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Review of: "Collective rationality in interactive decisions: Evidence for team reasoning" by Andrew M. Colman, Briony D. Pulford, Jo Rose

Introduction

Approach of decision theory and game theory based on assumption that each player try to maximize his utility function. But for some interactive cases it seems reasonable to maximize utility function of whole group of players.

Fundamental assumptions of expected utility theory and subjective expected utility theory are *rationality* of a player and attemption to maximize self *utility* by player in all circumstances. We can measure individual preferences of each player with utility, and in game it is payoff. Russel's interpretation of rationality is "the choice of the right means to an end that you wish to achieve".

Research into judgment and decision making for interactive decisions or games shows that humans often deviate from full rationality in practice, because they are limited by bounded rationality that constrains them, in difficult decisions, to use rough–and–ready judgmental heuristics that are faster but that sometimes generate biased judgments and decisions.

In such games persons often try to increase *collective* utility instead of individual one. *Team reasoning* — based on collective preferences decision making approach. Theories of team resoning assume that players motivate to maximize either collective or individual utilities depending on circumstances.

Payoff dominance

In two-player game, a *Nash equilibrium* (is an outcome from which neither player could profit by deviating unilaterally and that therefore gives neither player retrospective grounds to regret the chosen strategy) is a pair of strategies that maximize payoff of player choosing it, given to strategy chosen by co-player. If game has only one Nash equilibrium, rational player should choose it, according the game theory, because it's only one variant to maximize payoff in this case for both players. For game with multiple equilibrium, where one better than any other for both players, it natural to assume for rational player to choose *payoff–dominant* strategy. But such choice can't be justified by game theory fundamental assumption.

Team reasoning offers the solution for payoff-dominance problem. Players identify profile of strategies that maximize collective payoff. If it is unique, they choose it.

Rationale and hypotheses

Team reasoning solves the payoff–dominance problem. The question is: "Do decision makers from collective preference on practice?" We can't observe directly preferences or modes of reasoning. Predictions can be made about choices that would result from collective utility maximization and team reasoning, and that behavior can be observed directly. For these aim where constructed two experiments. Games with unique Nash equilibria and disunique *Pareto–dominant* disequilibria outcomes — outcomes that were not Nash equilibria, but offered higher payoffs for both player, were used in experiments.

Experiment 1

Participants

The 81 participants were chosen as decision makers at this experiment (36 men and 45 women). Mostly undergraduate students, aged 16—45. Each participant earned between £4.00 and £13.00 according to the payoffs in a single game selected randomly from among those used in the experiment.

Fund-raising

You and other students collect funds for charity. In the first hour, you and your best friend each raise some money. Here is a list of the possible options:

	You raise	Your friend raises
Option A	£1	£7
Option B	£3	£3
Option C	£5	£6
Option D	£6	£4
Option E	£4	£1

Which option do you prefer?
A B C D E (circle one)

What do you expect the other person to choose?
A B C D E (circle one)

GM site

You are involved in a group of people who are against a proposed test site for genetically modified crops. You and another group member spend half an hour in the local town collecting money for publicity opposing the new test site. Here is a list of the possible options:

	You collect	Other person collects
Option A	£1	£7
Option B	£4	£5
Option C	£4	£6
Option D	£6	£3
Option E	£4	£0

Which option do you prefer?
A B C D E (circle one)

What do you expect the other person to choose?
A B C D E (circle one)

Figure 1. Decision vignettes designed to prime collective preferences (team-reasoning vignettes), with Option A maximizing altruism, B equality-seeking, C collective rationality, D individual rationality, and E competition.

Prize draw
You and your next-door neighbour enter a prize draw at a school fete. Here is a list of the possible options:

Option A	£3	£7
Option B	£4	£4
Option C	£5	£6
Option D	£6	£2
Option E	£5	£0

Which option do you prefer?
A B C D E (circle one)

What do you expect the other person to choose?
A B C D E (circle one)

Poker
You and a classmate play a session of poker on the internet. Here is a list of the possible options:

Option A	£1	£6
Option B	£2	£2
Option C	£4	£5
Option D	£5	£2
Option E	£4	£0

Which option do you prefer?
A B C D E (circle one)

What do you expect the other person to choose?
A B C D E (circle one)

Figure 2. Decision vignettes designed to prime individual rationality. Option A maximizes altruism, B equality-seeking, C collective rationality, D individual rationality, and E competition.

Materials

On the Figure1 you can see *team–reasoning vignettes*. Authors hypothesized that collective preferences would be primed by vignettes describing decisions in which the payoffs contribute to a respected public good, provided that the individuals play their parts in the collectively rational outcome. Both games symmetric 5×5 and has a singular Nash equilibrium where both choose D and a collectively rational outcome where both choose C.

On the Figure2 described 2 vignettes designed to prime individualistic preferences, owing to the fact that payoffs provide culturally acceptable benefits to individuals rather than public goods. Authors hypothesized that individualistic preferences would be primed by frames involving competitive gambling and recreational games with individual payoffs to the winners. Both games symmetric 5×5 games, each with a singular Nash equilibrium where both players choose D and a collectively rational outcome where both choose C.

In each vignette, players choose from a list of five options for assigning substantial monetary payoffs to self and an unidentified co-player, and they also indicated which options they expected their co-player to choose. The five options invariably represented altruism (maximizing co-player's payoff), equality-seeking (minimizing absolute difference between own and co-player's payoff), collective rationality (maximizing joint payoff), individual rationality (maximizing own payoff), and competition (maximizing own minus co-player's payoff).

	A	B	C	D	E
Fund-raising	0.00	4.94	59.26	34.57	1.23
GM site	2.47	11.11	49.36	35.80	1.23
Prize draw	1.23	16.05	23.46	54.32	4.94
Poker	1.23	6.17	22.22	59.26	11.11

Note. A = altruism, B = equality-seeking, C = collective rationality, D = individual rationality, E = competition.

Figure 3. Experiment 1 results (percentages), for lifelike vignettes designed to prime collective rationality (Fund-raising and GM site) and individual rationality (Prize draw and Poker).

Results

Full result you can see in Figure 3. In "Fund–raising" vignette substantial majority of players (59.26%) chose the collectively rational option (C), and most of the rest (34.57%) chose the individually rational option associated with the unique Nash equilibrium (D). Ignoring five players who chose other options as predicted by theories of team reasoning, a large majority (77.08%) of the players who chose the collective option expected their co-players to choose it also.

In the team-reasoning "GM site" vignette a majority (49.36%) chose the collectively rational option (C), and most of the rest (35.80%) chose the individually rational option associated with the unique Nash equilibrium (D). The proportion that chose the collectively rational option was larger than the proportion that chose the individually rational option. Once again, a large majority (77.50%) of the players who chose the collective option expected their co-players to choose it.

Of the two vignettes designed to encourage individual rationality (Figure 2), "Prize draw" elicited 54.32% individually rational and 23.46% collectively rational choices, and "Poker" 59.26% individually rational and 22.22% collectively rational choices. The majority preferences in these vignettes were individually rational, in line with the predictions of game theory.

The results of this experiment suggest that the interpretive framing of the games had a moderately powerful effect on the outcome preferences and mode of reasoning adopted by the players, with predominantly collective rationality and team reasoning only in the vignettes designed to prime it, although each of the four games had a Pareto-dominant outcome—one that yielded higher payoffs to both players than the Nash equilibrium. However, it is impossible to judge how much influence interpretive framing had on collective rationality and team reasoning in the team-reasoning vignettes. Experiment 2 was therefore performed in order to seek evidence for team reasoning in abstract games

	II	C	D	E
	C	8, 8	5, 9	5, 5
I	D	9, 5	7, 7	5, 9
	E	5, 5	9, 5	6, 6

Game 1

	II	C	D	E
	C	8, 8	7, 7	5, 9
I	D	7, 7	6, 6	6, 5
	E	9, 5	5, 6	7, 7

Game 2

	II	C	D	E
	C	9, 9	7, 10	7, 5
I	D	10, 7	7, 7	6, 9
	E	5, 7	9, 6	8, 8

Game 3

	II	C	D	E
	C	8, 8	9, 6	5, 9
I	D	6, 9	7, 7	5, 5
	E	9, 5	5, 5	6, 6

Game 4

	II	C	D	E
	C	8, 8	5, 5	5, 9
I	D	5, 5	6, 6	6, 7
	E	9, 5	7, 6	7, 7

Game 5

Figure 4. The five games used in Experiment 2, in normal (strategic) form, with singular Nash equilibria at (E,E), collectively rational outcomes at (C,C), and payoffs in pounds sterling.

without interpretive framing.

Experiment 2

Participants

The same participants as for Experiment 1. Experiment 2 followed immediately after Experiment 1, without any debriefing until both experiments were completed.

Participants earned between £5.00 and £9.00 according to their payoffs in the randomly selected game.

Materials

The players made one–off decisions in five symmetric 3×3 games presented abstractly, without interpretive framing. Figure 4 shows all five game matrices. Each of these games has a unique Nash equilibrium and a distinct, collectively rational, Pareto–dominant outcome. Authors think that this class of games would be likely to elicit team reasoning in spite of having unique game-theoretic solutions that differed from the team–reasoning outcomes.

To see why the (C,C) outcome in each of the games in Fig. 5 is collectively rational, note that this outcome is Pareto optimal in the sense that no outcome yields higher payoffs to both players — in any outcome in which one player does better, the co-player does worse. A consequence of this is that the (C,C) outcome maximizes the joint payoff (sum of payoffs) of the pair of players. But (C,C) is not individually rational in any of these games, because it is not a Nash equilibrium. In Game 1, for example, C is not a best reply to C, because if Player I choses C, then Player II receives a higher payoff by choosing D than by choosing C — Player II's payoff is 9 following a D choice and 8 following a C choice. For this reason, (C,C) is not a Nash equilibrium, and the C strategy is not a rational choice for either player, because players are not choosing best replies to each other's strategies and are therefore not maximizing their individual utilities. The only Nash equilibria in the games in Figure 4 are at (E,E). In Game 1, for example, if Player I chooses E, then Player II's best reply is E, and conversely if Player II chooses E, then Player I's best reply is E. Each of these games has a unique Nash equilibrium at (E,E) that is the rational outcome according to orthodox game theory, but this uniquely rational solution is Pareto-dominated by the outcome at (C,C), where both players receive higher payoffs.

The games were presented to the players verbally rather than in matrix form. For Game 1, for example, the description was: "You choose C or D or E. The other person chooses C or D or E. Here are the possible outcomes: You choose C; the other person chooses C. You get £8, the other gets £8. You choose C; the other person chooses D. You get £5, the other gets £9. . .", and so on. The singular Nash equilibrium of every game in Fig. 5 is (E,E) and the collectively rational outcome is (C,C). Payoffs represent pounds sterling.

Results

The percentages of players who chose collectively and individually rational strategies are displayed graphically in Figure 5. In every game in which team reasoning was pitted directly against individual rationality, an absolute majority of players chose the team-reasoning strategy, and a smaller proportion chose the individually rational (Nash equilibrium) strategy.

Players who chose team–reasoning strategies in the abstract 3×3 games generally predicted that their co–players would choose them also. Expectations of team–reasoning co–player choices by team–reasoning players in Games 1–5 were 88.37%, 78.26%, 75.56%, 81.16%, and 79.55%, respectively. This, and the similar finding in Experiment 1, is consistent with the theoretical prediction that players who engage in team reasoning need to be confident that their co–players will do the same.

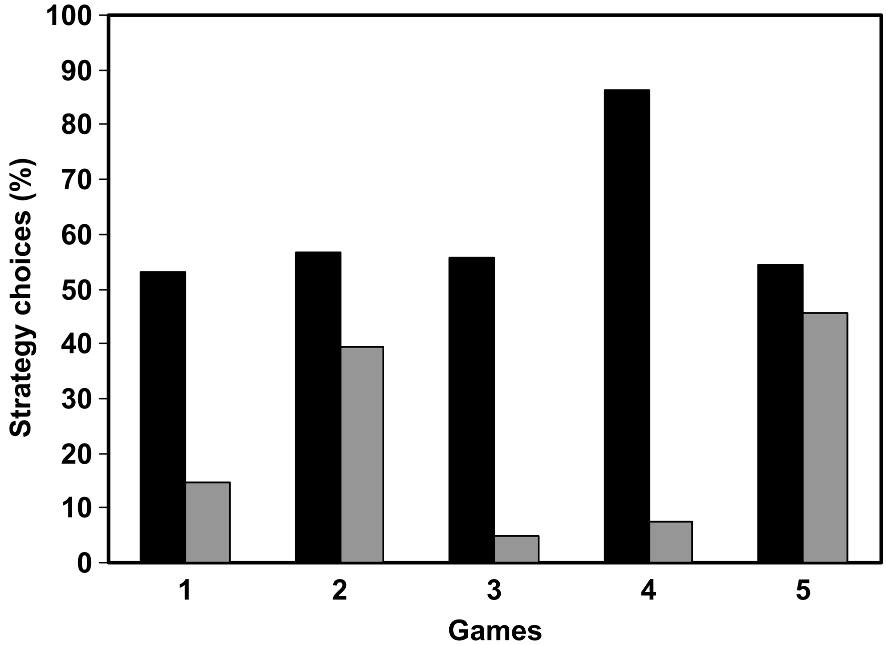

Figure 5. Collective versus individual rationality: Percentages of collectively rational (dark bars) and individually rational (light bars) strategy choices in five abstract 3×3 games.

Conclusions

Games in which collectively rational strategy and individually rational strategy with a smaller payoffs were represented in both experiments. Substantial majorities of decision makers chose in bot experiments the collectively rational strategy. It means that team reasoning tends to influence decision making in strategic interactions of those types.

Both experiments shows that pairs of players who choose team reasoning strategies received higher payoff then those who choose Nash equilibrium. But it doesn't mean that they were motivated by maximization of self–utilities, because collective rational choices where out of equilibrium in all games.

The results of experiments show that team reasoning motivates decision makers in interactive decision making process can be a link between game theory and its close neighbor, social psychology. A proper understanding of social behavior needs to take account of collective rationality and team reasoning, and team reasoning needs to be incorporated into any game theory that purports to explain naturally occurring interactive decisions. This may be necessary, because everyday experience suggests that it is not uncommon for people to set aside their individual self-interests and to make decisions in what they judge to be best interests of their families, or the companies that employ them, or their departments or universities, or the religious, ethnic, or national groups with which they identify themselves, sometimes fervently, and a comprehensive understanding of strategic interaction needs to recognize and understand this mode of decision making.