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The role of perceived intention as a fast social heuristic for the promotion of collective rationality and increasing human cooperation in an economic game

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Abstract

In the studies of human cooperation, the problem is always the choice between individual benefit and collective benefit, which is modeled by the game. On the other hand, based on the Dual processing of decision-making, whether cooperative decision-making is the type I or type II has been discussed a lot. Some studies consider cooperative decision-making as type 1 and others as type 2. According to some theories, the human self is inter-subjective, and it is created by the interaction between I and Me. The classical model of game theory does not consider it. In this article, we first enter common sense and intersubjectivity into the game theory model and show that a level of estimation of the intention of the opposite player is necessary for cooperation. Then we show that if the individual perceives himself in a joint situation through the knowledge of the opposite player's intention, the cooperative decision-making process is carried out Fast, and therefore it must be considered type 1, and if he considers himself as an individual, his decision-making must be considered type 2. As a result, belonging to a social environment has priority over the type of decision-making. The statistical population includes 20 master's students who each made 100 binary decisions and produced a total of 2000 data. The analysis method is regression analysis. Based on an intersubjective model of game theory the result of the analysis of a linear regression model shows that the response time decreases and the level of cooperation increases significantly as people's understanding of another's intention increases, and also the response time increases and the level of cooperation decreases at the same time as this intention decreases. Because collaborative decision-making takes place in an intersubjective space, it is said that it is influenced by common sense before than dual cognitive processing. Therefore, if there is a community of common sense, collective rationality and as result cooperation is internalized and shows itself as system 1. But if there is no common sense, people decide to cooperate or not as separate individual atoms.

Keywords: reaction time, human cooperation, dual processing theory, social cognition, intentionality, common sense
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1 Introduction

In today's modern world, many people spend time and money to vote, pay taxes, help charities, donate blood, and so on, while many others do not [2].

Cooperative behaviors or decisions are defined as actions in which people assume personal costs for the benefit of an individual or a group of other individuals. This type of behavior has existed since our hunter-gatherer ancestors and has been shown by various actions such as cohabitation, cooperative hunting, and resource sharing, all of which were necessary for their survival [12].

However, generalized cooperation remains one of the greatest open problems in science. Therefore, an important question is why some people cooperate and others violate cooperation. There are at least six mechanisms have been proposed to explain human cooperation in evolution history. kinship selection means dependence on relatives, direct reciprocity means mutual benefits, indirect reciprocity means maintaining a good record and reputation, group selection means the specific exclusion of non-cooperatives by cooperative groups, multilevel selection (means competition not only between individuals but also between groups, and Finally, institutional cooperation that is based on reward and punishment mechanism [20].

In studies of human cooperation, the issue is always the choice between individual benefit and collective benefit. Individual benefit means maximizing one's own income regardless of what other people will choose. This is an economic considerations point of view. The second mechanism is the sense of fairness or inequality aversion, and it can be called social efficiency. The processing bases of these two strategies may be different. In theories, many studies claim that human cognition and specifically selected behaviors are governed by the interaction between two different well-known distinctions between Type 1 and Type 2 cognitive processes [21]. Type 1 processing is characterized by being autonomous - it does not require "controlled attention". Autonomic processes are fast, automatic, unconscious, independent of cognitive ability, and experience-based decision-making and give rise to intuition. In Type 2 processing, responses rely on hypothetical thinking and working memory. This type of response is slow, conscious, sequential, and correlated with cognitive ability. Researchers have manipulated cognitive processes using time-limit methods [7]. For example, to promote Type 1 processing, participants respond within a given time window or "time pressure" condition. In contrast, to facilitate Type 2 processing, participants may think carefully about the decision problem for some time before deciding by a "time delay" condition. An early study on decision time and cooperation found that manipulating time pressure reduced cooperative behavior and Increases the time delay in economic games [19].

According to the first mechanism, we are primarily and inherently more social essentially. Therefore, in front of the decisions, we first feel fairness, but later, consciously or calculatingly, we focus more on economic and self-centered considerations [8]. According to this model, which is more consistent with a psychological perspective, affective considerations have social elements, while calculative considerations are more analytical and focused on maximizing utility [8]. In the second model, it is shown that the primary motive is seeking personal economic benefit, but these motives are later ignored by social preferences that aim to acquire justice and fairness. According to this model, which is consistent with the classical economic view, people inherently make decisions based on economic and calculative interests [16].

Cooperative decision-making or behavior has been investigated mainly using the concept of social dilemmas [29]. Social dilemmas were defined as situations of interdependence characterized by a conflict between short-term personal interests and long-term collective interests. Two of the most prominent and widely used social dilemmas are the Prisoner's Dilemma Game and the Public Goods Game. Prisoner's Dilemma is an updated version of the public goods game and the multiplayer of the Prisoner's Dilemma game. It has received much attention over the years and has become a leading paradigm for exploring collaborative decision-making [5].

Specifically, the game involves two players, and each player must choose between two strategies: cooperation or non-cooperation (see Table 1). Both players will receive a reward (R) if they both cooperate and a penalty (P) if they both decide to violate cooperation. However, when a violator meets a contributor, he exploits the contributor and becomes tempted (T), leaving the contributor rewarded (S). In the prisoner's puzzle game, the outcomes must have the following relationship: [T>R>P>S]. These two social ways have been used to model human behavior in social issues such as pollution control, intergroup conflict, or natural resources.

2 Dependence of the individual self on the common social mind

According to the argument of the German thinker Johann Gottlieb Fichte, the human self is necessarily social. According to this argument, it is not the case that in the beginning people exist as individuals and then these people entered into a relationship with each other. Rather, people's selves are formed through relationships with other selves.

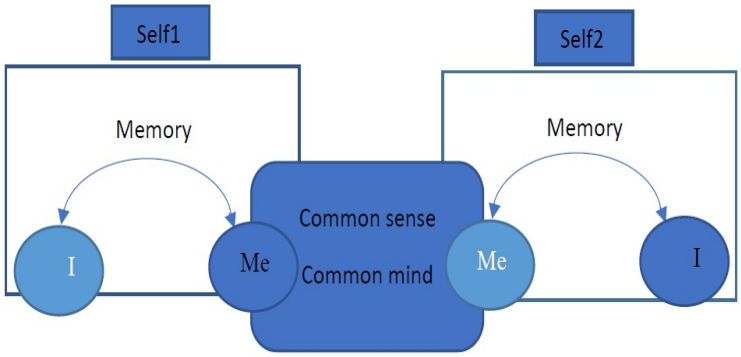

Figure 1: Herbert Mead's model of human self and relation of it to common sense

This type of reasoning is not based on empirical evidence but works on rational reasoning. According to Fichte's argument, for a person to perceive the current action as an action that he performed, there must be other people who attribute that action to him as his true action.

This idea is developed by the famous psychologist and philosopher George Herbert Mead, by distinguishing between the "self" or "I" and the "social self" or "Me". In this idea, a person's self-awareness and his/herself arise as a result of the interaction between the two selves. In short, this distinction means that humans (unlike animals) have the capacity to see themselves in the eyes of others (the "social self") and to experience the "I" as the source of their actions. but they can only understand it through the "social self". Mead offers a Darwinian explanation for this dichotomy, arguing that for the human species, social cooperation has been essential to survival so sociality is an intrinsic feature of our existence. In this approach, common sense or transactive memory is omnipresent because it establishes a continuous feedback mechanism between the "I" and the "Me". The simplest example Mead gives is speaking: when we talk to others, we mostly don't have a preconceived plan in mind for what to say next but speak spontaneously. Only when the spoken word is out to do we realize what we said, and proceed based on the memory of the previous word, so we can create a consistent flow of speech [13].

Considering this issue, the intersubjective mind can be called "common sense" which are the basic elements of memory, especially autobiographical. Without common sense, there is no self and therefore no agent capable of action or decision. Common sense accumulates in a comprehensive throughout the life of a human person [14].

This approach is very consistent with the recent studies of Micael Tomasello [27]. Tomasello and his colleagues have shown that humans have three types of cognition, first is individual intentionality, the second is collective intentionality, and the third is shared intentionality [27]. The first type of personal intentionality or personal intention is a personal purposeful behavior, such as climbing a tree to pick fruit or opening a box containing a treat. Individual intention assumes a high level of cognitive performance because it requires conceptualizing an outcome (goal) and devising a series of actions, each of which is evaluated for its effectiveness in contributing to the outcome. The second type of cognition is collective intentionality. On the one hand, this form of cognition is collective because people must engage in complex social interactions to engage specific social norms and conventions, and on the other hand, it is conscious because the resulting norms and conventions aim to promote some types of social interaction. Tomasello argues that collective intentionality is absent in great apes. In the third type of contribution, which is unique, Tomasello provides an analysis of what he calls common intention, which is when two or more people cooperate in achieving a common goal.

Collective intentionality is the ability of minds to jointly focus on the objects of reality and the situation of affairs, goals, or values, collective intentionality appears in various ways such as common intention, common attention, common belief, collective acceptance, and collective emotion. The collective intention is a title for common attitudes including cognitive (common opinion), conceptual (common intention), or emotional (common feeling). Among the basic types of states of collective intention, the collective intention has been the focus of collective intentionality analysis since the first use of this title. The collective intention is essential for such social phenomena as coordination, cooperation, and communication [22].

According to Tomasello, participation is an inherent human phenomenon and that language would not occur in animals that did not previously engage in cooperative behavior and therefore would not evolve [26].

3 Team reasoning, and common sense modeling in game theory

For Tomasello, new and unique psychological mechanisms enable individuals to create a plural "we" with others, such as how "we" must defend our group against other groups. His approach claims that there are the skills and motivations for building an intersubjective and plural "we," that is, the skills and motivations for cooperating with others in acts of a common goal [3, 11]. These skills could be called we mode cognition in literature [15].

Classical game theory has difficulty in explaining how individually rational agents can act in a rational collective action such as participation in a public good or with coordination [6]. But by adding the concept of intentionality, especially shared intentionality, to the classical model, this problem can be solved. In collective reasoning, the central idea is that humans can form a common factor with others, called the "we-mode". In the analysis of the prisoner's dilemma, "I-mode" is often used for analysis. If with a new format, the cost matrix of the game can be changed as follows:

		Player 1	
		Strategy A	Strategy B
Player 2	Strategy A	R, R	S, T
	Strategy B	T, S	P, P

Table 1: The classic Prisoner's Dilemma

		Player 1	
		Strategy A	Strategy B
Player 2	Strategy A	R	$\frac{S+T}{2}$
	Strategy B	$\frac{T+S}{2}$	P

Table 2: The Prisoner's Dilemma became a Team Reasoning

In Table 1, people's question is, for choice best strategy between the 2 options is "Which choice should I make?" But in the second Table 2 with new formatting, people's question is " Which choice should we make? " Now the question is how to create "We Mode" in people. Our answer in this article is that We-Mode arises when there is common sense or a common mind between people.

According to the above table, strategy A is a combination of choosing R and S for each player, and strategy B is a combination of T and P. On the other hand, according to Herbert Mead's model of self, strategy A is the result of two factors. The first factor is the common-sense effect or guesses that the first player makes about the other's action. The second factor is the effect of the first player's guess or common sense on the second player's guess regarding the first player's action. These guesses are about the degree of "we" and "I" of people.

According to the above explanations, the players' guesses about each other are presented in the following two debates

The strategies of the players can be described as follows:

Strategy A: Player1's guess from Player2's guess regarding the sociality (or cooperative) of the Player1's decision *(R* the Player1's guess of the Player2's sociality decision + S* the Player1's guess of Player2's individual decision)

$$\mathrm{R} * \mathrm{p1} * \mathrm{p21} + \mathrm{S} * (1 - \mathrm{p1})\, \mathrm{p21}.$$

Strategy B: Player1's guess from the Player2's guess regarding the individuality (or not cooperative) of the Player1's decision * (T* playare'2 guess of the player2's sociality decision + P the Player1's guess of Player2's individual decision)

$$\mathrm{T} * \mathrm{p1} * (1 - \mathrm{p21}) + \mathrm{P} * (1 - \mathrm{p1})\,(1 - \mathrm{p21})\,.$$

		Shared mind or shared memory between me and another	
		Player 1's guess about the intention of other's sociality p1	Player 1's about the intention of others' individuality 1-p1
Shared mind or shared memory between me and another	Player 2's guesses from my guess as to the intent her sociality p21	p21 p1	p21 (1-p1)
	Player 2's guesses from my guess as to the intent of her individuality	(1-p21)p1	(1-p21)(1-p1)

Table 3: Guesses of the first player based on common sense

Therefore, the action or decision of the first player is:

$$V1 = A1 + B1 = R * p1 * p21 + S*(1-p1)\,p21 + T * p1*(1-p21) + P*(1-p1)\,(1-p21)$$

and the action or decision of the second player is:

$$V2 = A2 + B2 = R * p1 * p21 + T*(1-p1)\,p21 + S * p1*(1-p21) + P*(1-p1)\,(1-p21)\,.$$

By examining the variations in the decision of players 1 and 2, we will have:

$$\frac{\partial V1}{\partial p1} = R * p21 - S * p21 + T - T * p21 - P*(1-p21)$$

$$\frac{\partial V2}{\partial p1} = R * p21 - T * p21 + S - S * p21 - P*(1-p21)\,.$$

By calculating the rate of variation of this action in order to find the optimal point for p1, we have:

$$\frac{\partial V2}{\partial p1} + \frac{\partial V1}{\partial p1} = 2 * R * p21 - 2 * S * p21 + T - 2 * T * p21 - 2 * P*(1-p21) + S > 0$$

$$p21 > \frac{-2 * P + T + S}{2 * (-P - R + T + S)}.$$

The result is that if common sense makes it possible for the players to guess each other's intentions with a value greater than the p21, specified above, the dilemma will disappear and we will either have collective reasoning or team reasoning and as a result, a cooperative decision will take place.

4 Method

To test the role and effect of common intention and sense in strengthening participation, a game test based on two ways was designed in *Psychtoolbox* software. The experiment is such that the participants are told that you and one other person are in group A and two other people are in group B. You will be shown the probability of their participation. Decisions are randomly divided between you and them. Of course, in practice, all the subjects are in the same group and it is pretended to them just to imagine that the player is in front of them.

They are told that suppose you and a member of group B traveled on the same plane and brought back a shared souvenir from the trip. Loading the plane will damage your souvenirs. Now, the airline asks you and another person to calculate the price of a souvenir to compensate you. But this work has one condition, and that is that if the announced price is the same for both of you, the announced amount will be paid to you by you. But if the amount announced by you is different, the person who announced a lower amount will receive the same plus a bonus already announced by

Figure 2: Stages showing the player2's intention and selection modes for the player 1

the airline, and the one who announced a higher amount will receive the minimum amount announced by the parties minus the fine that the airline will pay.

As seen in Figure 2, if both travelers report that the price of souvenirs is 7, both of them will receive 7, and if both travelers report that the price of souvenirs is 6, they will both receive 6. If different prices are reported, both travelers will receive a reward or penalty based on the lowest price and amount. In this way, the passenger who reported the lowest price receives a reward: low price (6) + reward (2) = receiving 8. And the passenger who reported the highest price pays a penalty: low price (6) - fine(2) = receive 1.

Travelers A and travelers B make decisions in different ways. Now, to check the influence and intention of the other party, the participants are told that the strategy to deal with the airplane will be shown to them randomly, which will show the amount of green color of his strategy in the form of a column bar.

5 Participants and material

20 male students and graduates of Iranian universities between the ages of 19 and 39 participated in this research. Participants played a version of the traveler's dilemma game, which is essentially a prisoner's dilemma game. The game was presented as a coordination game whereby two players are asked to choose between two high and low prices. If both participants choose the same price, be it low or high, they both end up paying the same price. However, if one player chooses low and the other chooses high, then the person who chooses low ends up with a payoff equal to the low plus a "bonus" represented by the third price (i.e. the sum of the bonus and The low price is higher than the high price. Whoever chooses the high price ends up with a result equal to the low price minus a "penalty", which is equal to the "reward", the third price. Therefore, a high price corresponds to cooperation and a low price corresponds to deviance. Social welfare is maximized if both participants choose the high price (cooperate) but choose the low price (non-cooperation) always regardless of the decision. The partner showed a higher individual income.

6 Procedures

Based on the designed experiment, we measured the effect of people's intentions regarding others' cooperation goals on the time of choice responses. In a social dilemma game, we experimentally manipulated the participant's information received about the other's intention for cooperation. Participants were faced with a series of 100 binary choices after 5 learning rounds and had to choose between a cooperation option and a non-cooperation option.

The participants were told that their test will be randomly matched with another person. Their partner is different and randomly chosen in each round. In reality, there were no real participants and they played against predefined strategies.

Subjects played a total of 100 rounds, in addition to 5 practice rounds. At the beginning of each round, participants received a visual cue about the possible strategy adopted by their partner assigned to that round. Battery charge indicator (see Figure 2). At the beginning of each round, the probability of cooperation of the partner of that round was presented to the participants to induce the corresponding intention in the participant, and then the gains of cooperation or non-cooperation were shown. Cooperation intentions were distributed as a percentage of total participation at 5 levels in equal numbers in 100 rounds of the game. So, from each of the percentages of 0%, 20%, 50%, 80% and 100%. We will have 20 pieces. Having five levels of intentions regarding partner cooperation allows for a more precise estimation of parameters in the analysis. Each participant faced a total of 20 rounds for each cooperation belief level,

Cooperator	Freq.	Percent	Cum.
0	1574	78.70	78.70
1	426	21.30	100.00
Total	2000	100.00	

Table 4:

coop	N	Mean	SD	Min	Max
0	1574	2.786	2.802	.392	34.373
1	426	2.9	2.984	.576	31.738

Table 5: Summary statistics: N mean sd min max by (coop)

randomly presented in 100 rounds. Response times ranged from the moment the payoff structure was displayed on the screen until the time the associated response key was pressed. Pressed with a decision, it was recorded.

7 Results

We analyzed a total of 2000 decisions (20 participants per 100 decisions) and used a GLS random effects model to estimate the relationship between response time and participation. This allowed us to estimate the net effects of intentions on response times.

8 Discussion

In this article, we first presented a model based on the theory of the sociability of the human subject to solve the lack of explanation of the game theory about human cooperation. We apply intersubjectivity in the prisoner's dilemma game [4]. According to this model, for the formation of cooperation, people must guess the intention of other players. This guess is formed in a common mental space that we call common sense.

In the individual mind's interpretation of rationality, system type 1 or system type 2, depending on the circumstances, lead directly to action or decision. But in the model of intersubjective rationality, the relationship between the individual and the environment is determined based on common sense and is prior to cognitive dual processing [28]. Therefore, awareness of other people's intentions, which actually represents common sense and is like a social heuristic, puts people fast in a position of cooperative decision-making.

Further, to experimentally show how the existence of common sense affects human decision-making, we designed an experiment to show that awareness of the other player's intention causes rapid adoption of cooperative decision-making. This result is consistent with Francesco Guala and his colleagues, who consider cooperative decision-belonging a group or group identity could be made fast social heuristic cooperative decision-making rather than deliberative. On the other hand, other studies such as [9, 17, 18] are pieces of evidence that show that collective reasoning can be considered social heuristic decision-making.

Most of the studies and research about human cooperation are done with the premise that people's mental processes are completely dependent on their individual rationality [22]. That people make decisions and choices independently without any meaningful connection with the environment, culture or history is a problem that has been criticized by behavioral economists and psychologists [23]. But why people's preferences are different in different societies and why people's minds are not suspended in any way and are always dependent on something that can be the environment, culture or civilization is a discussion that is related to the field of distributed cognition or extended mind [10]. To increase participation, one should not think that people of society make individual decisions. Rather, they have common ground with each other, and more than before they have the will to make a decision at the individual level,

rt	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Cooperate	.508	.161	3.15	.002	.192	.825	***
Constant	2.702	.268	10.07	0	2.176	3.229	***

Mean dependent var	2.811	SD dependent var	2.841
Overall r-squared	0.000	Number of obs	2000
Chi-square	9.929	Prob> chi2	0.002
R-squared within	0.005	R-squared between	0.046

$***p < .01$, $**p < .05$, $*p < .1$

this happened at the level of the existing laws in the society, whether officially or officially. In this article, this public space is called common sense, which is a Kantian concept [25] and it exists because self-consciousness is not possible in an atomized form, and is always with the other that one reaches self-consciousness.

Cooperation between actors is more likely when their understanding of the environment they are in overlaps. When actors' mental models converge significantly, they make better decisions about what they feel in common. As a result, they are more likely to see potential opportunities for win-win solutions. In contrast, when actors' mental models differ greatly, they are more likely to perceive the world in a conflicting manner and are less likely to see things they may have in common. According to the model that was presented, our processing system is dependent on common rationality and this can further affect studies related to human cooperation [24].

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