exchange, the basis of specialization and wealth creation” (pg. 2). In order to explain these seemingly contradictory behaviors, that cooperation and reciprocity are universal in social relationships and yet competitive behavior is predominant and beneficial in economic markets, V. Smith (1998) argues that one must distinguish between personal and impersonal exchange. Friends exchange favors and can easily monitor the equality of reciprocity in the relationship. In exchanging goods in the marketplace, parties compete within the context of established property rights, and have implicitly established reciprocal duties. V. Smith (1998) writes:

If A gives help, favors, food, or objects to B, B must recognize his own obligation to fulfill A’s right to something in return, somewhere, sometime, if the relationship is to be maintained. This is the foundation of human social behavior, of bilateral associations, friendships in particular, and friendships in general. But social exchange requires not only positive reciprocity—trading favors—but also negative reciprocity, the endogenous policeman whereby failures to reciprocate are punished with unkind acts in which A reminds B of his or her



obligations. Without negative reciprocity, reciprocating altruists invite invasion by free riders (pg. 17-18).

Smith's (1998) argument is that reciprocity is universal, even in impersonal market exchanges, and that different rules or property rights will develop to maintain its existence.

To summarize, sociologists have argued that reciprocity is a fundamental norm found in all cultures. Evolutionary psychologists have provided evidence to indicate that reciprocity is a characteristic beneficial to the survival of a species and that reciprocity has likely been adapted into the human mind. Experimental economists have begun using reciprocity to explain some puzzling laboratory results and have argued that reciprocity is a necessary feature for the formation and proper functioning of economic markets.

If reciprocity is a key variable in social exchange, then in order for co-opetition to flourish, the parties must develop norms or rules of reciprocal behavior. These norms or rules will be contingent on the environment in which the behavior takes place. While it is beyond the scope of this paper to propose necessary and sufficient universal norms or rules of behavior for co-opetition, we will illustrate how different experimental environments will lead to different cooperative and competitive behavior.

The next section of this paper outlines a two-stage game where players choose either cooperative or competitive behavior in Stage 1, followed by an opportunity for reciprocal behavior in Stage 2. Several competing hypotheses are offered to explain subject behavior. The third section of the paper presents two experiments, one conducted in the classroom and the other in a computerized laboratory, designed to test the competing hypotheses. The results are described separately for each experiment. The final section of the paper compares and contrasts the outcomes from both experiments, and concludes with several implications for management and strategy.

A Co-Opetition Game

Figure 1 presents a diagram of the two-player, two-stage co-opetition game in extensive form. In Stage 1, each player chooses simultaneously between cooperation and competition. To reduce potential bias in the results, the choices actually presented to the subjects were simply labeled "X" and "Y", respectively. However, to avoid confusion in our discussion, we shall refer to the cooperative choice as COO and the competitive choice as CMP. After players make their simultaneous decisions in Stage 1, the choices are revealed and Stage 2 begins. Stage 2 is a one-round ultimatum bargaining game, where the combination of choices determines the size of the pie to be divided, and the assignment of bargaining roles. In ultimatum bargaining games one player is designated the Sender and the other the Receiver. Typically, the Sender makes a proposal to the Receiver on how to split the pie. The amount the Sender proposes to keep is called the "demand". The remainder available for the Receiver is called the "offer". If the Receiver accepts the offer, each receives their share of the pie. If the Receiver rejects the offer, each receives nothing.



Figure 1
Co-opetition Game in Extensive Form, Experiment 1

P1

P2

N

COO

CMP

P2

P1

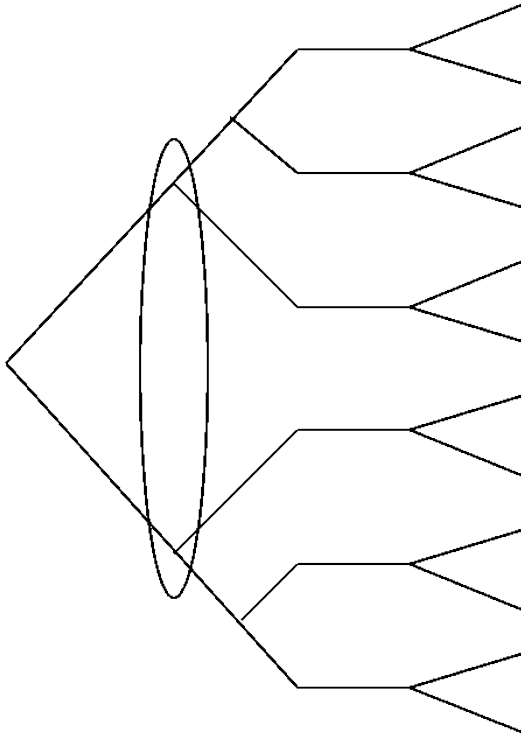
P2

P1

P1

P2

COO



CMP

COO

CMP

.5

.5

.5

.5

P2



P1

P1

P2

P2

P1

N

(0, 0)

(0, 0)

(0, 0)

(0, 0)

(0, 0)

(0, 0)

(14 - e, e)

a

r



r

r

r

r

r

a

a

a

a

a

(e, 14 - e)

(e, 12 - e)

(12 - e, e)

(6 - e, e)

(e, 6 - e)



In the first experiment if both players chose COO in Stage 1, the size of the pie in Stage 2 was 14 units and the Sender was determined randomly with each player having a 50/50 chance. If one player chose COO and the other CMP, the size of the pie shrank to 12 units, but the player choosing CMP was designated the Sender. Finally, if both players chose CMP, the pie shrank to 6 units and once again the role of the Sender was chosen randomly with each player having a 50/50 chance. Thus, players faced a choice between acting cooperatively to ensure a larger sized pie but not guaranteeing their role of the Sender, or acting competitively, where the size of the pie shrinks but their chance of becoming the Sender improves. The game was designed to capture the essence of co-opetition - cooperate to create the largest possible pie then compete to divide the proceeds.

Three different sets of hypotheses are offered to predict behavior in the game. Hypotheses are generated based on the assumptions: 1) of game theoretic reasoning; 2) of co-opetition, as described the literature, and 3) that the norm of reciprocity is the driving factor in player behavior. The hypotheses are summarized in Table 1. We begin by specifying the game theoretic solution.

Table 1
Hypotheses

General Hypotheses based upon Reasoning from:	Decisions in Stage 1	Sender's Demand	Receiver's Decision
Game Theory	CMP/CMP	Pie - e	Accept any positive offer
Co-opetition	COO/COO	Pie - e	Accept any positive offer
Reciprocity	COO/COO	$P * R_n$	Accept offer if reciprocally fair

Because players may not make binding commitments in advance, and the pie size and roles are common knowledge, the game can then be solved by backward induction. Backward induction presumes you begin your analysis at the end of the game and work backwards to find the optimal strategy. To illustrate this technique, assume that the game will be played just once, both players have chosen COO, and the size of the pie is 14 units. Further, assume that Player 1 has been assigned the role of the Sender and has made an offer of e units ($e \geq 0$) to Player 2. Player 2 must decide whether to accept or reject e. This situation corresponds to the top two branches of Figure 1. For ease of presentation, the potential payoffs and subsequent branches in the game tree are displayed with a single end-point: pie size - e. If we assume that any payoff is preferred to a zero payoff, Player 2 should accept e and Player 1 receives $14 - e$. Since any positive offer should be accepted, the actual amount of e should be the minimum possible positive offer. Similarly, if Player 1 had been assigned as the Receiver, we expect Player 1 to accept e. Since the COO/COO choices result in the random assignment of roles, the expected payoff to each player is $0.5*(14 - e + e) = 7$ units.

A similar analysis reveals the payoffs for each remaining combination of Stage 1 choices. For example, if both players choose CMP, following the logic above, the size of the pie



shrinks to 6 units and their expected payoffs are $0.5*(6 - e + e) = 3$ units. If one player chooses COO and the other CMP, the size of the pie is 12 units, and the player choosing CMP is assigned the role of the Sender, and the player choosing COO the role of the Receiver. The payoffs are $12 - e$ for the Sender and e for the Receiver. Thus, each player has a dominant strategy to choose CMP since the expected payoff is greater than that for choosing COO, regardless of what the other player does. Game-theoretic reasoning also specifies that the Sender make only a minimal offer, e , to the Receiver, and that the Receiver accepts all positive offers.

A second set of hypotheses can be derived from the prescriptions of co-opetition. Co-opetition is presumably a normative theory and while exact predictions are not easily specified, we offer the following interpretation: co-opetition proposes that competitors cooperate when creating a pie and compete when dividing it up. Thus, in Stage 1 each player should make the cooperate (COO) choice, attempting to generate the largest possible pie. In Stage 2, where strict competition is prescribed, the player's should adhere to the standard game theoretic prediction of ultimatum bargaining. The Sender offers only a minimal amount of the pie, and the Receiver accepts any positive offer.

The third set of predictions is based on reciprocity. If a player expects that he or she will meet up with the other player again, then the norm of reciprocity is activated. If there is no or a very unlikely chance of the two players meeting again, then reciprocity is not a factor. Reciprocity requires that in Stage 1 both players choose COO since this results in the largest pie. In Stage 2, the Sender should offer a "fair" amount of the pie. We propose that the reciprocity hypothesis predicts the Sender will offer $(P * R_n)$, where P is the size of the pie and R_n is the percentage required for reciprocal fairness. We next present two experiments to examine these hypotheses.

Experiment 1

Design And Method

Experiment 1 was conducted with 184 students, in the last semester of their undergraduate degree program, enrolled in two sections of a capstone strategic management course at a large mid-western university. The experiment was conducted during a regularly scheduled class.

To begin the experiment all subjects were given written instructions on the structure of the two-stage co-opetition game. The instructions were also read aloud. Subjects were playing for extra credit points amounting to about 1% of their final grade. The strategy method was used to elicit responses; this required each subject to specify his or her strategy under every possible contingency of the game. Subjects filled out the form shown in Figure 2, which captures all decision contingencies. In Stage 1, subjects were asked to choose either COO or CMP. In Stage 2 of the game, each subject was asked to designate how many points he would be willing to offer as the Sender, and the minimum number of points he would be willing to accept as the Receiver, under all the possible contingencies of the game.



Figure 2
Decision Form for Experiment 1

Stage 1:

I choose X / Y (circle choice)

Stage 2:

If the pie size is:	As Sender, I will offer:	As Receiver, I am will to accept any offer greater than:
14		
12		
6		

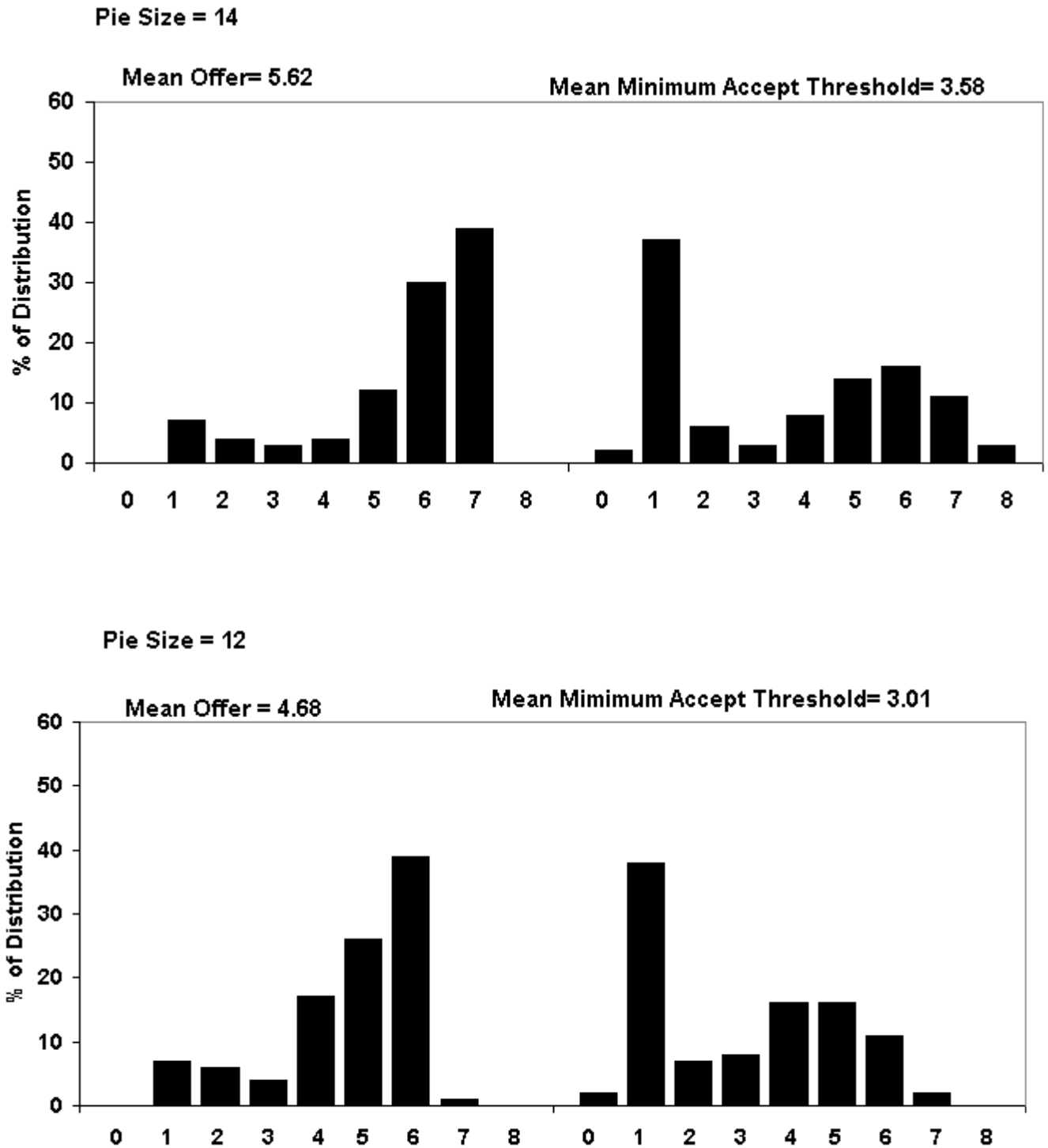
Each subject was told that his or her strategy would be randomly matched against another subject's strategy. If both subjects choose COO (CMP), the size of the pie would be 14 extra-credit points (6) and each would have a 50/50 chance of being assigned the Sender. If one chose COO and the other chose CMP, the pie would be 12 points, and the player choosing CMP would be assigned the role of the Sender. The offer amount would be read from the Sender's decision sheet and compared to the minimum accept threshold reported on the Receiver's decision sheet. If the offer exceeded this amount, the points were split as specified. If the offer was less than this amount, both players received zero extra credit points. Subjects were told the game would be played once and that all players' choices would remain anonymous. The random matching of subjects occurred after the class and the results were given to the students during the next class meeting.

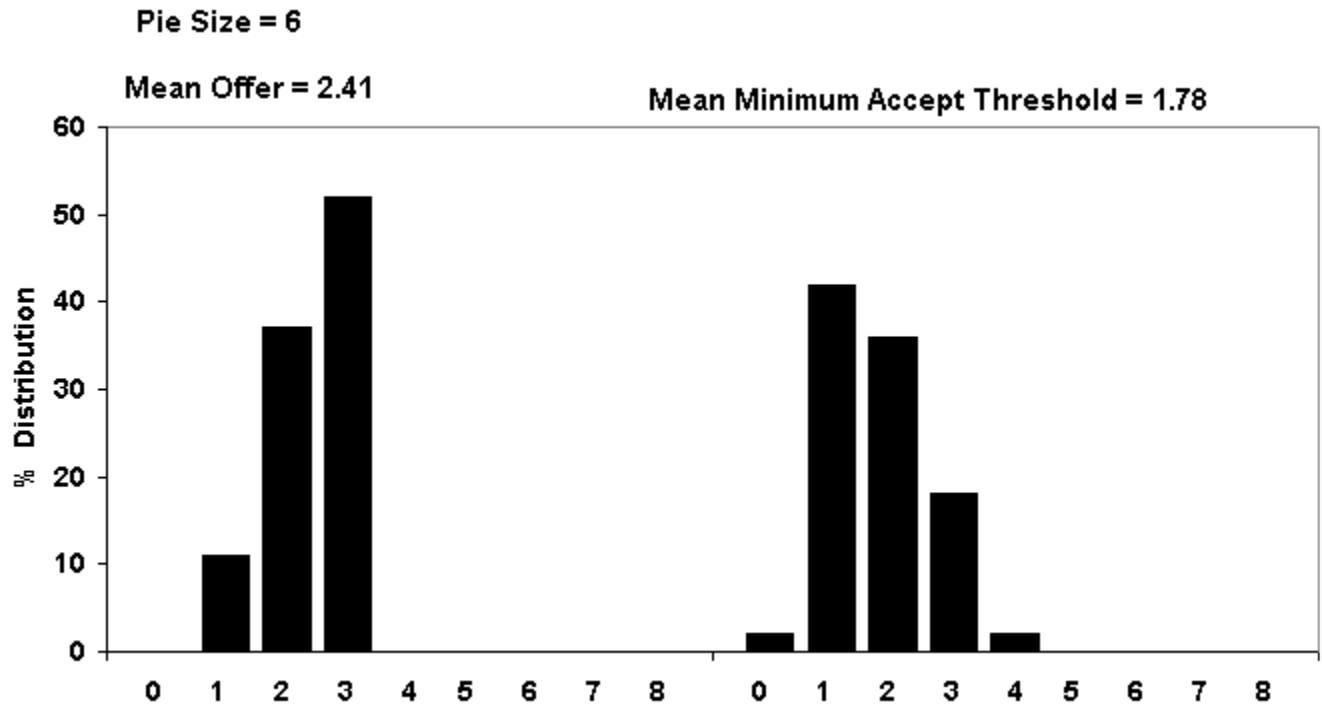
Experiment 1 – Results

Eighty eight percent of subjects chose to play cooperatively in Stage 1. While the decisions were randomly paired (per instructions) to determine the extra credit points each student earned, the analyses that follow do not reflect these pairings. Since the data was collected using the strategy method, we focus on aggregate responses across all contingencies. The distribution of Stage 2 offers and minimum accept thresholds by pie size are shown in Figure 3. The top panel shows the aggregate Stage 2 decisions for players, assuming both made cooperative choices in Stage 1, and the pie size was 14. The middle panel shows similar distributions if the players discovered that one had chosen cooperatively and the other competitively in Stage 1, and the pie size was 12. Finally, the bottom panel reports the decisions for players who both made competitive choices in Stage 1. The distribution of offers is shown as the left set of vertical bars, and the minimal accept threshold as the right set. Because the size of pie varies between panels, the figure reports the percent distribution, a comparable metric. The mean offer and mean accept thresholds are shown near the top of each panel.



Figure 3
Distribution of Sender's Offers and Minimum Acceptable Offers





For a pie size of 14 the mean offer was 5.62 and the mean minimum accept threshold was 3.58. For a pie size of 12 the mean offer dropped to 4.68 and the mean minimum accept threshold fell to 3.01. If the resulting pie size was 6, the mean offer dropped to 2.41 and the mean accept threshold fell to 1.78. These declines are not surprising, given that players have a smaller pie to split. What's interesting is the consistency of results between pie sizes. For each pie size, the modal response was to offer half of the pie. Thirty nine percent of players offered 7 when the pie was 14, 39% offered 6 when the pie was 12, and 52% offered 3 when the pie was 6. The modal response for the minimum accept threshold across each pie size was to accept an offer of 1 or more. Thirty seven percent of all players accepted an offer of 1 or more when the pie was 14, 38% accepted a similar amount when the pie was 12, and 42% accepted when the pie was 6.

We also calculated the ratio of offer to minimum accept threshold for each subject by pie size. Excluding three subjects who were willing to accept a zero offer, the ratio was 1.55, 2.37, and 2.64 for pie sizes of 6, 12, and 14 respectively. Roughly, subjects were willing to offer more than twice the minimum amount they were willing to accept.

Using the complete strategies collected from the subjects, a round robin tournament was simulated in which each strategy was matched against every other strategy in the population. A score was computed for each strategy based on its aggregate performance (in extra credit points) against all other strategies. For example, assume that a strategy has a policy of choosing to cooperate in Stage 1, accepting all offers equal to or greater than 1 in Stage 2, and offering exactly half the pie in all contingencies. If this strategy is matched up against itself, it will earn 7



as a Sender and 7 as a The Receiver when the pie is 14. Since it is possible for each strategy to be randomly assigned as either a Sender or a Receiver, strategies were matched against each other twice and, where appropriate, a strategy's score as both a Sender and a Receiver was computed. The analysis revealed that the 184 subjects used 100 different strategies. A summary of the more popular strategies (unique strategies that were used by more than two different subjects) is reported in Table 2. This table shows the rank, frequency, Stage 1 decision, offer and minimum accept threshold by pie size, and the final score from the round-robin tournament. Three different strategies tied for the highest score, earning 2204 points, and one of these three was the most frequently used ($n = 21$) strategy in the entire population. This popular strategy chose to cooperate in Stage 1, offered exactly half of the pie as the Sender, and accepted all offers of 1 or greater as the Receiver. Of the 11 popular strategies, 10 chose cooperation in Stage 1. A review of the best-performing strategies, including those not reported in Table 2, indicates several common features. Typically, these strategies cooperated in Stage 1, offered half of the pie as the Sender, and accepted minimal offers as the Receiver. The worst performing strategy, with a score of 1016, cooperated on Stage 1, but demanded half when the pie was 6, and more than half (7 and 8) when the pie was 12 and 14 (respectively). Only seventeen strategies, adopted by a total of 21 subjects, chose competition in Stage 1. The median rank of these strategies was 77, clearly under-performing the average. The highest performing strategy that chose to compete in Stage 1 was ranked 37th overall, earning 2072 points.

Table 2
Selected Results for Experiment 1 Round Robin Tournament

Strategy Label	Rank2	Frequency	Stage 1	O3	A3	O12	A12	O14	A14	Tourney	Average
1	1	21	X	3	1	6	1	7	1	2204	5.99
2	1	1	X	2	1	5	1	7	1	2204	5.99
3	1	1	X	3	0	6	0	7	0	2204	5.99
4	24	3	X	3	1	5	1	6	1	2202	5.98
5	24	1	X	3	1	4	1	6	1	2202	5.98
6	24	1	X	2	4	5	1	6	1	2202	5.98
19	47	2	X	3	2	6	3	7	4	2152	5.85
20	47	1	X	3	1	6	4	7	4	2152	5.85
25	55	1	X	3	2	6	3	7	5	2124	5.77
26	55	6	X	3	2	6	4	7	5	2124	5.77
27	62	1	X	3	2	5	4	6	5	2122	5.77
28	62	1	X	2	2	5	4	6	5	2122	5.77
29	62	1	X	2	2	4	3	6	5	2122	5.77
36	73	1	X	2	2	5	4	6	5	2080	5.65
37	75	1	Y	3	1	5	1	6	1	2072	5.63
48	87	1	X	2	2	6	5	7	6	2028	5.51
49	88	1	Y	2	2	5	4	5	5	2026	5.51
50	88	7	X	2	2	4	4	5	5	2026	5.51
51	96	1	X	3	2	6	4	7	6	2024	5.50



52	97	1	X	2	2	4	4	7	6	2024	5.50
61	108	1	X	3	3	5	5	5	5	1970	5.35
62	109	2	X	3	3	6	5	7	6	1968	5.35
63	109	7	X	3	2	6	5	7	6	1968	5.35
64	109	1	X	3	1	6	5	7	6	1968	5.35
65	119	1	X	3	3	5	5	6	6	1966	5.34
66	119	1	X	3	2	5	5	6	6	1966	5.34
67	119	4	X	2	2	5	5	6	6	1966	5.34
68	119	1	X	1	1	5	5	6	6	1966	5.34
69	126	1	X	2	1	3	2	4	2	1961	5.33
83	149	1	X	3	2	5	6	7	6	1908	5.18
84	150	1	X	1	1	2	2	3	2	1906	5.18
85	151	1	X	3	3	3	3	3	3	1886	5.13
86	152	1	X	2	2	4	3	3	4	1871	5.08
87	153	1	X	3	2	5	5	5	6	1870	5.08
88	154	1	X	1	1	2	5	4	6	1742	4.73
89	155	1	X	3	3	5	5	7	7	1686	4.58
90	156	1	X	3	2	4	5	6	7	1684	4.58
91	157	16	X	3	3	6	6	7	7	1626	4.42
92	173	1	X	3	3	6	6	6	7	1624	4.41
93	174	1	Y	2	1	2	1	2	1	1586	4.31
94	175	1	Y	1	1	2	1	2	1	1551	4.21
95	175	1	Y	1	1	2	2	2	2	1551	4.21
96	177	4	Y	1	1	1	1	1	1	1521	4.13
97	181	1	X	2	3	2	6	2	7	1348	3.66
98	182	1	X	3	3	4	4	6	8	1264	3.43
99	183	1	X	3	3	5	7	6	8	1112	3.02
100	184	1	X	2	3	5	7	5	8	1016	2.76

To summarize, several results from Experiment 1 are noteworthy. First, 88% of subjects chose cooperatively in Stage 1. Second, most subjects chose to offer significantly more than the minimal positive offer predicted by game theoretic reasoning. This suggests that the co-opetition and reciprocity hypotheses are better predictors of behavior than the game theoretic hypotheses. Two interpretations of the ultimatum bargaining results are possible. First, since the game was played without repetition using the strategy method, any attempt by the Receiver to punish greedy Senders would be futile. Subjects may recognize early on the strong bargaining position of the Sender and thus, be willing to accept minimal offers if necessary. This interpretation would also suggest that as Senders, subjects should demand the majority of the pie. Clearly, this is not the case. A second interpretation incorporating reciprocity may explain this inconsistency. When in the role of the Sender, the mean offer by subjects is approximately 40% of the pie, indicating that most subjects are willing to offer a "fair" amount of the pie. Why be fair when you are in the stronger bargaining position? A key issue may be how the assignment of the Sender and the Receiver was realized. As has been shown in other experiments (Hoffman



& Spitzer, 1985; Hoffman, McCabe, Shachat, & Smith, 1994), when the assignment of the Sender and the Receiver is random or arbitrary, as was the case in this experiment, subjects are more likely to frame the bargaining as a personal exchange. In this case, the norm of reciprocity is strong. This leads the Senders to make fair offers, since it is an accepted norm of behavior. Since the experimental design did not allow repeated interactions, subjects in the role of the Receiver may recognize there is no chance to punish a greedy Sender, and thus have little reason to reject any positive offer. To better understand the effects reciprocity, a second experiment is presented that allows for repeated interactions.

Experiment 2

Design and Method

Experiment 2 differed from Experiment 1 in the following respects: (1) The co-petition game was repeated for 50 trials. (2) Subjects made choices as the game progressed (decision method), rather than specifying their complete strategy for both stages of the trial (strategy method). (3) The experiment included two treatments. In one condition (Fixed), anonymous subjects were paired for all 50 trials. In the other condition (Random), anonymous subjects were randomly matched with an opponent in each of the 50 trials. (4) The game was played in a laboratory of networked computers that allowed subjects to make decisions in real time and receive immediate feedback following the outcome of each trial. (5) Payoffs, contingent on performance, were monetary rather than extra-credit points. The size of the pie to be divided was 100 francs (an experimental currency converted to \$US at the end of the experiment) for a COO/COO choice, 80 for COO/CMP, and 60 for a CMP/CMP outcome.

Forty subjects from a western University participated in Experiment 2. Subjects consisted of undergraduate and graduate business students who responded to an announcement in class. The announcement promised payoffs contingent upon performance, from \$5 to \$30 for participation in a two-hour computer controlled experiment on economic decision making. As subjects signed up, they were randomly assigned to one of the two conditions.

The experiment was conducted in a computer laboratory that contained over twenty networked microcomputers. As subjects entered the laboratory they were randomly seated at one of the workstations and asked to read a copy of the instructions placed beside them. The instructions welcomed the subjects to the lab and informed them that if they made careful decisions they had an opportunity to earn a considerable sum of money, which would be paid to them in cash at the end of the experiment. The instructions were also read aloud. After subjects were given an opportunity to ask questions, the experiment began.

Subjects began the game by choosing COO or CMP on their workstations. After all decisions were made, a central computer matched the subjects according to the condition. Within each pairing, if both subjects chose COO or CMP, the computer randomly assigned one subject the Sender and the other the Receiver. The player assigned as the Sender then entered the amount she wished to offer the Receiver. This amount was displayed to the Receiver who either accepted or rejected the offer. As in the first experiment, if the offer was



accepted, the Receiver earned the amount of the offer, and the Sender earned the difference between the size of the pie and the offer amount. At the end of each trial the computer displayed the subject's current and accumulated earnings. Because subjects were paired, the computer program dictated that all participants proceed at roughly the same pace, but allowed subjects sufficient time to contemplate each decision. At the end of the experiment subjects were paid based upon their accumulated earnings for all 50 trials, plus a \$5.00 show-up fee. Subjects were paid individually and anonymously, and then dismissed from the laboratory. Average earnings were \$18.15.

Results - Experiment 2

The discussion of results focuses on several key measures: the proportion of cooperative choices, mean demand (pie size minus offer amount), percent rejections, and mean payoffs for both the Senders and the Receivers. These measures are summarized by condition in Table 3 and discussed below. The proportion of cooperative choices was significantly higher in the Fixed condition (88%) than in the Random condition (64%) ($z = 13.01$, $p < 0.000$). Interestingly, mean demand was also significantly higher in the Fixed condition (58) than in the Random condition (53) ($t = 7.445$, $p < 0.000$). Mean demand given the Stage 1 outcome is also reported in Table 3. As expected, across both conditions the Senders demanded more (in absolute terms) when they had a larger pie to split. To compare relative demand given a particular Stage 1 outcome, we computed the mean percent demand, both in total and for each outcome category. These results suggest that the Senders demanded a slightly greater percentage of the pie in the Fixed condition (60%) than in the Random condition (58%) ($t = 3.426$, $p < 0.000$). The mean percent demanded increases in the outcome categories for the Senders in the Fixed condition and is significantly greater in each outcome category than for the Senders in the Random condition (results of these statistical tests are available on request).

Although the Senders demanded more (both in absolute and relative terms), reject rates were lower in the Fixed condition (10%) than in the Random condition (15%) ($z = 2.397$, $p < 0.008$) and, increased as the size of the pie shrunk. The combination of greater demand and lower reject rates enabled the Senders in the Fixed condition to earn more than their counterparts in Random condition (51.7 and 44.4 francs, respectively; $t = 5.687$, $p < 0.000$). Lower reject rates in the Fixed condition also allowed the Receivers to earn more than their counterparts in the Random condition (36.3 and 33.9 francs, respectively; $t = 2.466$, $p < 0.014$). Finally, as expected, the Senders earned higher payoffs than the Receivers in both the Fixed (51.7 and 36.3 francs, respectively; $t = 13.517$, $p < 0.000$) and Random (44.4 and 33.9 francs, respectively; $t = 9.207$, $p < 0.000$) conditions. However, this is only part of the story. Mean payoff for the Receivers following a COO/COO outcome was 38.2 and 37.3 in the Fixed and Random conditions, respectively. If these Receivers would have chosen competitively, shifting the outcome from COO/COO to CMP/COO changing their role to that of the Sender, they would not have increased their expected earnings. The Senders in this outcome category earned only 36.2 and 36.5 in the Fixed and Random conditions, respectively.



Table 3
Summary Measures from Experiment 2

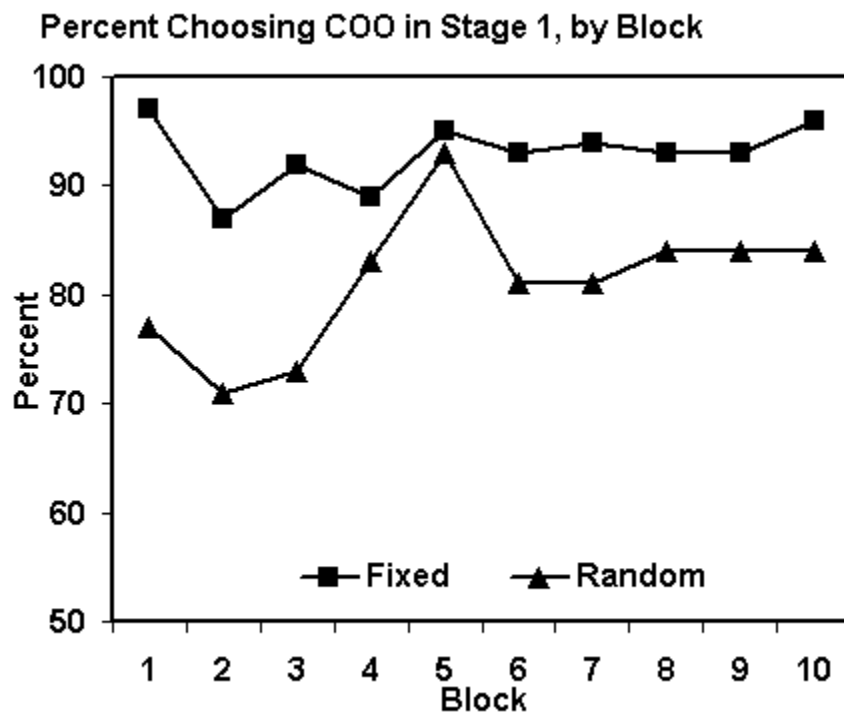
Measure	Condition	
	Fixed	Random
Proportion of Cooperative Choice	88%	64%
Mean Demand – Total	58	53
Mean Demand COO/COO outcome	59	58
Mean Demand CMP/COO outcome	49	46
Mean Demand CMP/CMP outcome	43	36
Mean Percent Demand – Total	60%	58%
Mean Percent Demand COO/COO outcome	59%	58%
Mean Percent Demand CMP/COO outcome	61%	57%
Mean Percent Demand CMP/CMP outcome	67%	57%
Percent Rejections – Total	10%	15%
Percent Rejections COO/COO outcome	8%	13%
Percent Rejections CMP/COO outcome	25%	19%
Percent Rejections CMP/CMP outcome	33%	25%
Mean Payoff for Sender – Total	51.7	44.4
Mean Payoff for Sender COO/COO outcome	54	49.5
Mean Payoff for Sender CMP/COO outcome	36.2	36.5
Mean Payoff for Sender CMP/CMP outcome	28.3	26.2
Mean Payoff for Receiver – Total	36.3	33.9
Mean Payoff for Receiver COO/COO outcome	38.2	37.3
Mean Payoff for Receiver CMP/COO outcome	24.2	28.6
Mean Payoff for Receiver CMP/CMP outcome	14.3	21.8

To analyze changes in these measures over time as subjects gained experience with the task, we computed the proportion of cooperative choice, mean demand (in both absolute and percentage terms) and percentage of rejects by block. Block is defined as five consecutive trials (i.e., trials 1- 5 are Block 1, trials 6 – 10 are Block 2, etc.). These results are displayed in Figure 4. The top-left panel of this figure shows the percent choosing cooperatively across block. Results for the Fixed condition appear as the solid line with square markers, and results for the Random condition appear as the solid line with triangular markers. To test for significance, we conducted a 2 x 10 (Condition by Block) ANOVA with Block as a repeated factor. The results indicated a significant effect for condition ($F = 4.48$, $p < 0.05$), no effect for



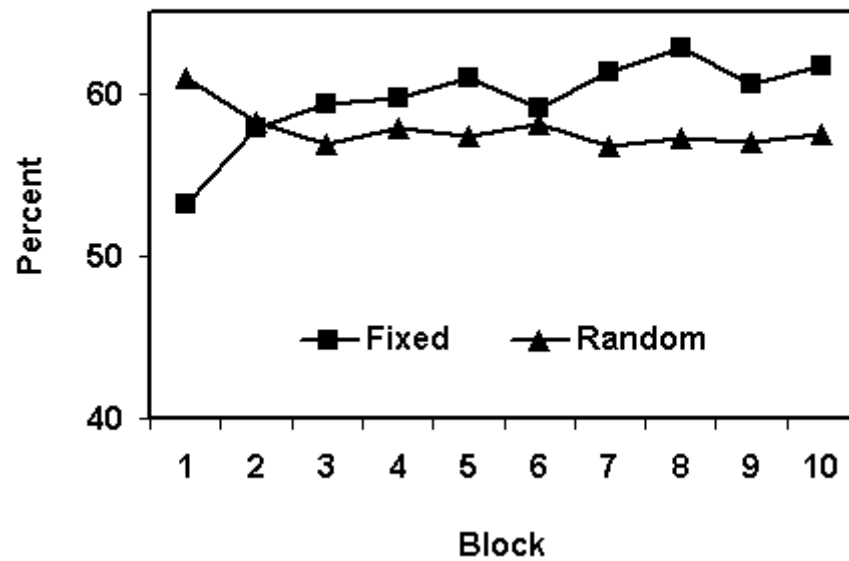
block ($F = 0.8603$, $p < 0.57$). The interpretation is straightforward: consistent with the results reported in Table 3 and discussed above, subjects in the Fixed condition made more cooperative choices than those in the Random condition. Further, these differing levels of cooperative choice did not change with experience.

Figure 4
Summary Measures by Block

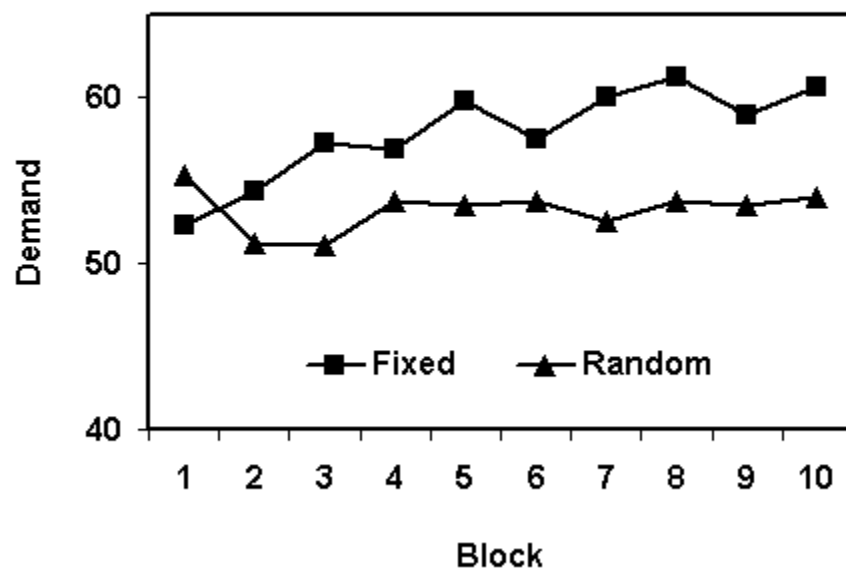




Percent Demand by Block

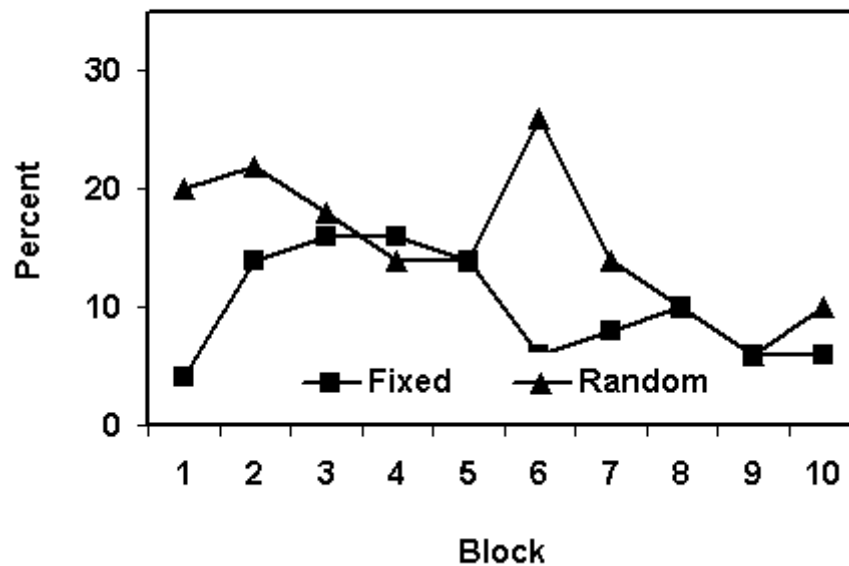


Absolute Demand by Block





Percent Rejections by Block



Absolute demand by condition is shown in the bottom-left panel of Figure 4. To test for significance another 2×10 (Condition by Block) ANOVA with Block as a repeated factor was conducted. The ANOVA revealed a significant effect for condition ($F = 57.03$, $p < 0.01$), block ($F = 2.53$, $p < 0.01$) and the condition $\times$ block interaction term ($F = 2.66$, $p < 0.01$). These results, consistent with Table 3 and the earlier discussion, indicate that the absolute level of demand was greater in the fixed condition and that the level of demand was not stable across blocks. As seen in this panel of Figure 4, the level of demand increases across blocks in the Fixed condition. For the Random condition, the level of demand initially declines then increases and remains stable.

We also computed the percent demanded by block. A preferred method would be to treat pie size as an independent factor in an ANOVA. However, too few observations were available to compare mean demand by pie size, across block. This analysis appears in the top-right panel of Figure 4. A 2×10 (Condition by Block) ANOVA with Block as a repeated factor shows a small but significant effect for condition ($F = 12.13$, $p < 0.01$), no effect for block ($F = 0.97$, $p < 0.46$), but a significant effect for the interaction term ($F = 4.95$, $p < 0.01$). Again, the interpretation is straightforward: the mean percentage of the pie demanded was higher in the Fixed condition, and seemed to increase across block, whereas this measure was generally lower in the Random condition and declined slightly during the first three blocks before stabilizing at approximately 57% throughout the remaining Blocks. The means of the percent demanded by condition show the familiar “crossing pattern”, indicative of an interaction effect.

The final measure considered is the percentage of Receiver rejections in Stage 2. This variable is displayed for both conditions across Block in the lower-right panel of Figure 4. A $2 \times$



10 (condition by Block) ANOVA with Block as a repeated factor revealed a significant effect for condition ($F = 13.43$, $p < 0.01$), block ($F = 2.91$, $p < 0.01$) and the condition by Block interaction ($f = 2.50$, $p < 0.01$). Consistent with the summary results reported in Table 3, rejections were more prevalent in the Random condition with Block explaining a significant portion of variance.

With more than 75% of observations across both conditions yielding a COO/COO outcome, more detailed analyses of these observations are in order. The number and percent of observations, percent rejections and the mean Sender payoff are displayed by category of percent demand on Table 4. The top half of the table shows these outcome measures for the Fixed condition and the bottom half of the table reports the results for the Random condition. Two findings are noticed. First, although the mean percent demand given a COO/COO outcome, reported in Table 3 and discussed above, was nearly identical across conditions (59% for the Fixed condition and 58% for the Random condition), the distribution of demand varied greatly. In the Fixed condition, subjects more frequently demanded either a “fair” share (0-50%) of the pie, or a rather “large” share (61-70% and 71-100%), whereas subjects in the random condition were more likely to demand a “modest” share (51-60%) of the pie. Second, reject rates, although higher in the Random condition, also varied as a function of percent demand. The Receivers in both conditions never rejected a demand in the 0-50% category. However, as the percent of the pie demanded increased, reject rates generally increased. In each category of demand, reject rates were higher in the random condition than in the fixed condition. The combination of similar mean demand yet higher reject rates in the Random condition had a large impact on the mean Sender payoff. The mean Sender payoff was higher in the Fixed condition (54.0) than the Random condition (49.5), and increased with percent demanded in the Fixed condition but generally declined in the Random condition.

Table 4
Mean Outcomes by Percent Demand Given COO/COO in Stage 1

Percent Demand	Number of Observations	Percent of Observations	Percent Rejections	Mean Sender Payoff
Fixed Condition				
0-50%	134	30.60%	0.00%	49
51-60%	188	42.90%	5.90%	54.9
61-70%	68	15.50%	20.60%	51.8
71-100%	48	11.00%	18.80%	67.4
Mean	438	100.00%	7.80%	54
Random Condition				
0-50%	30	9.50%	0.00%	50
51-60%	248	78.20%	7.70%	52.9
61-70%	33	10.40%	54.50%	29.8
71-100%	6	1.90%	83.30%	12.5



Mean	317	100.00%	13.20%	49.5
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Discussion

The results across both experiments show that the majority of subjects act cooperatively in the first stage of interaction, do not make excessive ultimatum demands once the size of the pie has been determined, and frequently reject positive offers. Each of these findings is inconsistent with game-theoretic predictions that specify competition (CMP) in Stage 1 of the game, offering only small positive amounts and accepting any positive offer in the second stage of the game. The results are also inconsistent with co-opetition hypotheses that stipulate cooperative behavior in Stage 1, but require the Sender to make aggressive demands in the second stage of the interaction. Only the reciprocity hypotheses, which entail cooperation in Stage 1 and making “fair” offers in Stage 2, are generally supported.

The behavior of subjects in Experiment 1 is particularly noteworthy. The environment, which ensured complete anonymity and provided no opportunity for either positive or negative reciprocity, was most amenable to promoting behavior consistent with the co-opetition hypotheses. Although subjects generally (88%) cooperated in Stage 1, they failed to make aggressive demands and frequently rejected positive offers, two actions inconsistent with our notions of co-opetition. Two explanations are possible. First, the design of the experiment did not preclude subjects from adopting norms of fair play or reciprocity that they brought with them to the experiment. Clearly, when faced with uncertain tasks, subjects can be expected to rely on behavior or heuristics that have worked well in natural settings in the past. Given that they had no experience with the task, which they faced only a single time, learning or adopting new norms of behavior was unlikely. Second, subjects were all from the same class, and although the experiments promised anonymity, there may have been some expectation that they would discuss their behaviors in a subsequent class period.

The second experiment where subjects could learn and adapt based on prior play, shows that repeated interactions have a greater cooperative effect when player pairings are fixed, rather than determined randomly in each trial. We argue that repeated play is not sufficient to maintain high levels of cooperation, rather repeated interactions must also allow for a high probability that the players will meet again and their past history of cooperation or competition be available.

Cooperation among competitors will not survive unless each party of exchange can expect to receive a benefit for a benefit given. The norm of reciprocity is deeply ingrained in human behavior and market participants must determine how this norm will affect co-opetive relationships in order to determine how relationships should be managed. Gouldner (1960) writes:

“...the reciprocity norm...imposes obligations only contingently, that is, in response to the benefits conferred by others. Moreover, such obligations of repayment are contingent upon the imputed value of the benefit received. The value of the benefit and the debt is in proportion to and varies with—among other things—the intensity of the recipient’s need at the time the benefit was bestowed (“a friend in need...”), the resources of the donor (“he gave although he could ill



afford it”), the motives imputed to the donor (“without regard of gain”) and the nature of the constraints which are perceived to exist or to be absent (“he gave of his own free will...”). Thus the norm of reciprocity may vary with the status of the participants within a society.” (pg. 171).

If cooperation and competition in economic markets are too be married, then market participants will have to develop more complicated standards of behavior than currently exist. While many understand the social rules of competition, and many more understand the social rules of cooperation, the rules that govern their simultaneous use of both are not transparent. Thus while reciprocity is necessary to get the cooperation in co-opetition, it may actually hinder the required competition.

Our contribution to the study of cooperative strategy in general, and co-opetition in particular, is in demonstrating a necessary condition for cooperation to emerge. Our results show that without an opportunity for reciprocal interaction, levels of cooperation will be lower. This demonstration was based on experimental evidence gathered from a game-theoretic model, both of which are only grudgingly accepted in management and strategy research (Ghemawat, 1997). Further experiments are required to explore the boundary conditions of reciprocity. Recent experimental evidence (Fehr and Gächter, 2002) shows that an important element of cooperation is altruistic punishment. In several public goods type experiments, it was found that subjects were consistently willing to punish free riders, even when the punishment was costly to the punisher and excluded the possibility for future material gain. It is argued that strong negative emotions are the triggers that cause the punishment of free riders. If true, this suggests that there is an emotional element in reciprocating behavior that should be further investigated in the laboratory. Field researchers interested in environmental factors that determine cooperative and competitive strategy should also explore these results.

There are several limitations of this study. First, as mentioned above, the results are based on student decisions in an experimental setting. Although nearly all of the students were enrolled in the college of business, generalizing their behavior to that of decision makers in actual firms may prove difficult. While our results seem fairly intuitive, replication or evidence from natural settings would prove a valuable complement. Second, although the experiment lasted 50 trials, this may not have been sufficient for subjects to learn and adopt new norms and behaviors. Especially if norms involving reciprocal action are as deeply ingrained in our behavior as Gouldner and others would have us believe. Finally, our results are likely dependent on certain arbitrary parameters used in our model. Different levels of cooperation may emerge if we changed the size of the pie, shrinkage rates for competitive choices, the exchange rate from francs, our experimental currency, to \$US, or even the randomization mechanism for determining roles of the Sender and the Receiver.



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