Introduction

One of the successes in contemporary social science is the development and proliferation of game theory. For a wide range of phenomena, game theory produces enormous insight into the strategic interaction of individuals. Its greatest power lies with predicting the behavior of large groups -- whether this is in the context of markets, political elections, information aggregation or when confronting large-scale social dilemmas. However, as Ostrom (1998) reminds us, game theory also generates predictions for small group behavior that are at variance with the results of carefully controlled (and replicated) laboratory experiments.

The primary approach adopted to explain the non-equilibrium behavior observed in experiments and connect it more carefully with game theoretic models is "behavioral game theory" (Camerer, 1997). Two branches of theoretical and experimental research have dominated recent research: the investigation of bounded rationality and learning behavior - how individuals learn to play a new game in an unfamiliar context; and the extension of utility functions to include so-called "exotic" preferences - other-regarding preferences for fairness, altruism, spite, status.[1] Both approaches have achieved considerable insight. This research focuses on the latter.

Introducing exotic preferences constitutes a marked shift in thinking about strategic play ~ at least for game theorists. Most models of strategic play assume that all

[1] This is a very active research area, with many recent journal publications and working papers. For bounded rationality and learning see, among others, Anderson, Goeree and Holt (1997), Camerer and Ho (1997), Cooper, Garvin and Kagel, (1997), McKelvey and Palfrey (1995,1996), Roth and Erev (1995), Samuelson (1996). On the topic of "exotic" preferences see Andreoni (1990), Andreoni and Miller (1998), Frank (1988) Rabin (1993, 1998) and the references therein. Of course, many other books and papers could be cited, and what we offer here is just a sample.

actors approach the game in the same manner. While actors may differ in their preferences over outcomes, they are not assumed to differ from one another in terms of reasoning about strategy. Suppose, however, that some actors in a bargaining setting show anger when given an offer that is too low, while others show no emotion. Does the display of emotion have any effect on bargaining? According to standard game theoretic models emotional outbursts should have no effect. However, anger can and does have an impact. Several years ago the second author had a used car for sale. One particularly irritating person came by, looked at the car and made a ridiculously low offer. The offer and the person's demeanor made Wilson angry and he rejected it. Later the same person called back, offering Wilson more than the second highest bidder. The offer was refused and Wilson sold to the lower bidder. From what we can tell, this form of emotionally charged behavior, overriding narrow self-interest, is not limited to the second author's personality quirks.

Modeling such strategies is very difficult. First, if actors hold "exotic" preferences, then there must be some way for them to credibly signal their type. At the same time others must be able to read those signals and find them credible. For traditional game theorists, credibility requires costly commitment. Signals about one's type, especially absent *any* reputation, are usually costless and at best constitute "cheap talk." Despite such objections, people engaged in exchange often signal their type and their partners are often very good at inferring the others' type.

This paper focuses on the problem of *social signaling* in which agents seek cues about others' intentions and send cues about-their own intentions. Rather than accounting for all possible social signals that individuals might display (and that can be inferred), we concentrate on simple, stylized, non-verbal facial expressions. We argue that people are adept at "reading" facial expressions. In the absence of any other information about their partner, they will rely on expressions to build expectations about their partner's behavior.

This ability to "read" another individual yields a mix of behavioral strategies that are much richer than most game theoretic models allow. In this paper we focus on a class of social signals that yield consistent behavioral predictions of non-equilibrium play in extensive-form two-person games. In particular we analyze behavioral play in the ultimatum game.

In the next section we sketch the motivation for the consistency of non-equilibrium behavior. In the second section we review some of the extensive literature on facial expressions, largely drawn from social psychology. Because human faces can produce complex blends of expressions, we adopt simplified facial icons. The third section discusses two laboratory experiments that lay the foundation for expectations about behavior and test those expectations using an ultimatum game. The fourth section discusses these results.

Motivation

An under utilized empirical model in political science is the "ultimatum " game. This game is a special case of the Baron and Ferejohn (1989) agenda model, which in turn is related to the Rubinstein (1982) bargaining model. The Baron and Ferejohn model has spawned an enormous amount of theoretical work in political science, but has generated surprisingly few empirical results. The generic model has one actor selected according to some commonly agreed upon rule. That actor then proposes an allocation of benefits to a group and that group in turn votes on the allocation according to some voting rule. If the allocation is accepted, the game ends and if not the game continues. If continuing then a new proposer is selected and a new allocation is proposed. One of the key findings is that if actors are impatient (they heavily discount the future) then under many voting rules the first proposer enjoys a substantial advantage when making allocations. That is, the first proposer can take a large share.

The "ultimatum" game is a simple variant of the Baron and Ferejohn "closed rale" model. It is equivalent to a one-period unanimity rale in which a randomly selected proposer offers an allocation that must be accepted by all parties. This way of thinking about the problem is much more related to models by Rubinstein (1982). While political scientists have not been motivated by the ultimatum game, economists have found it a fascinating object for study. Indeed, it has spawned an entire cottage industry.

The structure of the ultimatum game is relatively simple. It is a two-person, complete information game with sequential play. One actor, the proposer, is given the right to divide some good. The second actor, the responder, is given the right to accept or reject the proposed division. Unlike the Baron and Ferejohn game, this game ends following the second move. Figure 1 provides a simplified version of the ultimatum game in extensive form. In this game Player 1 is the proposer and can choose left or right. By convention the top value at the end node is Player 1's payoff, while the bottom number is Player 2's payoff. The numbers are purely arbitrary (think of them as dollars). Once Player 1 has made her choice, then Player 2 makes a choice at the second node. Player 2 can either accept or reject the division. Accepting involves a move to the left or right (depending on the first move), while a rejection involves moving down. A rejection means both parties get nothing. Each branch of the game constitutes a subgame, and in each subgame, accepting the division is the equilibrium. Moreover, the unequal division (player l's move to the left) is the subgame perfect equilibrium.

<Figure 1 About Hero

While this game is very simple (and says a great deal about concerns with fairness and equity), political scientists have not paid much attention to this class of games. One exception is Morton and Diermier (1997) who test aspects of Baron and Ferejohn (1989) and find it wanting. By contrast, in experimental economics the ultimatum game has generated considerable research (see reviews by Thaler, 1988; Guth and Tietz, 1990;

Camerer and Thaler, 1995; Roth, 1995). While the theoretical properties of this game are well understood, the empirical findings show that subjects often engage in fairness and are perfectly willing to reject what they feel are unfair offers.

In laboratory experiments, where subjects can choose their own allocation (rather than have a pair of allocations imposed by the experimenter), the majority of subjects propose somewhere between a 50/50 and 60/40 split. This finding has been replicated in many settings and cultures. Such proposed divisions are invariably accepted. Researchers have also noted that when proposers take larger shares, such as an 80/20 split, then over half of the time the division is rejected. It is, Camerer (1997) notes, as if subjects have an implicit notion of fairness that they bring to these games. What is clear from traditional game theory is that neither fairness nor rejection is predicted.

But fairness is only a description of a phenomenon (or a normative position taken by actors). It does not describe the motivations of actors. Bolton (1998) argues that there are three explanations of motivation that have dominated in discussions of fairness. The first focuses on *altruism.* Here actors have other-regarding preferences in which there is a positive return for giving to someone else. A second model of motivation focuses on the *distribution* of outcomes. In this sense individuals are not only concerned with their own outcomes, but also their outcomes relative to others. The final model focuses on *intentions.* Here people have preferences for their "type" of partner in bargaining setting. If another has been nice to you, then you might want to reply in kind.

With respect to the ultimatum game, if people have altruistic motivations, then most of the time even divisions should be observed. This should be independent of the pairings of partners (and independent of specific pieces of information about those partners). If people have distributional motivations then we ought to observe reasonably high rates of rejection when offers are unequal. That is, if the respondent is attuned to the relative distribution of payoffs and the difference is huge, then a rejection reduces the difference — even at a cost to the individual. Finally if people have motivation to seek the intention of their partners and if they have the basis on which to form beliefs about their partners' intention, then equal allocations should often be seen. Unequal splits can also occur and they will not be rejected if they are consistent with beliefs about intention.

There appears to be support for all three models of motivation. In an attempt to disentangle the question of fairness a number of researchers have turned to "dictator" games. These are a close relative to ultimatum games in that the proposer makes an allocation and the respondent get no opportunity to reject; the respondent must take any allocation that is proposed. Here the results by Hoffman, McCabe, Shachat and Smith (1994) and Hoffman, McCabe and Smith (1997) are instructive. In their experiments they increase the anonymity of subjects — not simply with respect to proposers and respondents, but also with respect to the experimenter. As anonymity is increased, so too does the share taken by the proposer. It turn, the closer the linkage between subjects, the more likely other-regarding behavior occurs. This point is driven home by Eckel and Grossman (1997) who find that giving subjects information about their counterpart changes the amount of donations: donations are larger to more needy recipients. Simply changing information about a partner has an effect on allocations. Taken together these findings tend to support the idea that subjects rely on some pieces of information about their partners in these settings when making "fair" decisions. Absent any information, "fairness" dissipates.

Returning to ultimatum games Eckel and Grossman (1998) and Solnick (1997) vary one piece of information about actors. They focus on sex differences. The procedures in the two experiments are similar except for the opportunity to observe one's counterpart. In the Eckel and Grossman study subjects observe the group (all male, all female, or mixed) although they do not know the exact identity of their partner. Solnick gives the subjects a male or female name for their partner, but subjects do not observe each other. Rejection rates are higher in the Solnick study overall, and the results on sex differences reverse. Women are less likely to reject, and offers from women less likely to be rejected in the Eckel and Grossman study; Solnick's subjects display the reverse pattern. This difference in results may be due to the difference in opportunity to size up one's potential partner.

The Eckel and Grossman findings are quite striking. The difference in rejection rates are caused by nothing more than knowing the partner's sex. This implies that people are seeking some piece of information about their partner, perhaps to read their intentions. That inference is supported with an imaginative experiment by Blount (1995). Her design has subjects playing as the recipient in a series of ultimatum games. They are asked to reveal their rejection levels — the point at which they would reject an allocation by a proposer. However, subjects faced three different types of proposers: the first an interested party who reaps the value of the allocation; the second a neutral party who decides the allocation but has no stake in the outcome; and the third a random device that simply selects an allocation. Under the first experimental condition some set of intentions can be inferred and a receiver has a basis for rationalizing a rejection. Under the second condition intentions can also be inferred, but a rejection merely harms an individual who had nothing to do with deciding the allocation. Finally, no intentions can be ascribed to the random mechanism. Blount (1995) finds clear differences between the random mechanism and those conditions in which allocations are decided by people. Subjects are much more willing to reject "unfair" offers when people make them.

Bolton et al. (1998) are intrigued by the data presented by Blount (1995), but do not see a direct test between distributive and intention models. They carry out such an experiment in which subjects play a normal form game using the strategy method. This is equivalent to sequential play. In their design the row player has two choices (under three distinct conditions), while the column player has six different choices. No matter the experimental condition there is always the same dominant strategy for the column player. However, given the mix of games, Bolton et al. are interested in seeing whether the column player selects different columns contingent on the row choice. They offer explicit predictions about what people should do if either distribution or intention models are correct. Even though the column player has a dominant strategy, there is still some variation in that player's strategies. Bolton et al. find that the column player's choices are not consistent with reading intentions on the part of the row player. However, the strategy method is a bit bothersome for thinking about intentions. At best, subjects can think inwardly about how they would interpret a row player just like themselves. But this form of looking inward is a far cry from understanding the intentions of others. Playing alone is different then playing with someone else. Sequential play might yield very different forms of behavior.

These usual results for ultimatum games find that rejections are common and that subjects have concerns about fairness. We think that there is interesting evidence pointing to subjects trying to infer the intentions of others. Most attempts at modeling intentions make reference to Rabin (1993) which has opened the door for modeling "exotic" preference. Rabin (1993) offers an explicit model of a preference for fairness and clearly states it when noting

> "If somebody is being nice to you, fairness dictates that you be nice to him. If somebody is being mean to you, fairness allows — and vindictiveness dictates ~ that you be mean to him." (p. 1281)

This is not only good advice for the playground (and a norm most children learn early on), but has tractable mathematical characteristics. As Camerer (1997) illustrates, Rabin's model can be thought of as an individual having a separable utility function in which player i has a preference for consumption for not only x_i but also for x_j such that $U_i(x_i + x_j) = v(x_i) + \alpha v(x_j)$. **In this sense if play j is being "nice" then player i has a** positive coefficient a > 0. If j has been "mean" then a < 0 and player i chooses an action that harms j (Camerer, 1997, pp. 169-70). In normal form games, Rabin illustrates a number of settings in which players can hold beliefs over others and beliefs about their beliefs that generate "fairness equilibrium."

Falk and Fischbacher (1998) take Rabin's model several steps further. First, they worry about whether the model can be extended to games with sequential play. Second, they worry not just about the consequences of action (outcomes) but the underlying motivation of an actor in taking some action. In Rabin's (1993) model, for games in normal form, the only concern is with actions and their implications. But as Rabin (1998) notes,

"A crucial feature of the psychology of reciprocity [an expectation over another's behavior] is that people determine their dispositions toward others according to motives attributed to these others, not solely according to the actions taken." (p. 22).

Falk and Fischbacher (1998) then suggest that it is important to model the ways in which actors infer the intentions of their partners based on something observed about a partner. But getting a handle on the dispositions of others is one of the central conundrums of social science. Falk and Fischbacher rely on the context surrounding a set of decisions and use that context to motivate their models. Basically they agree with Rabin that actors will differentiate among actions by others. However, that assessment will be made relative to some marker. So, in a binary ultimatum game, the marker is an equitable allocation versus an inequitable allocation. However, in a different setting in which the proposer has the choice over two unequal splits, e.g., substitute (3,19) for (5,5) on the right branch of Figure 1, then the proposer can be forgiven for choosing the inequitable allocation that benefits the proposer. As Falk and Fischbacher argue, fairness is no longer a consideration because there is no fair allocation.

While in the spirit of models of "exotic" preference, it seems that the Falk and Fischbacher model requires a huge cognitive investment. Actors need to discern the decision context, compare it with many other contexts that they know, assess the intention of actors in each of those contexts, and finally figure out what is the fair response given the current situation. In our view, suppose people use very simple cues about others to try to discern intentionality?

In much the same manner Levine (1998) proposes a version of the Rabin (1993) model, arguing that actors place different weights on their partner's payoffs that are a function of their own characteristics (altruistic or spiteful) and beliefs about their partners' characteristics. Consequently the type of game may yield somewhat different payoffs for the same type of individual. More importantly, as Levine notes, this transforms the game into a signaling game since player's actions will reveal something about their levels of altruism or spite (1998, p. 595).

We agree that reading intentions are important. In the next section we discuss a literature in which actors read intentions directly and at the same time signal their intentions.

Inferring Intentions

Drawing a correct inference about another's intention may lead actors to consider "fair" outcomes. But how might an actor's intentions be communicated? The idea of directly reading another's intention is appealing, but of course is not possible. However, psychologists suggest that individuals generate a raft of signals -- ranging from the timbre of one's voice to the stance of one's body — which betray one's intention, even if that intention is being masked. In part the argument is that humans have an evolved capacity to read the intentions of others, along with an evolved physiological set of signaling mechanisms. Research in psychology on the communication of intentions has focused primarily on autistic persons and primates (see Baron-Cohen, 1995, and O'Connell, 1998). Psychologists are interested in the capacity of individuals to put themselves in the place of others, referred to as having a "theory of mind" (TOM) about another person. This capability requires that a person be able to separate what he knows or understands from what another might.

A simplified test of this concept is often given to children. A child is shown a box of a familiar brand of candy and is asked to guess its contents. The child typically guesses that candy is in the box but is then shown that the box contains pencils. The child is then told that another person will come into the room and will be asked what is in the box. The child is asked to predict what that person will say. Most children over the age of three believe that the response will be "candy"; these children are able to place themselves into another's shoes and imagine what it is like to be the other. By contrast, autistic children invariably predict that the other person will think the box contains pencils. Autistics appear to be unable to disentangle what they know from what the other might know, or to look beyond their own knowledge and understand the mental state of the other. A "theory of mind" is a necessary precondition for predicting what others will do. An autistic person's inability to pick up on the intentions of others leads to serious problems in social interaction. The problem is not one of social ineptness, but rather a failure of the cognitive ability to imagine the mental state of another person.

There is a wide array of work in psychology suggesting that normal functioning humans have a capacity for reading the intentions of others. This capacity is part of ordinary childhood development. Autistic children do not demonstrate this capacity and as a consequence find it impossible to read beyond their own mind. This implies that the structure of the brain is crucial for enabling individuals to draw inferences about the actions and intentions of others and that this capacity is not merely a process of socialization. As such, reading intentions should not be dismissed and should be incorporated into behavioral modeling of social interaction.

Emotions.

At the same time the emotional state of another might be an important signal of intention. Frank (1988) argues that emotions are useful for signaling intentions, and holding a reputation for being emotional can yield significant advantages. For example, a reputation for vengefulness enhances a bargaining position, but a credible commitment to revenge requires a powerful emotional display. The display of anger, which cannot easily be simulated, makes credible the threat of (irrational) revenge. Emotions act as commitment devices - as incentives to behave (or not behave) in a particular manner. Guilt acts as a kind of tax on cheating, for example. Furthermore, he argues, people form judgements about others' emotional state on the basis of observable cues, such as "the pitch and timbre of the voice, perspiration, facial muscle tone and expression, and movement of the eyes.. ..Some people we sense we can trust, but of others we remain forever wary."(p. 8).

Facial expressions, among other factors, provide "tell tale cues" to the underlying emotional state of a person - or of an animal. This is especially true for expressions that require muscles that are not (or not typically) under conscious control. These "reliable" cues can be used to predict cooperation or reciprocity (Chapter 6, 7). Frank presents experimental evidence that subjects accurately predict cooperation by others. (p. 137-143).

Faces.

To this point we have argued that the ability to read the intentions of others is important for humans and we have noted that emotion may be an important source of intention -- a source that can be easily read and used to modify one's strategic action. These signals may be an uncontrolled physiological marker of an individual's affective state.

Signals embodied in traits are beyond the control of the signaling actor, but many other social signals are (largely) deliberate or at least contingent on the situation. A social signal that is quite obvious (and may or may not be strictly controlled by the expressor) is the human face. There is an extensive body of research on human faces and what they mean to observers. Much of this literature derives from Darwin (1872/ 1998), who argued that humans, like animals, have evolved patterns of signaling behavior, including (but not limited to) facial expressions.

The original thrust behind Darwin's characterization is twofold. First, he argues that facial expressions (and other displays) are evolved and serve a function for the species. So a peacock's ostentatious display of his tail or a chimpanzee's baring of her teeth is innate to the species. Second, expressions serve to signal something to others. In other words, universal, common signals are used to warn, invite or soothe members of the same species and on occasion other species as well. We now turn to a discussion of faces as social signals and argue that they provide one important way of thinking about signaling (and reading) intentionality.

Contemporary researchers largely follow the lead of Ekman (1972; 1983) and concentrate on the first part of Darwin's argument. This approach holds that there is a universal set of evolved human facial expressions. Many are thought to be involuntary, and to reflect basic emotions. The bulk of the research has turned toward understanding what facial expressions reveal about someone's underlying emotional state. The literature has largely followed a research stream defined by Ekman (1972) in which he argues that universal expressions are the product of distinct emotions. Facial expressions constitute emotional leakage, in which the emotional content should be obvious to others, since they too share the same universal repertoire of expressions. Learned social behavior works to mask those emotions, and cultural differences lead to different forms of masking. Therefore facial expressions can sometime be hard to read (for a general critique of the "universal" recognition of emotion, see Fridlund, 1994, Chapter 10).

Researchers for the most part have not taken up the question of the role of facial expressions in *social* signaling. Since the focus has been primarily on meaning and interpretation, there has been almost no investigation of behavioral responses. The consequences of a facial expression for behavior in social settings have not been investigated. In a challenge to what he calls the "emotions view" of faces, Fridlund (1994) proposes a "behavioral ecology" view of faces, arguing that facial expressions *and their interpretation by others* is crucial. "The balance of signaling and vigilance, countersignaling and countervigilance, produces a signaling 'ecology' that is analogous to the balance of resources and consumers, and predator and prey, that characterize all natural ecosystems." (Fridlund, 1994, p. 128). Facial expressions and their interpretation involve a delicate game in which expressions are signals about intentionality. This is the perspective from which we start.

It is surprising that little research has focused on expressions as social signals, because there is an extensive literature on what facial expressions mean for children. From the outset, faces are important for child development. Johnson et al. (1991) trace the reaction of new born infants to a variety of paper stimuli the size and shape of a human head. Face-like images range from a human-like face to one with the same parts, but scrambled, to a blank piece of paper. Measuring eye and head movement, they find that newborhs pay much closer attention to images resembling a human face than to others. These findings are all the more impressive in that the infants tested were less than one hour old. These researchers conclude that children are born with a system that orients them toward face-like patterns; only as they mature do they develop a cortical system that allows for sophisticated face-processing activities. They note,"... a primary purpose of the first system is to ensure that during the first month or so of life appropriate input (i.e., faces) is provided to the rapidly developing cortical circuitry that will subsequently underlie face-processing in the adult." (p. 18).

The point from work on human faces is that they are an important source of information for social interaction. Humans are pre-attuned to pay attention to faces. From constant exposure they learn to read faces. Even so, they are often difficult to read.

Abstract Images of Facial Expressions.

Considerable research shows that particular expressions are difficult to "read," and that the emotional content of an expression is often unclear (see the critique by Russell, 1993). Even something as simple as a "smile" can easily be misinterpreted or misrepresented — especially if a single snapshot is pulled out of context (Ekman et al., 1998; Leonard et al., 1991; Fernandezdols and Ruizbelda, 1995). Human facial expressions are complex; the muscle groups on the face can easily send a wide spectrum of signals. While most researchers are looking for the six primary emotions — happiness, sadness, anger, fear, surprise and disgust — humans are capable of sending subtle blends of expressions. In addition differences in physical attractiveness, slight differences in expression, and unfamiliarity with the posed face all lead to variations in assessing emotions. To correct for these problems a handful of researchers have adopted highly stylized aspects of faces in order to detect the primary elements of facial expressions.

If there are specific components of expressions that signal specific emotional states, then these should be susceptible to systematic evaluation. Taking this insight, McKelvie (1973) designed an experiment in which he used schematic representations of faces. These schematics resemble variations on the ubiquitous "happy face" wishing everyone a nice day. McKelvie uses an oval to represent a head and then draws in line segment representations of eyebrows, eyes, nose and mouth. These are systematically varied and then presented as stimuli to subjects.

A total of 128 schematic faces are used; each subject is presented with a sample of 16 faces. Working one at a time, subjects are asked to rate how easy it is to find an adjective to describe the face and then asked to score the appropriateness or inappropriateness of each of 46 adjectives for describing the face. The adjectives reflect four different emotional categories (happy, sad, angry and scheming) and one other category (vacant). His analysis shows that the shape of eyes and the structure of the nose has little effect on evaluations. Instead, eyebrow and mouth shape have the greatest effect. He cautions that neutral (horizontal) eyebrow or mouth expressions signal little. "However, when brow and mouth move from the horizontal, clear differences in meaning emerge: medially down-turned brows indicate anger or schemingness; medially upturned brows are seen as sad; an upturned mouth denotes happiness; and a down-turned mouth is seen as angry or sad." (McKelvie, 1973, p. 345). In short, even simple schematic representations of faces can trigger emotional affect that is well recognized.

Part of McKelvie's study was replicated using pre-school children. MacDonald et al. (1996) use schematic drawings of facial expressions thought to represent the six primary emotions, as well as selected photographs from Ekman and Friesen's "Pictures of Facial Affect" (1978). In one of the experimental conditions children are asked to choose specific emotional categories when viewing either the pictures or the schematics. MacDonald et al. find that accuracy in picking the proper label is significantly greater for the schematic drawings than for the photographs. Accuracy varies, however, with children having the easiest time identifying happiness, sadness and anger (p. 383). The simplifications of the schematics are readily apparent to these children and the emotion evoked is usually readily interpretable. A similar finding for adults comes from Katsikitis (1997) whose subjects compare both pictures of actors and line drawings of those same faces. For certain of the emotions (like surprise), the line drawings tend to be easier to interpret (see also Yamada, 1993).

The lesson to draw from these studies is that humans are very good at recognizing emotional content even in highly stylized schematics. Pictures have meaning and they are readily interpreted. In a subsequent section of this paper we will rely on these results in order to concentrate on relatively clean expressions.

Experiments

We are faced with two questions. First, do subjects impute intentions about others based on abstract icons? Second, if subjects draw inferences about intention from these icons, do they matter for behavior? The first experiment is designed to determine whether abstract facial icons have meaning that is relevant for social exchange. In the second experiment we explore whether the meaning embedded in abstract icons affects strategic behavior in the ultimatum game.

Experiment 1.

The first experiment, carried out at Virginia Tech, was a survey designed to gauge subjects' impressions of schematic faces. The instrument probes whether subject's expectations about behavior are shaped by facial expressions. The results from this experiment are used to calibrate expectations for the second experiment.

The survey instrument was administered to a sample of 524 subjects (324 male, 192 female and 8 who failed to indicate their sex) in Principles of Economics classes at Virginia Polytechnic Institute and State University in January, 1998. The classes consisted primarily of college sophomores; about 1/3 were business majors, 1/3 engineering majors and the rest from assorted fields. Subjects were asked to complete a three-page survey during a regular class meeting time, either at the beginning or the end of class, and were not compensated for their participation. On the first page of the survey, each subject was assigned one of nine icons and asked to rate its characteristics. The icons are based on a 3x3 design involving three manipulations of the mouth and three manipulations of the eyebrows, and were designed to evoke different affective responses. The icons used in the survey are shown in Figure 2.

<Figure 2 About Hero

Subjects were randomly assigned to a particular icon and told that the icon "is supposed to represent a type of person." They then were asked to choose the most appropriate response for their icon on twenty-five word-pair items using a seven-point semantic differential scale. In the scale, a value of (1) means the word on the left is "very" close to matching the meaning of the icon, (2) is "somewhat" close, (3) is "slightly" close and (4) is "neither." The scale is symmetric to the right of (4). Left/right word order was randomly assigned for the word pairs.

The items were ordered in a consistent direction and factor analysis was used to uncover any underlying structure to the data. Eight items, forming two dimensions, are of interest.[2] The first dimension includes the pairings kind/cruel, pleasant/unpleasant, friendly/unfriendly and amiable/hostile. This dimension taps a general assessment of the "niceness" of the icon. The second dimension includes the pairings honest/dishonest, generous/selfish, trustworthy/untrustworthy and considerate/inconsiderate. This dimension taps several behavioral attributes about social interactions. In a sense subjects are drawing inferences about intentions.

Two scales were built based on the items constituting each dimension. For both the "niceness" and the "behavioral" scale four items were added and an average score was calculated for each respondent. Two models were then estimated for each scale; the first

[2] Under principal components all 8 items scale together quite well. However, using dimensions are recovered.

model focuses on the main effects which the second includes all the interaction terms. The complete research design is a 3x3 design in which three positions of the mouth and three positions of eyebrows are tested. These involved upturned eyebrows and mouths, neutral (horizontal) eyebrows and mouths and down-turned eyebrows and mouths. Four main effects are included in the models. The variable SMILE is a dummy variable for icons with an upturned mouth. Likewise FROWN is a dummy variable for a down-turned mouth. UPBROW is a dummy variable for upturned eyebrows and DOWNBROW does the same for down-turned eyebrows. The neutral position is then reflected in the intercept term of the regression. In model 2, these variables are include interaction terms as indicated. Finally we add a dummy variable for the SEX of the respondent, controlling for perceptual differences that might emerge from assessing these icons.

Table 1 details the regressions for the two models. Both models confirm findings by McKelvie (1973) and others. The positioning of both the mouth and eyebrows makes a difference. With respect to the behavioral intentions scale the intercept term reflects the midpoint of the general semantic differential scale and is consistent with what we might expect from a neutral icon. The effect of eyebrows is pronounced. When the eyebrows are upturned, they decrease the evaluation (move it toward the "trustworthy" end of the scale) by almost a full point. Down-turned eyebrows have exactly the opposite effect. The down-turned mouth position has a modest effect on behavioral assessments and the upturned mouth has little effect. Under Model 2 a smile now has a modest independent effect on assessing behavioral intentions. It yields a more favorable evaluation of behavior. There is also a strong interaction between a smile and downturned brows. The coefficient is positive indicating a less favorable evaluation of behavior. The effect of a smile can be deceiving; its effect is positive or negative depending on the position of the eyebrows. While the main effects alone lead one to believe that the frown/downbrow combination is the most negatively perceived, the interaction terms adjust the evaluations so that the conflicting message of the smile/downbrow icon is perceived with suspicion.

<Table 1 About Hero

When turning to the "niceness" scale, both the smile and the eyebrow positions are strongly related to the evaluation of the icon. These results are consistent with the behavior scale in that a smile and upturned eyebrows result in a more positive assessment, while a frown and down-turned eyebrows lead to a more negative assessment. The interaction terms have the greatest effect with the combination of a frown and down-turned brows. The negative coefficient indicates some dampening of the strong main effects for the frown and down-brow. It is also the case that female respondents are more likely to evaluate the icons harshly with respect to affect. The effect is not large, but is statistically strong.

In short, the position of eyebrows and mouth both matter for the inferences that respondents draw about the icon. While the direction is the same for judgments about intentions and character, the latter has uniformly stronger main effects. These data strongly support the idea that respondents can draw meaning from the icons. The next task is to see if these inferences carry over in the play of strategic games.

Experiment 2.

Experiment 2 incorporates a series of two-person bargaining games in extensive form. At the outset, each subject is randomly assigned a facial icons (three of which are drawn from Experiment 1). Subjects then play a series of games where they are randomly rematched with other players each round. We first describe the games, then the experimental design and procedure, and then discuss the results.

Two general classes of games are analyzed; both are two-person sequential games with perfect and complete information. Each game has a unique subgame perfect Nash equilibrium. In the first class of games there are minimal equity considerations. The second class of games are limited choice variants of the ultimatum game; in these games subjects now have to be concerned with equity and the potential for negative reciprocity in the form of a retaliatory move by a partner.

To illustrate, consider Game A given in extensive form in Figure 3. Two actors, 1 and 2, face a series of moves through the game; their payoffs at each end point are given in dollars. Actor 1 has the first move and can choose can chose to end the game (and receive $9.00, giving $19 to Actor 2), or she can choose down, passing the move back to Actor 2. If the latter, Actor 2 can then choose to end the game (receiving $14.00, with $14 for Actor 1) or pass the move back to Actor 1. If the move is passed, then Actor 1 has the final choice in the game ~ in this case to pick a payoff of either $9.00 or $2.00. Game A has a unique subgame perfect Nash equilibrium at the middle right endpoint of the game, where Actor 1 moves down and Actor 2 moves right, with payoffs of $19.00 and $14.00.

<Figure 3 About Here >

Game B is a limited-choice ultimatum game identical to that given in figure 1. Actor 1 has a choice between two alternative divisions of a fixed amount of money and Actor 2 has the choice of accepting that division or choosing a payoff of zero for both players. This latter move is a "rejection" of the division. As noted earlier the subgame perfect equilibrium is for Actor 1 to move left and for Actor 2 to accept the division, with the resulting payoffs of $19.00 and $3.00, respectively.

For each game, the unique subgame-perfect equilibrium constitutes a prediction for behavioral play in a laboratory setting. Game A is straightforward: there is a single equilibrium and little to tempt the players away from equilibrium play. However, for Game B, if actors have exotic preferences that take into one another into account, then the subgame perfect equilibrium may not be a reasonable prediction. For example, if

Actor 1 believes that Actor 2 thinks he is "nice" then Actor 1 has to worry about a rejection. This is in the spirit of Rabin's (1993) model. On the other hand, it may be that Actor 1 holds simple beliefs that Actor 2 will retaliate for any non-equitable split (this is consistent with Bolton's (1991) model). In either case, actors much hold strong beliefs. In this experiment we use facial icons to manipulate those beliefs.

Experimental Design. In this experiment pairs of subjects participate in a series of distinct two-person games. A total of 228 subjects were recruited from the local student population at Rice University. Students were contacted in their dining hall and asked to volunteer for a decision making experiment. Subjects signed up for one of thirty-two planned experimental sessions.

The laboratory accommodates eight subjects, each seated in a cubicle formed by moveable partitions, facing a computer. Although subjects are in the same room and can hear one another, they cannot see one another's computer screen. At the outset of the experiment subjects are cautioned not to speak and told that if they do so, then the experiment will be canceled. All experimental sessions are conducted over local area network and the network handles all communication between subjects. In 14 of the 32 sessions fewer than eight turned up, and only six subjects participated in the experiment.

Upon arrival, a subject chooses a seat at a terminal Subjects are given self-paced instructions and shown how to make their choices in the sequential game. These instructions are attached as Appendix 1. In each experimental session, subjects participate in as many as 30 decision periods and are randomly rematched prior to each decision. Because of the limited number of subjects, same-pair play often occurs. However, subjects carry no unique identification, so it is impossible for them to know with whom they are paired at each decision.

Two different sets of experimental sessions were run at different times. Series A was run in February 1998 and involved subjects facing as many as 18 distinct games played over 30 periods. Series B sessions were run in September 1998 and involved subjects facing 9 distinct games in 9 ordered periods. In Series B a variant of Game B was the first decision problem faced by all subjects. In subsequent analysis we acknowledge the possibility that history affects play

Procedure. Regardless of the manipulation, the same procedure is used in each period of play. Before each game begins, subjects are randomly assigned and told their role (in the experiment, they are called "Decision Maker" 1 or 2). The subject assigned to be player 1 gets the right to move first. In the ultimatum game this means a choice of either a left or right branch. Once a choice is made, player 2 is notified of the move. At that point player 2 makes a choice, in this case to accept or reject the proposed division, and the corresponding payoff box is circled on the computer screen, both players are notified of the outcome and both are asked to record their payoffs for that period. The computer mediates the all communication between players. Subjects are only told the moves of their own partners, and not the plays of other subjects in the experiment. Once the period ends, subjects are instructed to wait until all pairs of players complete their decisions. At that point the subjects are shuffled and re-paired.

At the conclusion of the experiment participants are paid in cash and in private. All payoffs in the games in Figure 2 are in U.S. dollars. Subjects are told at the outset that they would be paid only for a single period of play. At the conclusion of the experiment they were asked to draw one card from a deck of 100 electronic cards displayed on the computer screen. Subjects were told that each period had an equal probability of being chosen, and the algorithm for the selection ensured this. When the cards was turned over the subject learned which period was drawn and what was earned.

Subjects were asked to verify that payoffs for the period drawn matched what they had recorded. Before being paid, subjects filled out an on-line questionnaire that asked them questions about their participation. The Series A experiments lasted almost 45 minutes, while the Series B experiments lasted almost 30 minutes. On average subjects earned $13.27 in Series A and $13.55 in Series B for their participation. Four subjects earned the maximum of $29.00 and six subjects earned $0.00 for their play. These latter subjects were paid a show-up fee of $3.00, but not informed until their debriefing that they would be paid this amount.

Icon assignments and pairings. The first manipulation in this experiment relates to what subjects know about their partner. At the outset each subject is randomly assigned a permanent identity. Figure 4 presents the pairings of icons used in the experiment. Two icons were used in each experiment, with equal numbers of subjects assigned each of the icons. In Series A there were six distinct pairings; in Series B there were five. In all sessions half of the subjects are randomly assigned one icon representation and the remaining half are assigned the other.

<Figure 4 About Hero

In each game within an experimental session a subject can be paired either with an individual with the same icon or an individual with a different icon. Prior to beginning a game subjects are shown the entire set of icons in the game (for an 8-person group this meant four images of each type of icon). When the subject is ready to begin, the icons are shuffled on the screen and the program selects an icon. The screen then displays the subject's own icon and the icon of his or her counterpart.

We are very deliberate in not tying the icon to any personal characteristics of subjects. They are simply told the icon assigned to them will be theirs for the entire experimental session. Our rationale is that this constitutes a very weak stimulus, and that a stronger connection between the icon and the subject would strengthen any observed behavioral effects.

The primary manipulations for the experiment involve pairings of icons with human facial characteristics. As detailed below, we have explicit predictions about out-of-equilibrium play in Game B. The type of icon held by the player and the partner influences these predicted behaviors. Three icons are used in which the angle of the eyebrows and orientation of the mouth are varied, as shown in Figure 4. A second set of icons is used that have no human facial content: a rectangle and an oval. These icons constitute one control condition for the experiment. It may be that subjects do not rely on human facial content to select strategic play. Instead they simply view the world as consisting of two types: "us" and "them." "In-group/out-group" effects are common in social psychological experiments (Tajfel and Turner, 1979; Turner, 1978).

In a final control condition subjects have no information about their counterparts. Their "icons" are blank. Subject see no screens that tell them about their counterpart's identity; they simply play a series of decision periods in which they were randomly re-matched with another participant.

Games. The second manipulation changes the type of game. In the Series A experiments there were an assortment of games, three of which were ultimatum games, several were simple bargaining games with a unique subgame perfect Nash equilibrium, and several were designed to test trust and reciprocity (see Eckel and Wilson, 1998). In the Series B games, the same three ultimatum games were used, four distinct simple equilibrium games were used, and two additional games were added — a dictator game and a reciprocal trust game. A limited set of games and experimental parameters are given in Figure 5 and the analysis in this paper focuses on these games. On the Figure the subgame perfect equilibrium for each game is circled

<Figure 5 About Hero

The order in which the three ultimatum games appear is blocked: In a third of the sessions Game 1 was the first game subjects encountered, in another third Game 2 was first, and so on. The second and third ultimatum games played by the subjects were separated by the remaining simple games, which were kept in the same order for each session. Games 1, 2, and 3 tap different aspects of ultimatum games. Game 1 has a large asymmetry in divisions (a split of {19,3} versus {11,11}). Game 2 is identical except that the payoff for a rejection increases from {0,0} to {1,1}. Finally, Game 3 has a smaller asymmetry in divisions (a split of {15,5} versus {10,10}). In each instance the subgame perfect equilibrium is the asymmetric split.

Aside from having a single branch, games 4 and 5 share the property that the equilibrium is obvious. In these games subjects have no incentive to use strategies that yield out-of-equilibrium behavior. Neither equity considerations nor fear of retaliation should enter into a subject's strategic calculation when playing these games. Game 6 is a two-branch game and is a bit more complex. It has a unique subgame perfect equilibrium. However, unlike Games 4 and 5, it requires more calculation on the part of subjects. In addition to a unique subgame perfect equilibrium, both subgames have Nash equilibria. These are noted on the Figure.

Predictions. Our predictions are derived both from game theoretic expectations and from behavioral expectations linked to the content of the icons. These predictions vary as a function of the type of game subjects play and the icons that they hold and against which they play.

The first hypothesis is taken directly from game theory. Despite the fact that subjects are assigned to different conditions — some with and some without icons -- game theory treats these as the same. The icons (signals of intention) are uninformative — they amount to "cheap talk."

> *Hypothesis 1 (Game Theoretic):* Subjects will choose strategies leading to the subgame perfect equilibrium.

The second hypothesis builds on our initial discussion. It acknowledges that the facial expressions trigger responses by both players. The effect of those expressions will vary by type of game and type of expression.

> *Hypothesis 2A (Simple Bargaining Games):* Icons have no effect on these games; subjects will settle on the subgame perfect equilibrium for the game.

In these games, neither player has a reason to rely on characteristics about their partner. Following simple maximizing behavior, both players will choose strategies that yield the subgame perfect equilibrium. The reputational content of the icons (trusting, honest, etc.) will have no impact on the decision calculus of either player.

> *Hypothesis 2B (Ultimatum Games):* Specific icon pairings will lead to more equitable divisions and fewer rejections.

Generally we expect three patterns to hold. First, only icons with facial content will be informative. Second, subjects are more likely to choose an equal division when they perceive their counterpart to be "nice." Third, rejections are more likely from "nice" icons that are given unequal offers.

These three patterns are predicated on the idea that the icons, even though a weak stimulus, have informative content — an idea supported by Experiment 1.

> Hypothesis 3.1. Conditions with no icon or an icon without a facial expression are uninformative. Subjects in these conditions will choose the equal divisions at lower rates than conditions with facial icons.

If subjects use the icon expressions to draw inferences then what the first mover sees in the partner will make a difference. The data from experiment 1 provides explicit orderings across the icons used here. First, the "happy" icon is regarded as the "nicest," followed by "devious" and then "angry." All three icons were statistically different from one another on the "niceness" scale, although the latter two items are closely related.[3] On the behavioral scale, "happy" is regarded as the most trustworthy, followed by "angry" and then "devious." As before, all pairwise comparisons are statistically different and there is greater separation between "happy" and the remaining two icons then between "angry" and devious.[4] This yields two distinct hypotheses:

> Hypothesis 3.2a. If proposers focus on the "niceness" of their counterpart, then the pattern of equal splits will be:
> $\text{Happy}_{\text{respondent}} > \text{Devious}_{\text{rcspondent}} > \text{Angry}_{\text{rcspondent}}$

> Hypothesis 3.2b. If proposers focus on behavioral inferences about their counterpart, then the pattern of equal splits will be:
> $\text{Happy}_{\text{respondent}} > \text{Angry}_{\text{respondent}} > \text{Devious}_{\text{respondent}}$

Similar hypotheses can be offered for patterns of rejection. The question now turns to how the respondents perceive proposers. If Rabin (1993) or Falk and Fischbacher (1998) are correct, then respondents have already observed the proposers action. Now they need to infer whether the action was in line with their beliefs and infer the proposers' intention.

> Hypothesis 3.3a. If respondents use the icons to draw inferences about the "niceness" of proposers, then the pattern of rejections will be:
> $\text{Happy}_{\text{proposer}} > \text{Devious}_{\text{proposer}} > \text{Angry}_{\text{proposer}}$

> Hypothesis 3.3b. If respondents use the icons to draw inferences about the behavior of proposers, then the pattern of rejections will be:
> $\text{Happy}_{\text{proposer}} > \text{Angry}_{\text{proposer}} > \text{Devious}_{\text{proposer}}$

Analysis. Hypothesis 1 predicts that subjects will choose the subgame perfect equilibrium. Figures 5 and 6 present the aggregate results for each game. The figures

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[3] The mean scale ratings for the icons were: Happy=2.38; Devious=5.20; Angry=6.04. value, the "nicer" the evaluation.

[4] The mean behavioral scale ratings were: Happy=2.75; Angry=4.83; Devious=5.27.

present the percentage of times each of payoff node was chosen and the numbers in parentheses are the frequencies. The Series A and Series B data are pooled. Figure 5 presents data for the three ultimatum games, while Figure 6 presents results for the simple bargaining games.

<Figures 5, 6 About Hero

On the one hand, there is little support for the predicted equilibrium under the ultimatum game. On average only about a third of the outcomes end up at the equilibrium. This finding is common for ultimatum games. Moreover, between 16 and 32 percent of the proposed divisions that involved an unequal division were rejected, while equal divisions were never rejected. This result is consistent with other ultimatum game experiments. Over half of all divisions, then, involved an equal division. This is contrary to Hypothesis 1, but is consistent with the literature.

There is substantial support for Hypothesis 2B which relates to the simple bargaining games. These games are depicted in Figure 6. In games 4 and 5 almost 90 percent of all outcomes are at the equilibrium. (The joint-payoff-maximizing cell in Game 5 draws more players away from the equilibrium than in Game 4.) These results make it clear that most subjects understood the structure of the game in extensive form.[5] From a game-theoretic standpoint, there are very few "errors" that would constitute out-of-equilibrium play. Game 6 presents a greater challenge to the concept of subgame perfection. Here the first mover chose the correct (right) branch in 125 out of 127 games. However, the subgame Nash equilibrium only was chosen just 60 percent of the time. Almost 38 percent of the time the second mover chose the equal division payoff, even

[5] We also asked respondents at the end of the experiment to tell us whether or not they understood the experiment. 122 of 126 subjects (96.8%) indicated the instructions were clear. We did not collect these data for the Series A experiments, but in debriefings we did not find there was any confusion among subjects.

though that actor could have been made better off by passing the move back to the first proposer.[6] It appears that considerations of equity influenced play in this game.

Two findings stand out. First, the game theoretic prediction does not fare well in the ultimatum game. However, this is consistent with a large number of ultimatum game experiments (see Camerer, 1998). Second, equilibrium predictions fare very well in simple bargaining games. Certainly the results from Games 4 and 5 lead us to think that subjects understand the structure of the extensive form game. The more complex Game 6 contains an attractive equal-split outcome that induces some equitable play on the part of subjects.

Hypothesis 2A predicts that the icon manipulations will have no effect on the simple bargaining games. This was tested with a simple model that estimated whether the Nash equilibrium was selected. The independent variables relate to conjectures about the content of icons. All variables are coded as dummy variables, taking on a value of 1 when satisfying the condition. The variable PAIRED indicates whether both subjects in the game held the same icon (subjects with different icons or subjects who were in the "blank" condition were assigned a value of zero). This variable enables us to test an "in-group" effect in which subjects treat subjects with the same icon in a similar manner. VERSION reflects whether subjects were in the Series B experiments. The remaining variables discriminate among the icons. The icon dummy variables are keyed to the partner. In games 4 and 5 the first mover has the key decision — to either quit or pass the move to the partner. Passing to the partner is equivalent to selecting the Nash

[6] When this game was played in Series A, it was embedded in a number of different games, so it is possible that players were trying to signal cooperation to the population. Because several Series A games involved important cooperative elements, this is a likely conjecture. When we compare Series A and Series B play in this game, there is a slight difference in the distribution of decisions. Comparing just the upper right and middle right branch outcomes between the two games (the data are too sparse for the other branches), the Series B subjects selecting the equilibrium 68.9% of the time compared with 54.0% for the Series A groups. This approaches significance under a simple chisquare test (x^2=2.89, df=l, p=.09).

equilibrium. In Game 6, the first mover almost always takes the subgame perfect branch. The key choice, then, is that by player 2 deciding whether to quit the game with an equal split or pass back to the partner. Hypothesis 2A predicts the partner's icon type does not matter. ANGRY is a dummy variable indicating whether the partner had the "angry" icon. A similar coding rule was used for HAPPY and DEVIOUS. Finally, ICON represents whether the partner had a non-facial icon (a rectangle or an oval).

In general there is no effect derived from the partner's icon for these games. For the one-branch games, which overwhelmingly ended at the equilibrium, there is a slight effect based on whether subjects were in the Series A or B experiments. Subjects in the Series B experiments were somewhat less likely to end up at the equilibrium. There was a small effect when subjects held the same icon. Finally, subjects holding a rectangle or oval icon, with no facial content, were less likely to settle on the equilibrium. These effects are weak and at the margin, and there were only 26 subjects in the two games (about 10 percent) who failed to reach the Nash equilibrium. A similar story can be told for the two-branch game (Game 6). At best there are weak effects for the Series B games. Generally the Hypothesis is supported. For simple bargaining games the icons do not matter.

<Table 2 About Hero

Effect of facial icons. Hypothesis 2B predicts the icons should matter for the ultimatum games and Hypotheses 3.1 through 3.3 have specific predictions for the pairings and actions. Table 3 contains the frequencies for different icon-pairings choosing equal allocations.

<Table 3 About Hero

Overall, Happy is the most likely to propose and receive an equal split, while the non-facial icon, Oval, is the least likely to get or propose an equal split. These results do not hold up over all pairings, although they reflect strong tendencies in the data. Most notably, pairing Happy and Happy results in the least number of unequal splits. Nonfacial icons evoke a quite different response from subjects when compared with the facial-icon sessions. We have not conducted sessions where facial and nonfacial icons are paired directly.

In order to test our Hypotheses we use probit regressions to estimate the probability of choosing an equal offer. The first set of hypothese concern proposers worrying about how responders interpret their actions. Four models are presented in Table 4 for which the dependent variable is the proposer's choice of an equal or unequal split.

Model 1 is a preliminary test of Hypothesis 3.1 That hypothesis predicts no difference between the control group (with no information about counterparts) and subjects holding icons with no facial content (rectangles and ovals). As before ICON is a dummy variable. PAIRED and VERSION remain coded as detailed above. A new dummy variable, GAME3 is added to the analysis. Subjects may be sensitive to the relative size of the unequal split and while it is the same for Games 1 and 2 it is different for Game 3. The sample in this regression excludes sessions with facial icons.[7]

<Table 4 About Hero

Model 1 shows there is a tendency for an icon (in this case a rectangle or an oval) to affect an actor's choice. However, it does not evoke sympathy, but rather decreases the likelihood that an equal split is chosen. Consequently, the non-facial icons, by themselves, do not contribute to an increase in equal divisions.

[7] When we split the sample and ran separate regressions for the two samples, the results differ somewhat and statistical significance is weaker, though the same pattern of coefficients is seen on the nonfacial and facial icons. In particular, the coefficient on Devious is always higher than that for the other two icons. If we analyze data for the first period of play in Series B, where there has been no history of play, the same pattern of results is also present. We are conducting additional analysis to investigate the role of the history of play in determining subjects' choices at later stages in the experiments.

Model 2 directly tests Hypothesis 3.1. It includes the full data and asks whether facial icons increase equal allocations. The dummy variable FACE is significant, strong and positive, indicating that facial icons are associated with equitable divisions. At the same time, the Series B experiments result in more asymmetric allocations, establishing an important intercept effect between the two designs. Finally, there is some price sensitivity to the magnitude of the split. When looking at a {15,5} split, subjects are more likely to choose an unequal split then when contemplating a {19,3} split. Overall, these findings support the prediction under Hypothesis 3.1 that facial icons yield an increase in the choice of equal allocations.

Model 3 is designed to test between Hypotheses 3.2a and 3.2b. The variable ICON is put back into the model to differentiate the blank control condition for the others. Dummy variables for the facial icons are also included. Again ICON, VERSION and GAMES all have independent effects. Only HAPPY, among the facial icons, is (weakly) significantly different from the intercept. However, the three coefficients fit the order suggested by Hypothesis 3.2b. Moreover, the difference in magnitude between Happy and Devious is very large. In short, proposers confronting a subject with a Happy face are more likely to suggest an equal split than subjects seeing a Devious face.

To further show the impact of these behavioral readings of faces, we construct a new variable BEHAVE that takes on the average value for the relevant icon of the index of behavioral items from experiment 1. Only sessions with facial icons are included in this estimate. The coefficient on this variable is strongly significant, indicating that subject's judgments about the trustworthiness and reliability of the icon of the respondent enter significantly into the choice of the proposer. A higher level of the index, indicating a perception that the icon is untrustworthy and uncooperative, is associated with a greater probability of choosing an unequal split.

Rejections. Hypotheses 3.3a and 3.3b make specific predictions concerning patterns of rejection. The overall rate of rejection is 19.5 percent and only occurs when proposers choose an unequal allocation. Therefore we only focus on unequal proposals. Table 5 presents the rejection rates based on proposer/responder pairings. There is considerable variability in the table, with the highest rate of rejection occurring when Devious as a responder is matched with Happy as a proposer.

<Table 5 About Hero

To disentangle the impact of specific icons and to test Hypotheses 3.3a and 3.3b we run three probit regressions. In each case the dependent variable is whether the respondent accepts the proposed unequal split. The independent variables as before. Model 1 in Table 6 tests whether the facial icons, as a whole, matter. Little is statistically significant in this model. By and large subjects with icons are somewhat more likely to accept uneven offers. The same is true when subjects play an ultimatum game where the uneven split is less extreme. Of some interest is the negative sign on the coefficient PAIRED. In effect, if subjects are paired with an icon like their own, they are less forgiving.

<Table 6 About Hero

Model 2 adds dummy variables for the proposer's facial icons. This allows us to test between Hypotheses 3.3a and 3.3b. In both instances the argument is that respondents use the proposer's icon to derive expectations about the proposer's actions. When those expectations are not met then the respondent infers something about the proposer's intentions. In these games, misplaced expectations lead to rejections. Although little is statistically significant in the model, the signs of the coefficients (and their relative magnitude) support Hypothesis 3.3b. Again, when the same individuals are paired with one another, they are more likely to reject an unequal offer. For the facial icons the largest coefficient is for Devious and it is positive. This implies that respondents expect Devious to offer an unequal allocation and consequently do not punish him. By contrast, the coefficient is negative for a proposer with a Happy icon. This implies that respondents expect Happy to choose an equal split and retaliate (by rejecting) when this does not happen. However, these estimates are weak and point to a lot of noise in the data.

Model 3 focuses directly on the facial icons. Again the decision to accept or reject the unequal split is the focus of the analysis. Only subjects with facial icons are included in the analysis. The dummy variable for the Angry icon is omitted in the analysis and is contained in the intercept. In this analysis the pattern between the icons remains. Again, if the proposer has a Happy icon and selects an unequal allocation, a rejection is more likely. With either Angry or Devious icons, subjects expect an unequal allocation and so they do not retaliate. The ordering reflects the prediction from Hypothesis 3.3b. This suggests that the inferences people draw about intentions are tied to inferences about the behavior of the partner.

Conclusion

These results lend support to conjectures by Rabin (1993), Falk and Fischbacher (1998) and Levine (1998) that individuals are concerned about the intentions of others. However, it does not appear to be the case that people have generalized preferences for "fairness." Instead, people take into account the intentions of their counterparts and then respond accordingly.

One point we have made in this research is that reading intentions requires knowing something about one's partner. In day-to-day encounters people routinely draw on a large number of cues about their partners. People commonly look to status, gender, and ethnicity as cues for action: In doing so, they draw heavily on stereotypes about the people with whom they first meet and deal. We also argue that people draw on one of the more visible physical features of others — the face. Moreover, we argue that people are quite adept at reading the intentions of others as translated through facial expressions.

Our data support the idea that abstract facial expressions can easily be read. At the same time those expressions are read in the same way by subjects — both for affective and behavioral content.

A second point from this research is that people draw behavioral expectations about their counterparts. By presenting subjects with various schematic faces we are able to manipulate the information subjects have available when making decisions. Subjects then respond, in consistent ways, to the information conveyed by the images. Often the response leads to out-of-equilibrium behavior. • Yet that behavior is not random. It is patterned based on the underlying expectations that subjects have for others. When those expectations are violated, subjects retaliate at a cost to themselves.

The general lesson to be drawn from this research is that game theory has pushed the social sciences to carefully consider strategic interaction. However, we are finding that standard game theoretic models fail to address many important aspects of strategic behavior. We are finding that actors can look beyond their own internal calculus and begin taking the other into account. The challenge for game theory (and all social scientists) is to build models that incorporate some of the psychological boundaries for the evolved human mind. This means not only taking into account our limited capacity for calculation, but to explore the role of emotion and reading intentions on strategic behavior.

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Table 1
Effect of Facial Characteristics on Perceptions of Icons
Standard Errors in Parentheses

	Model 1		Model 2	
	Behavior	**Niceness**	**Behavior**	**Niceness**
Intercept	4.89*** (.11)	4.21*** (.12)	3.90*** (.14)	4.08*** (.14)
 **SMILE**	-.13 (.11)	-.82*** (.12)	-.38* (.20)	-.91*** (.22)
 **UPBROW**	-.71*** (.11)	-.97*** (.13)	-.56*** (.19)	-.75*** (.22)
 **FROWN**	.22** (.11)	.67*** (.10)	.45** (.19)	1.12*** (.22)
 **DOWNBROW**	1.03*** (.11)	1.41*** (.12)	.94*** (.17)	1.54*** (.19)
SEX (1=Female)	-.002 (.09)	.21** (.10)	-.01 (.09)	.21** (.10)
 **Interaction**			-.16 (.27)	-.13 (.30)
 **Interaction**			-.47* (.25)	-.79*** (.28)
			.84*** (.24)	.39** (.28)

Interaction				
 **Interaction**			-.29 (.28)	-.54* (.30)
r2	.37	.54	.41	.56
	***p<.01	**p<.05	*p < .10	

Table 2

Probit Estimates for Choosing a Move Leading to the Nash Equilibrium in Simple Bargaining Games (Standard Errors in Parentheses)

	Games 4 & 5°	Game 6
INTERCEPT	2.266** (.334)	-.157 (.294)
PAIRED	-.385 (.241)	.180 (.272)
VERSION	-.503** (.239)	.453* (.241)
ANGRY	--	-.093 (.382)
HAPPY	-.481 (.322)	.419 (.391)
DEVIOUS	-.181 (.372)	-.165 (.409)
ICON	-.608* (.318)	.607 (.373)
GAME5	-.385* (.229)	--
loglikelihood	n=255, -76.64	n=125, -77.91

° Note that the variable ANGRY was excluded from the estimation for games 4 and 5. When Player 2 was the ANGRY icon, Player 1 never played non-Nash, so the probability is one for this icon. When it is included, its coefficient is 5.998, with standard error 13398.32. The other coefficients are of the same sign and magnitude shown here.

***p<.01
**p<.05
*p<.1

NEW Table 3
Percentage of Proposers Choosing the Equal Split in the Ultimatum Game
(All games, all series pooled; numbers in italics)

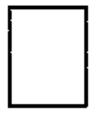
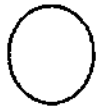
Proposer's Icon	Respondent's Icon						
						**Blank**	**Total**
	44.2 *19/43*	53.9 *7/13*	56.5 *13/23*	-	-	-	49.4 *39/79*
	66.7 *4/6*	60.0 *15/25*	70.8 *17/24*	-	-	-	65.5 *36/55*
	50.0 *9/18*	57.1 *12/21*	79.1 *34/43*	-	-	-	67.1 *55/82*
	-	-	-	50.0 *7/14*	30.0 *6/20*	-	38.2 *13/34*
	-	-	-	41.9 *13/31*	36.8 *7/19*	-	40.0 *20/50*
Blank	-	-	-	-	-	53.2 *42/79*	53.2 *42/79*
Total	47.8 *32/67*	57.6 *34/59*	71.1 *64/90*	44.4 *20/45*	33.3 *13/39*	53.2 *42/79*	54.1 *205/379*

Table 4

Probit Estimates for Choosing the Nash Equilibrium in Ultimatum Games (Standard Errors in Parentheses)

	Model 1	Model 2	Model 3	Model 4
INTERCEPT	.142 (.203)	.266* (.143)	.427** (.175)	1.583*** (.367)
ICON	-.416* (.230)	--	-.388* (.208)	--
FACE	--	.318 (.141)	--	--
PAIRED	.148 (.285)	-.003 (.143)	.130 (.153)	.077 (.182)
VERSION	.104 (.204)	-.440** (0.134)	-.434*** (.136)	-.836*** (.186)
GAME 3	-.332 (.208)	-.286** (.135)	-.266* (.137)	-.253 (.187)
ANGRY	--	--	.084 (.229)	--
HAPPY	--	--	.356* (.214)	--
DEVIOUS	--	--	-.268 (.233)	--
BEHAVE	--	--	--	-.209*** (.0780)
	n=163 llr=-109.26	n=379, llr=-250.95	n=379, llr=-245.03	n=216 -130.22

***p<.01
**p<.05
*p<.1

NEW Table 5
Rejections by Respondents for Unequal Proposed Splits in the Ultimatum Game
(All games, all series pooled; numbers in italics)

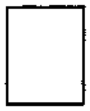
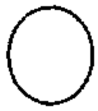
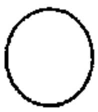
Proposer's Icon	**Respondent's Icon**						
						**Blank**	**Total**
	20.8 *5/24*	0.0 *0/6*	20.2 *2/10*	-	-	-	17.5 *7/40*
	0.0 *0/2*	10.0 *1/10*	28.6 *2/7*	-	-	-	15.8 *3/19*
	44.4 *4/9*	22.2 *2/9*	33.3 *3/9*	-	-	-	33.3 *9/27*
	-	-	-	42.9 *3/7*	7.1 *1/14*	-	19.1 *4/21*
	-	-	-	0.0 *0/18*	25.0 *3/12*	-	10.0 *3/30*
Blank	-	-	-	-	-	21.6 *8/37*	21.6 *8/37*
Total	25.7 *9/35*	12.0 *3/25*	26.9 *7/26*	12.0 *3/25*	15.4 *4/26*	21.6 *8/37*	19.5 *34/174*

Table 6
Probit Estimates for Accepting an Unequal Offer in Ultimatum Games
(Standard Errors in Parentheses)

	Model 1	Model 2	Model 3
INTERCEPT	.573** (.292)	.539* (.294)	.240 (.530)
ICON	.446 (.346)	.507 (.352)	
FACE	.135 (.309)		
PAIRED	-.329 (.253)	-.457* (.266)	.004 (.338)
VERSION	.109 (.235)	.115 (.240)	.597* (.361)
GAME 3	.390* (.236)	.448* (.246)	1.035*** (.379)
ANGRY		.457 (.451)	
HAPPY		-.288 (.359)	-.720 (.472)
DEVIOUS		.472 (.380)	.063 (.461)
	n=174 LL=-82.82	N=174 LL=-80.28	N=86 LL=-39.50

***p<.01

**p<.05

*p<.1

Figure 1

A Simple Ultimatum Game

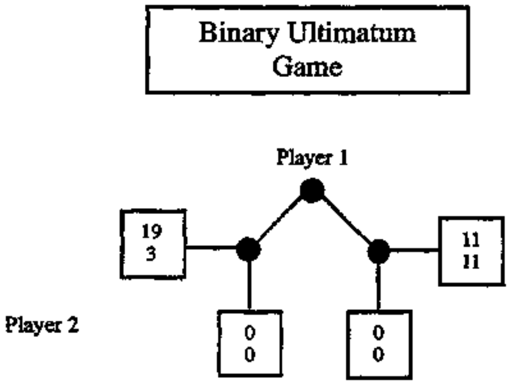


Figure 2
Icons Used in Survey

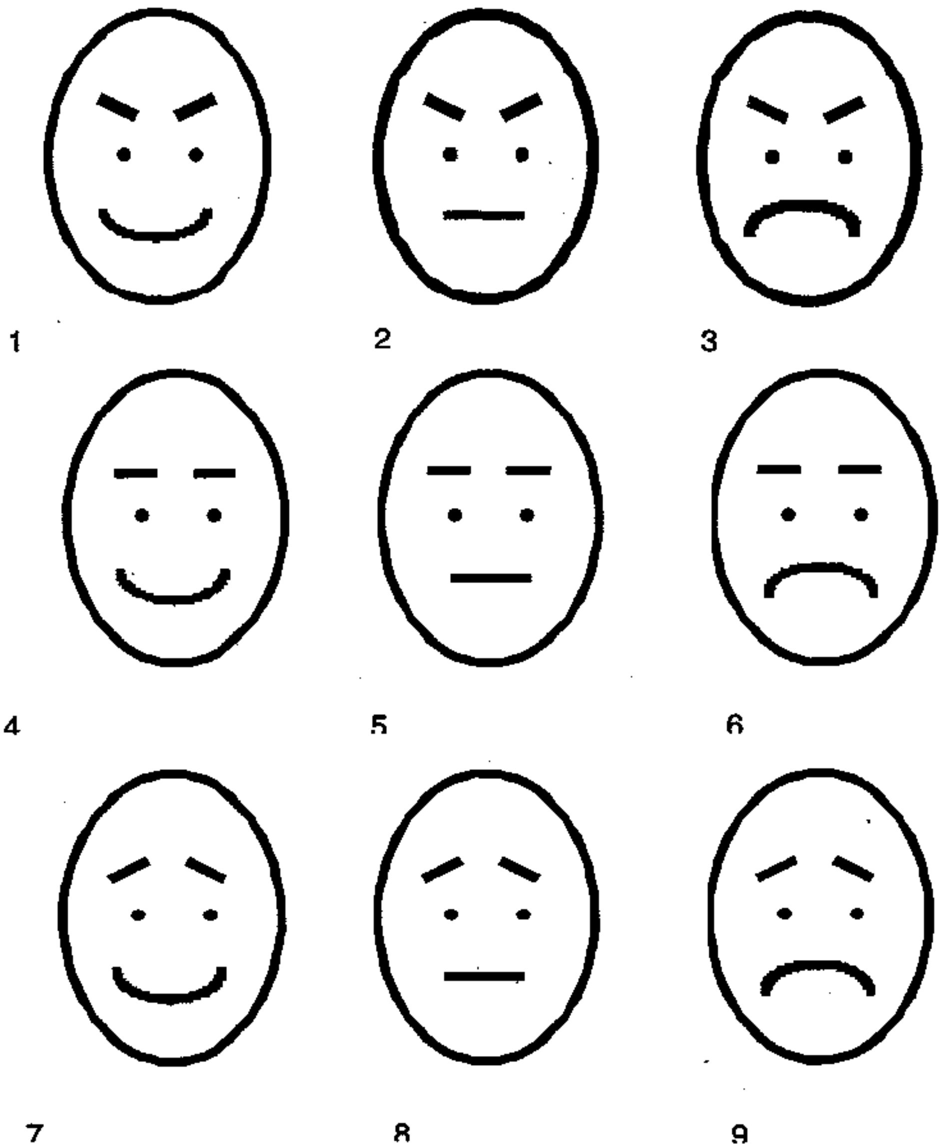


Figure 3
Representative Games Used in Experiment 2

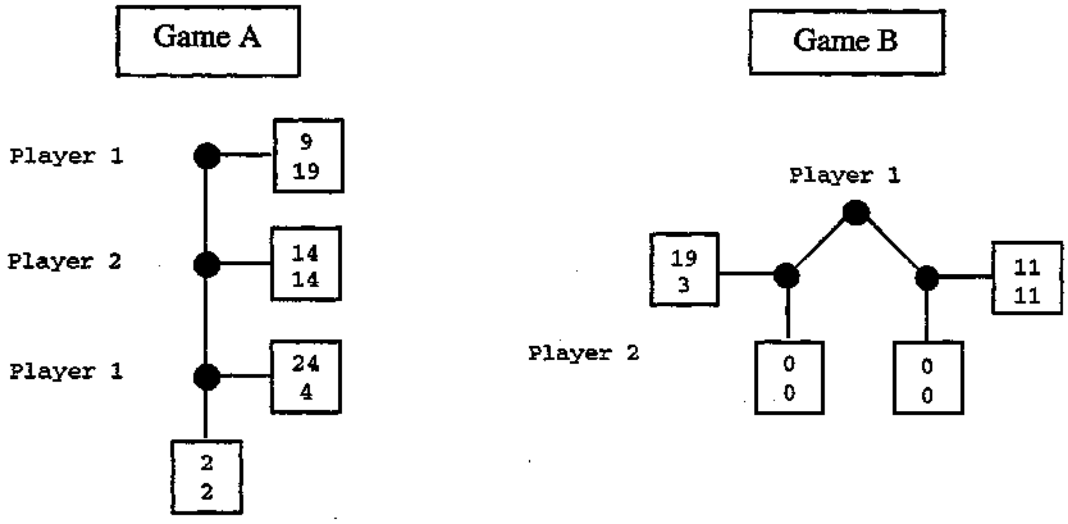


Figure 4
Icon Pairs Used in Experiment

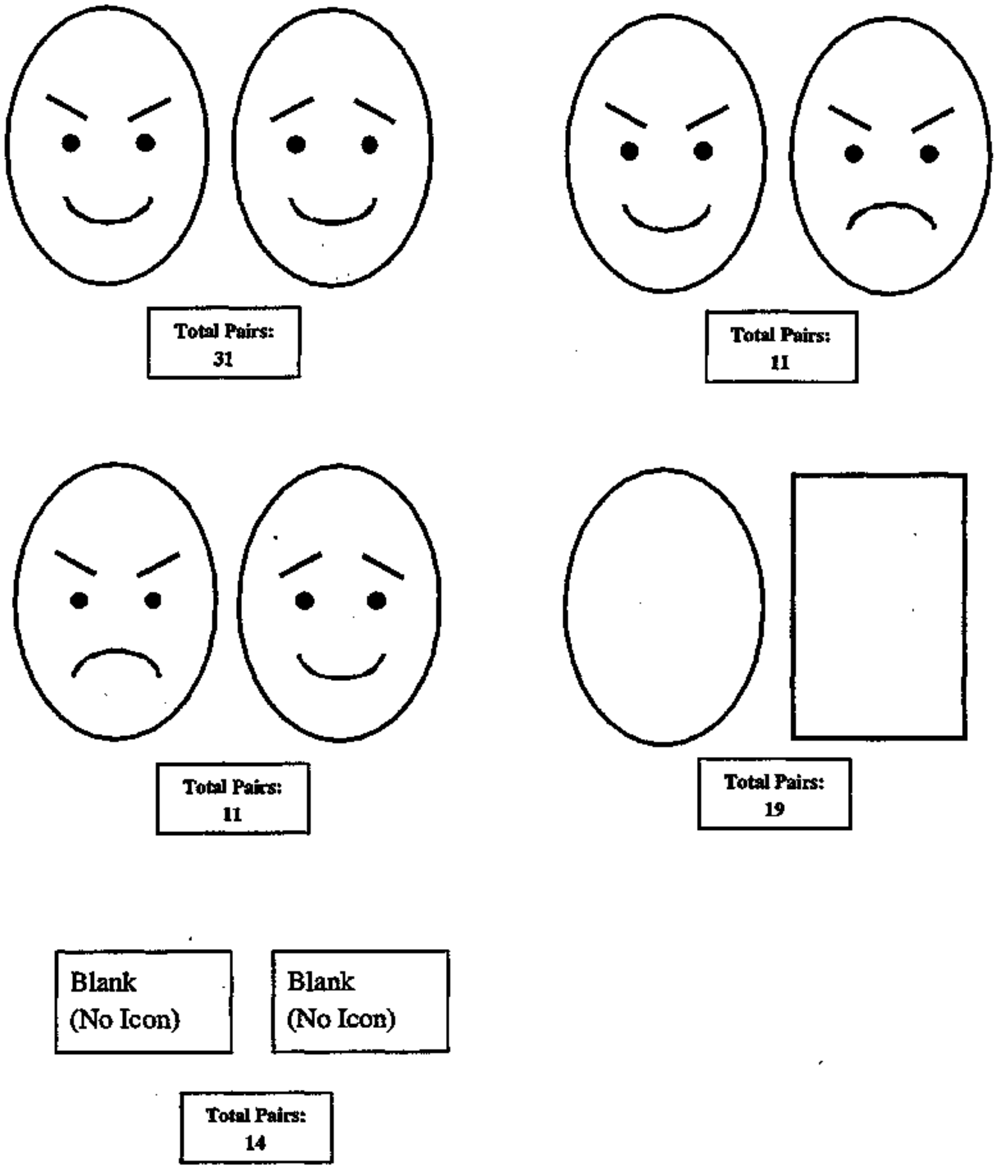


Figure 5
A Subset of Games and Parameters used in Series A and B Experiments

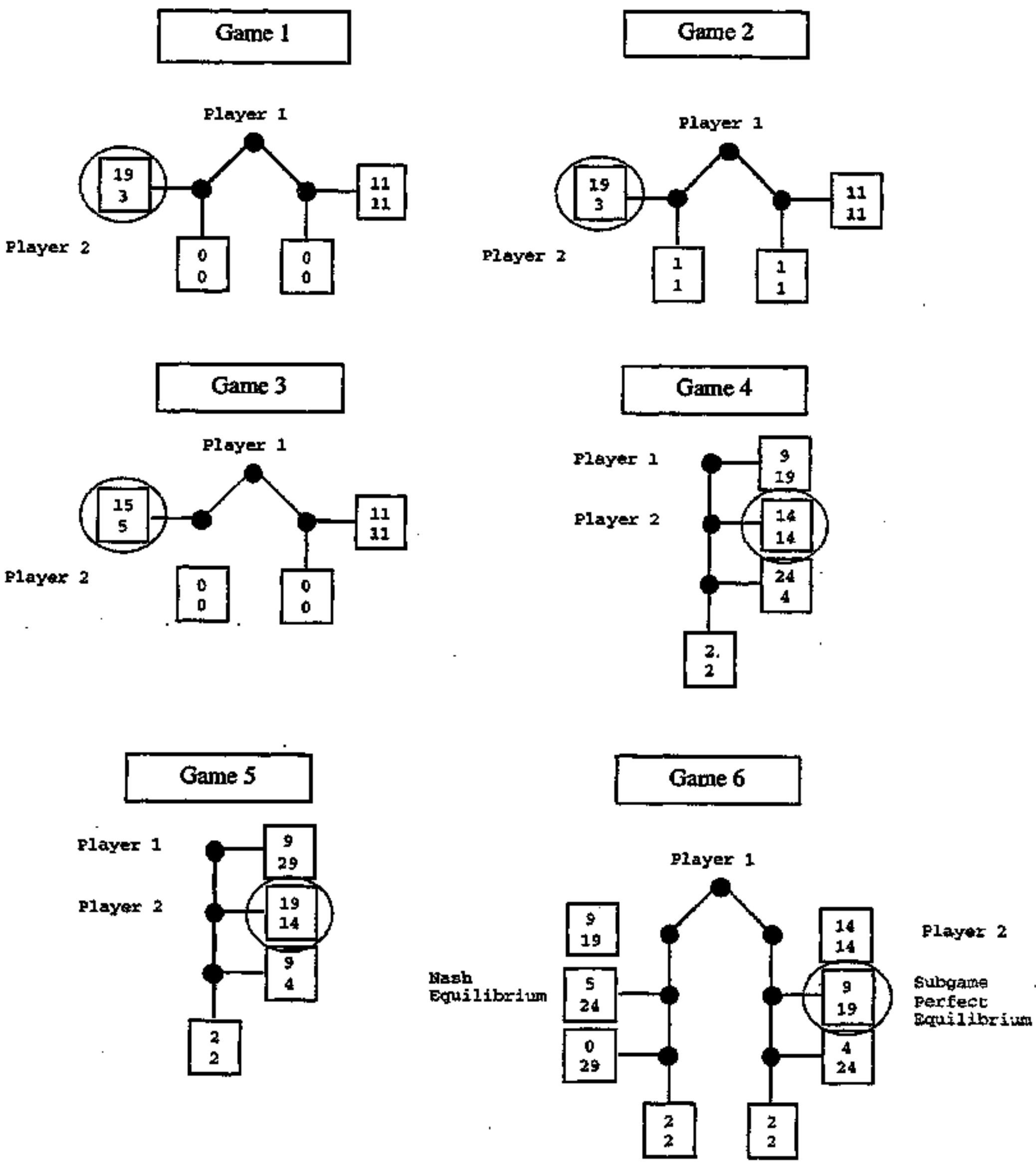


Figure 6
Aggregate Outcomes for Ultimatum Games

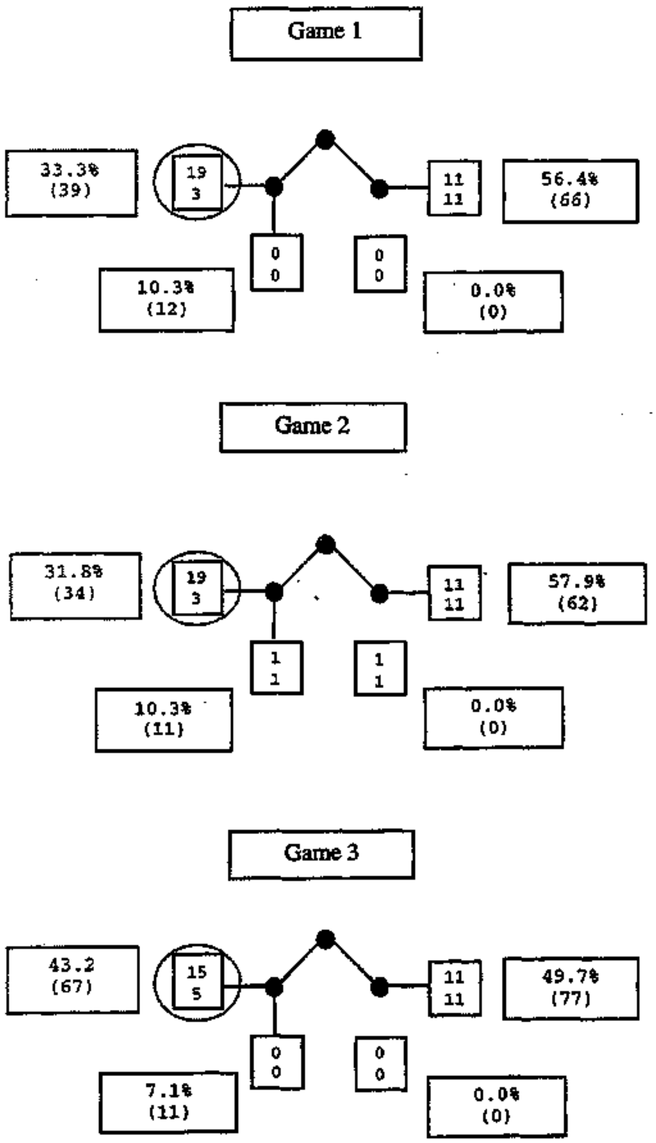


Figure 7
Aggregate Outcomes for Simple Bargaining Games