

The Influence of Emotion in Negotiations: A Game Theory Framework

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*Editors' Note: Perhaps the "other side of the coin" of the preceding chapter, this chapter's authors review what has been learned about long-term relationships from the insights of game theory. They note that game theory's presumption of "rational," interest-maximizing negotiators is a significant limitation, in a world in which is increasingly accepted that we all think from the starting point of our emotions (see Patera and Gamm, *Emotions – A Blind Spot in Negotiation Training*, chapter 19 in *Venturing Beyond the Classroom*). Evolutionary game theory, they argue, provides a basis to learn from repeated interactions, which could be adapted by introducing emotional bias into the game theory framework. This would allow game theory to be used in analysis of altruism, empathy, reputation and other phenomena which are becoming more and more important in teaching negotiation. Their analysis also challenges us all to absorb more via a kind of intelligence most negotiators rather desperately avoid exercising: the mathematical.*

Introduction

Meeting the needs of a business partner fosters mutual empathy and creates significant leverage for the present and future deals. It signifies a desire to place relationship over short-term gain. The more significant the need met, the deeper the emotional impact. Game theory provides a powerful platform for analyzing preferred strategies; however, the restriction of game theory to "rational" players leaves

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no direct means to interject emotional influence. Evolutionary game theory gives players opportunity to learn from repeated interactions. While the actions in evolutionary game theory are typically directed by changes in some measure of profit, and thus selfishly motivated, repeated interaction has some semblance to a long-term business relationship. We take advantage of this feature to propose a means for introducing emotional bias into a game theory framework.

Repeated interaction of evolutionary game theory allows parties to assess collaborative tendencies. When the other party consistently acts in a mutually beneficial manner, trust, and therefore mutual empathy, is increased and risk decreased. However, predictability does not connote trust. Zero-sum behavior promotes distrust, magnifying perceived risk in continued interaction. In dealing with human psychology, trust is earned slowly, whereas acts of betrayal promote immediate retraction. Any model of human bias based upon empathy should incorporate such a response function.

In evolutionary game theory, the next move is typically constructed as a function of the prior position and a differential in a value function. We draw an analogy with differential control theory in engineering unit operations. However, we advocate integral control in modeling evolving long-term relationships. Integral control is less reactionary and more stable with respect to fluctuations in behavior, since future choice is a function of the current state and history. Thus, early choices will be sensitive to non-cooperative behavior, but later choices will be guided by cumulative experiences, accommodating the occasional glitch.

We assert that behavior aside from price that promotes mutual empathy acts as a catalyst to accelerate the relationship bonding process. The degree of trust produced in a long-term relationship can be achieved more quickly if there is auxiliary supporting behavior. Thus, we can use evolutionary game theory that incorporates bias in the choice updating scheme as a means to also include elements usually associated with emotions and irrational behavior. With the described modifications to game theory, elements such as gifting outside the deal (Chamoun and Hazlett 2007; 2009) can both accelerate the approach to a Nash equilibrium, if it exists, and shift the equilibrium position.

Game Theory Externals

Rational Behavior

Game theory arose out of a need to reduce subjectivity in decision-making, particularly in social interactions. It borrowed heavily from

laws of interacting elements found in the traditional sciences, such as the kinetic theory of gases, with the aim of understanding social relationships. The need to quantify responses couched the practice in economical terms, reducing decisions to those that support or erode individual or social objectives. Roger Myerson (1991: 1) defines game theory as the study of mathematical models of conflict and cooperation between intelligent rational decision-makers, with rationality demonstrated in decision-making driven by the desire to maximize utility. Thus, rational behavior is confirmed by selfish decision-making. It is akin to a Hippocratic oath to do no harm to self. Evaluated directly, altruistic behavior is irrational. This leaves a dilemma, for human behavior is rampant with decision-making for the better good of society or elevating the needs of others over self.

Still, Paul Weirich (2007) reminds us, "There are no dilemmas of rationality." Tom Siegfried (2006: 21) stated, "Game theory does not actually assume that people always behave selfishly or rationally. Game theory tells you what will happen if people do behave selfishly and rationally." Thus, game theory is not the study of human behavior, but merely gives us a mathematical framework that can be useful in comparing alternatives, to make decision-making less subjective.

Emotions and Irrational Behavior

Roy Lewicki and colleagues (2010: 138) state that "perception, cognition and emotion are the basic building blocks of all social encounters, including negotiation, in the sense that our social actions are guided by how we perceive, analyze, and feel about the other party, the situation, and our own interest and positions." Thus, all human interactive behavior is filtered through emotions regardless of whether those emotions remain unexpressed or undemonstrated. The association of emotions with irrational behavior is, therefore, an unfortunate consequence of game theory. Cheyney Ryan (2006: 77), meanwhile, has elaborated on the distinction of philosopher John Rawls between behaving rationally and reasonably. Rational behavior is that consistent with personal goals; reasonable behavior also takes into consideration the impact of personal goals on others. As such, rationality is a capacity, whereas reasonableness is a virtue. One avenue to incorporating emotions is to exploit the definition of irrational behavior as accepting changes in utility that seem unfavorable. This can be accomplished by borrowing the role of temperature from the world of physics. Molecules take seemingly random movements, termed Brownian motion, even under a potential gradient if thermal energy of the molecules is sufficient to overcome local barriers. This principle is captured in simulated annealing, now a standard method in optimization.

Applied initially to local structure problems in the traditional sciences (Kirkpatrick, Gelatt, Jr., and Vecchi 1983), it has found application in social problems, such as neighborhood segregation (Schelling 1971). In simulated annealing, when the environment is “hot,” even increases to an objective function are accepted. With time, the environment is allowed to “cool,” and choices become increasingly more objective. Like the slow cooling of a glass-like material, the deliberate approach towards equilibrium facilitates a resulting crystalline structure free of stress defects. Analogously, simulated annealing allows jumping out of local minima in favor of a global optimum.

Recognizing rationality as behavior that aligns with choices to increase (maximize) utility, we can introduce temperature in virtually any utility construct in the role of emotions. When we are hot or excited, our choices can run counter to those of an objective decision-maker. When we cool off and are calm, our decisions conform to expectations. To introduce emotions into game theory, we must simply allow for an assessment of emotional state, and recognize a broader spectrum of responses. For application of emotions in repeated games, we must allow the emotional state to be constantly reassessed. Should emotions always run high, there is some probability of choices that are effectively randomized, or at least counter to reason. The challenge to the counterpart is to diffuse strong emotions, restore the benefits of rational thinking, and reduce the risk of counterintuitive choices harmful to one’s own utility. Modeling emotions in this fashion is proper when choices are unlinked or less strongly connected to measures of utility. In other words, some emotions “blind us” from using utility as a driver, and as a result, outcomes are more random, or even opposite, than expected. When emotions, such as trust or anger, reinforce or justify specific choices, they should be incorporated directly into the measure of utility.

Emotions and Utility

Emotion can be a powerful motivator or an overwhelming distraction. Eliciting emotion in the other party can likewise compel or repel. For example, Daniel Druckman and Mara Olekalns (2008: 1-11) discuss the role of anger, normally considered a negative response: “Display of anger can be beneficial if used to signal how strongly one feels about an issue, about the fairness of proposed distribution or procedures, or about possible consequences of continuing intransigence.” Van Kleef and colleagues (2007) found a positive and significant association between anger and dominating behavior in that an angry negotiator tended to adopt a more competitive stance. Once anger is expressed, it must sometimes be resolved before negotiating issues can resume,

if at all (Lewicki, Saunders, and Barry 2010: 299). Prediction of response to identical stimuli is also compounded by social preference. Pro-social people become more cooperative in loss than gain, whereas pro-self people become more cooperative with gain (Carnevale and Keenan 1990; De Dreu and McCusker 1997). Fairness, a driver for all sorts of decisions during negotiations, is also largely a matter of perception, and perceived fairness in procedures as important as fairness in outcomes (Welsh 2006). Unexpressed emotion is perhaps more problematic (Shapiro 2006).

On the other hand, game theory assumes that players can formulate an expression of what they want, and are able to evaluate the consequences of decisions on the basis of impact to their wants, commonly called a utility function. It can be any quantifiable want. In extending game theory to real social contexts, the challenge comes in how to quantify feelings or intermix the rational and irrational into an objective function. Of course, once a new utility function is fully parameterized, all behavior purporting to support increase in utility suddenly satisfies the definition of rational decision-making. This yields us one avenue to incorporate specific emotions or actions linked to certain emotion-driven responses. The sections that follow identify reciprocity, altruism, distributive justice, and mutual empathy as behavior motivators that could possibly be incorporated into an expression of utility.

Reciprocity

Why do a deed perceived to benefit others at a direct cost to our utility? Action in hopes of reciprocation is motivation for a broad spectrum of social behaviors. In discussion of the rule of reciprocity, Robert Cialdini (1993: 17) declared, "we are obligated to the future repayment of favors, gifts, invitations, and the like." Granting unsolicited favors can result in either direct or indirect reciprocity. Direct reciprocity is captured by a tit for tat rule – I scratch your back, you scratch mine. In indirect reciprocity, I scratch your back, someone else will, in turn, scratch mine. Indirect reciprocity in essence relies on actions becoming to some degree public, to complete the circle. According to Deborah Larson (1998: 121), reciprocity, matching of concessions, is difficult to assess without common measures of value. When no such standards exist, norms and customary expectations, such as equity, equality, and need, establish fairness. Equality connotes common reward, whereas equity divides the spoils on the basis of merit. Need, meanwhile, circumvents the concept of parity. Need elevates value. The meeting of needs is a higher form of compensation than the disposition of objects. Reciprocity, of course, need not be in tangible goods.

Reciprocity certainly includes emotions (Keltner and Haidt 1999), either positive or negative. Warm-heartedness expressed by employers produced open-minded employees (Yifeng, Tjosvold, and Peiguan 2008). According to Barry (2007), "Emotionality is not an alternative to cognition at the negotiation table, but rather a complementary force." Good feelings can be pervasive in business and social relationships, yet emotions can also escalate at the expense of reason as the basis for decision-making.

Altruism and mutual empathy

Altruism is defined as helping someone else out at a cost to you with no return benefit. In reality, many altruistic behaviors do result in benefit, but it may come in the form of indirect reciprocity, reputation-building, or simply generation of good feelings for the giver. The giving process fosters mutual empathy, defined as "the experience of being known and accepted deeply by another, being aware of another being aware of you . . . among the most psychologically important human experiences" (O'Hara 1997: 314). Mutual empathy, sometimes referred to as relational empathy, is a strong driver in altruistic behavior. Among the strongest relationship bonds, intergenerational giving and kinship (Wade-Benzoni 2006) are prime motivators for self-sacrifice. However, we also generate relationships through repeated interaction. Relationship changes the dynamics of any interaction or negotiation (Lewicki, Saunders, and Barry 2010). Of course, this can either be positive or negative. In the case of negative relationships, behavior would cease to be altruistic in favor or some form of punishment, even if it costs us.

Distributive justice

Reasoning of the individual leading to decision-making is critical to the understanding of social systems, yet in the absence of sufficient feedback, we only have behavior or behavioral changes as indicators of motivation. According to Daniel Druckman and Cecelia Albin (2009), perceived justice in outcomes increases durability of agreements. The need for equality is commonly expressed in splitting the difference, when a profit window is presented though parity in profit sharing, may not carry identical value to both parties based on effort or need. Agreement on a standard of fairness has a positive impact on negotiations and outcome satisfaction (Lewicki, Saunders, and Barry 2010: 317). Injustice and inequality are thus drivers for change.

Reputation

Networks form group associations that can influence behavior. Social networking brings new clientele based upon independent experience.

According to Martin Nowak and Karl Sigmund (2005: 1291-1298), "Cooperation through indirect reciprocity . . . requires the evolution of reputations and communication of those reputations among the larger group." We are led to believe that name brands are better than generics due to the reputation that follows the product or a spokesperson behind the product. We are also influenced by perceived long-term commitment to a product and pattern much buying behavior on the basis of warranties and brand longevity. Reputation impacts perceived risk.

Repeated Games

Repeated games provide incentives that differ fundamentally from traditional game theory. As such, the study of repeated games launched another branch of study, evolutionary game theory. George Mailath and Larry Samuelson (2006: 9) state, "The common force organizing market transactions is the prospect of future interactions." People simply behave differently with the prospect of future interaction, and indeed, some behaviors are intended to promote such opportunities. In repeated games, however, players may become either more cooperative or more belligerent.

In evolutionary game theory, no single repeated action is guaranteed to maximize utility. In fact, a mixed strategy often maximizes benefit – multiple strategies with defined probabilities of occurrence. The ability to assess the consequences of your actions in formulating a next move strategy depends upon how much you know about the other party's decisions and motivation as well as your own. Also, equilibria in repeated games rely on open-endedness. That is, if players knew in advance the number of rounds, behavior to maximize utility would be affected by the approach toward the end of the relationship (Myerson 1991: 310). Similarly, initial behavior in the absence of trust may be predictably selfish to protect against the unknown, yet there is an incentive to be generous to promote generosity on behalf of others. In essence, early generous behavior can be a catalyst to promote behavior normally reserved for interactions only after a significant history of benevolence (Chamoun and Hazlett 2009).

Risk in Decision-Making

Much psychotherapy deals only with behavior and not the underlying emotions supporting behavior. The goal is to correct behavior. Similarly, physicians treat symptoms rather than causes. Incorporating emotions into behavioral games can also only deal with actions that may result from an undercurrent of emotions. We treat emotions as motivators for an observable action. We do not need to know why if be-

havior becomes predictable in some fashion. Much decision-making is based upon the degree of fear, ignorance, paranoia, or confidence. We can lump all such factors into the category of making decisions with associated risk. There are tools available to help decision-makers remove subjectivity in assessing risk.

Discounting

Economists use discounting routinely to account for the time value of money. Games also can incorporate discounting, sometimes referred to as patience, in repeated interactions or multiple-round negotiations. In dealing with parties who are not infinitely patient or unequally patient, there is additional risk beyond your assessment of utility that the interaction will terminate in nonagreement. The concept of robustness (Chamoun 2003), the ability to close a deal in few meetings, is closely related due, in part, to cost of continuing negotiations, especially in international markets when considering the cost of travel. Opportunities literally shrink without a deal closing. Roger Myerson (1991: 398) suggests,

[a] good bargainer should try to create the perception that there is a relatively high probability that bargaining may terminate in disagreement whenever one of his offers is rejected, whereas there is a relatively low probability that bargaining may terminate in disagreement when he rejects someone else's offer.

In other words, make offers firmly, and reject offers politely. Sometimes a suboptimal result is better than no result.

Quantifying Risk

Seldom do business decisions rest on a clear-cut reserve price. Other factors enter the evaluation, some of which are known, while others are intangibles. Even when an outcome can be reduced to a formula, uncertainties exist in the parameter set. Often tools are used to quantify the range of outcomes based upon Monte Carlo computations covering the range of all input parameters. These are all methods to quantify risk in business decision-making. While the expected value may hold particular interest, business decision-makers also rely on estimates of upside and downside potential as percentiles on a cumulative probability curve. Whether these presets are \pm one standard deviation, or arbitrarily set at, say ten percent and ninety percent is unimportant. What is significant is that no one value can be treated as representative without additional information, and decision-makers must account for this risk. We assert that pricing games include

flexibility in setting reserves. If risk can be further clarified in the course of a negotiation or in a repeated game, better estimates can be produced, allowing players to adjust “risky pricing” on the fly. A portion of such risk involves uncertainties regarding the other party and the perceived tendency toward integrative rather than distributive decision-making.

Similarly, any utility function can be approached as a risky computation. With the ability to allow extraneous probabilities in an expression of utility (Fishburn 1970), direct incorporation of feelings is greatly simplified. Still, “emotions” like trust (technically not a single emotion, but a compound) may perhaps be the easiest to capture, since they are borne out in a pattern of behavior. Trust is gained slowly but easily lost. Many of the classic game theory games, such as The Prisoner’s Dilemma, Dove-Hawk, and the Ultimatum game, have trust, or lack of it, at the core of decision-making. Nash showed that in single-play, n -person games, an equilibrium can frequently be achieved where no single player could expect to do any better by unilaterally switching strategies. Evolutionary game theory tells us that patterns of unilateral behavior can maximize utility; however, utility can best be maximized through cooperative behavior and trust in the other party to act in an integrative fashion. Trust is an expression of risk assessment, and is a key to formulating emotional responses into a game theory framework.

Games Incorporating Emotions

Taking Emotional Temperature

The role of temperature masks obvious choices based solely on utility. In simulated annealing, a decision is accepted or rejected based upon the strength of the change in utility measure in contrast with ambient noise. Games, however, usually involve a choice between alternatives with differing consequences, some of which depend on choices of another player. A Nash equilibrium exists if neither player can improve their utility by changing their position with the choice of the other player held constant (Binmore 2007). With binary games, such as Prisoner’s Dilemma, this can be easily accommodated by computing a choice based upon relative differences in utility with a decision to accept or reject this choice as a measure of emotional blindness. In a binary choice game, a parameter, θ , can be constructed.

$$\theta = e^{-|U_1 - U_2| / \kappa T(t)} \quad (1)$$

where U_i is the expected utility of strategy i , T is the temperature, possibly a function of time, and κ is an adjustable constant. We can interpret θ as the probability that an energetically unfavorable strategy is adopted. Use of temperature in an Arrhenius expression is not new, but the specific interpretation of θ in binary decision-making is. The product, κT , carries units of energy. If we carry forward this analogy, utility must have the same units. When the utility differential between choices, ΔU , is negligible in contrast to thermal noise, κT , choices are indiscriminant with regard to utility. The basis of choice is controlled by any one of possible emotions, urges, or allegiances. When $4\kappa T = \Delta U$, we essentially return to rational decision-making, rejecting over ninety-nine percent of decisions resulting in utility degradation. For games with a pure rational strategy, we can compute the emotional energy, κT , using the observed quantity, θ .

$$\kappa T(t) = -\frac{|\Delta U|}{\ln(\theta)} \quad (2)$$

In games where an equilibrium strategy involves a fixed probability of selection of strategy 1, we can relate the predicted equilibrium probability distribution with the observed one to take the emotional temperature. In repeated games, the emotional temperature can evolve. Historical values can be tracked and projected to aid in future decision-making by a rational counterpart interacting with an emotional player. A prior exercise to assess emotional temperature may be equally fortelling for interactions of subsequent interest.

As in the analogy with chemistry, and in particular with the kinetic theory of gases, such expressions deal with populations. All molecules have dynamically changing energy levels as molecules interact and exchange collision energy. The temperature is not well represented by the energy level of any single molecule at a single point in time. A good assessment of temperature involves taking an average over a large number of samples representing the population, or a large observation time window with a single sample.

Examples

James Andreoni and John Miller (1993: 570-585) reported repeated Prisoner's Dilemma statistics in games designed to test the influence of altruism with the possibility of unknown augmented utility functions that ascribe pleasure from mutual cooperation. Subjects were told that the opportunity to earn a considerable sum existed, as the game was carried out with cash reward. The units of utility were \$0.01. Games were played in four modes, but herein, we examine only the first two. Mode one involved computer matching of partners between

fourteen subjects for ten rounds of Prisoner’s Dilemma with payout functions as shown in Figure 1.

		PLAYER 2	
		Cooperate	Defect
PLAYER 1	Cooperate	7, 7	0, 12
	Defect	12, 0	4, 4

Fig. 1 The symmetric Prisoner’s Dilemma payoffs as given by Andreoni and Miller(1993)

At the end of each set of ten rounds, partners were rematched for a total of twenty ten-period games. In the second mode, players were randomly paired at each iteration for a total of 200 matchings. To be consistent with the prior game, players were given personal performance summaries every ten rounds of play. The results are reproduced in Figure 2.

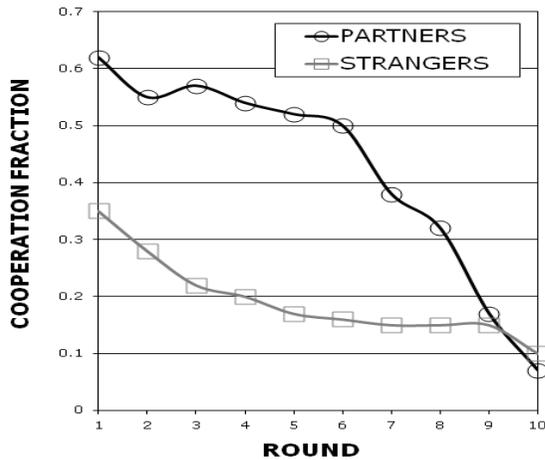


Fig. 2. Results from repeated play of Prisoners Dilemma with partners for ten rounds each and randomly assigned pairings per iteration. Adapted from Figure 2 of Andreoni and Miller (1993).

Figure 3 shows the average payoffs per round for each mode of play. It should be noted that population averages for both those choosing to cooperate and defect decline as the Nash equilibrium for all to defect is approached.

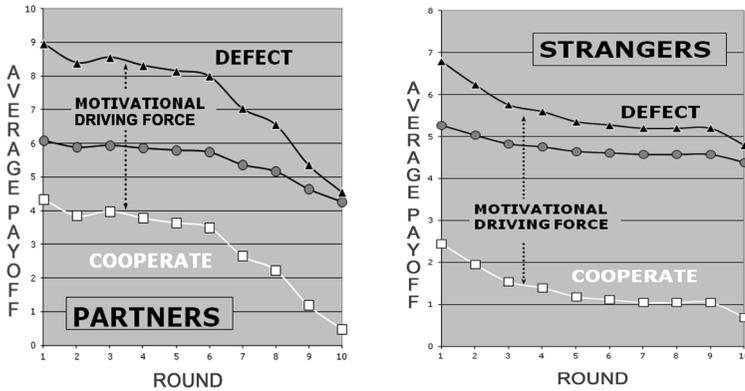


Fig. 3. Tracking the overall average payout (gray circles) and those who choose to cooperate (white squares) and defect (black triangles) in each round of play: (a) Partners are matched and play ten rounds together; and (b) Players are matched at each iteration, i.e., strangers.

Why would the population succeeding as a whole migrate to lower payoffs for all? First, those who defect are aware of the upside potential of staying with their choice, especially immersed within a population eager to cooperate. Indeed, defectors were rewarded on average much higher than those choosing to cooperate. The risk of joint cooperation for defectors is a loss of five in utility. It is not those who are rewarded for cooperation who are unhappy. Rather, those choosing to cooperate, anticipating a gain in utility of seven but receiving zero reward, can harbor feeling of betrayal and possibly a need for retaliation, a very strong emotion driving change. According to Morton Deutsch (1975: 140), "... there is usually a positive circular relation between the well-being of the individuals in a group (or society) and the well-functioning of that group." Those individuals unhappy with their outcome, though they may be in the minority, drive the group towards stability at the expense of overall population reward. The only way to purge future betrayal is to adopt defection. Still, some may be reluctant to assume the role of traitor trying to capitalize on others, based upon moral principles. There is also a lack of equity in population averages, making fairness also a motivator to defect. However, these players could only sense population statistics as the games progressed. Finally, we see a marked difference in the play of partners, where history plays a role in future dealings, and strangers paired for a one-off game. Most notable is the starting fraction of those choosing

to cooperate. Knowing a relationship of ten rounds would proceed, partners were also twice as likely to start play with intention to cooperate. This is the win-win scenario, but it is unstable. The onset of defection eliminates cooperate-cooperate as a sustainable result, as the probability of this outcome pairing decays rapidly.

Still, there is something else happening in the partners mode not evident with strangers. The rate of cooperation decay is mild with partners until it exhibits a precipitous change after crossing the fifty percent threshold. The average payoff for cooperation dramatically drops below the guaranteed payoff for defection. The payoff for indiscriminating players who choose cooperation fifty percent of the time can be computed as 5.75, considerably more than players choosing to cooperate with this frequency were obtaining on average. There may also be an analogy to reaching a percolation threshold in science in which defection has sufficiently “invaded” the interaction, making reward for cooperation a cognitive idealization, like abandoning a sinking ship. Another possible metastable position in repeated games with relationship would be to alternate choices systematically, so each player receives the maximum payout half the time. In this case, such reciprocating players would receive an average payout of 6 – marginally better than for an indiscriminant population and far above the Nash equilibrium payout.

Next, we apply Equation 1 to analyze the initial emotional temperature and its evolution through repeated game play. These results, shown in Figure 4, were normalized with respect to the equilibrium payout.

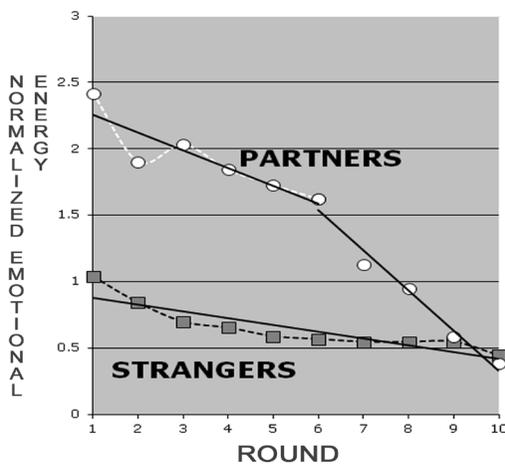


Fig. 4. Extracting a measure of the emotional energy, κT , from repeated Prisoner's Dilemma play for partners (white circles) and strangers (gray squares). Solid lines represent regression in at least squares sense with the slope quantifying a rate of temperature change.

The appropriate activation energy is not that taken from payout difference in Figure 1 for single play, but rather the actual average payouts experienced in the population for the binary choice presented. This difference between average payouts for cooperate and defect is dynamic. While individuals may experience a greater degree of success and disappointment, we concentrate on the population average difference as the risk barrier experienced in cooperation. The emotional temperature, indicative of making choices using criteria other than provided utility functions, is approximately 2.5 times higher at the onset of game play when a relationship was pending. Even after ten rounds of play, Nash equilibrium is not reached, as some emotional energy persists. Some oscillatory response could be expected in discrete play data, especially for small populations, as players react, gather data, and assess trends. The emotional energy of partners is drained rapidly as rationality prevails following crossing the threshold for indiscriminate players with the associated underwhelming reward. With the distinction provided by Morton Deutsch (1975: 143) between equity and equality as values for the basis of distributive justice, perhaps there was a shift from equality towards equity when social relations entered game play. While this may help explain differences in initial emotional energy between games with partners and strangers, we note the differences in average payouts between those choosing cooperation and defection within each game as potential drivers for distributive justice are remarkably similar, stay fairly constant, and are approximately equal to the difference (four) at the Nash equilibrium.

The same driving force used to compute emotional energy can be recognized as a measure of fairness, though the true range of reward disparity is much larger than this. The other side of the coin of fairness is envy. The population might be assessed as satisfied if only average payout was considered. Only when the population is subdivided, exposing disparities in utility and underlying emotions, can outcomes and population kinetics be reconciled. Key will be taking the concept of emotional temperature as an observable and allowing more creative outcomes by exposing another degree of freedom.

Conclusion

We find it interesting that economics are always performed on forward estimates, but emotions and trust in the other party are predominantly based upon historical information. Game theory can be extended to include parameters related to emotions, thus expanding the definition of rational behavior. It can also be appended to account for emotional blindness, using the concept of emotional energy and

temperature. We were able to show how to take the emotional temperature of a player or group based upon a history of action, a parameter which may prove useful in long-term relationships or repeated games. As defined, fairness and fairness history can be used in virtually any game. With more opportunities to portray factors leading real people to real decisions, the landscape for game theory to provide a platform for business and social decision-making becomes usefully enlarged.

Future Work

Similar analysis can be carried out, with variations in payout and rules of engagement, to target different emotions. Such games need to include larger populations for greater statistical significance. It is proposed to go beyond post-game analysis. We plan to propose gaming experiences for use in teaching negotiation concepts that are able to quantify emotions and utilize them in forward modeling, especially games in which trust is the only variable contributing to the measure of risk. Gifting is additionally proposed in the role of a catalyst with the ability to accelerate a relationship. We will explore leveraging existing formulations in chemistry to capture this type of external in social contexts.

Notes

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