Game Theoretic Decision Behavior under Interpersonal Affective Communications

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***Abstract*— Essential features of human communication is affective interactions in terms of interpersonal perception / attitude and opinion on the addressed issues. This paper focuses on understanding the cognitive mechanism of game theoretic decision behavior in the context of multi-agent systems taking into account the relationship between interpersonal perception / attitude and expressed opinion in iterative two person communication processes. Based on the hypothetical framework on the cognitive mechanism some experiments using subjects were conducted on the given game theoretic decision situations. The obtained data were analyzed to extract the properties modifying primary pay-off matrix into more subjective one owing to interpersonal perception / attitude on interpersonal "*reliability*" and "*self-sacrifice*" and changing the interpersonal perception / attitude by the expressed behavior under successive iteration.**

I. Introduction

In human affective communications their expressed opinions possibly alter according to the change of inner states on interpersonal perception and attitudes. Even in the case of game theoretic decisions the realistic human behavior seems to be possibly irrational under interpersonal affective communications. These kinds of behavior are experienced in human life situations.

This paper is addressed to the game theoretic decision behavior under interpersonal affective communications in the situations encountered in human life, and the cognitive mechanism of inner processes in mind is understood by a conceptual psycho-behavioral multi-agent model through investigation of a questionnaire survey and analysis of some experiments using subjects in this context.

II. Conceptual Multi-Agent Model of Interpersonal Human Behavior

In the previous studies[1][2] the framework of an interactive structure model of behavior generating inner process under interpersonal affection was proposed by employing a concept of multi-agent systems. While the conceptual model designates general collective human behaviors, the model could be interpreted into our addressed problems for collective decision behavior under interpersonal affective communications. At present "collective decision behavior" may be understood including either "group decision" or "game theoretic decision[3]." *Fig.* 1 shows the structural framework generating inner process for collective decision making under interpersonal affections.

Suppose two persons, *A* and *B*, are engaging in collective decision making under interpersonal affective communication with iterative trials. On each trial they express their own opinions choosing among the possible actions (or alternatives) according to their individual inner states in mind. In our collective decision situations a group action or a combination of *A*'s and *B*'s actions derives a resulting societal state which brings an *primary*, e.g., economical or physical, reward. Corresponding to the expected rewards *A* and *B* respectively set up their own desired opinions on preference among the possible actions in the primary inner process. Then *A* (or alternatively *B*) takes the interpersonal attitude for the partner *B* (*A*) and the perceived opinion which was expressed by *B* (*A*) in the previous trial into account, and *A* (*B*) can express his/her modified opinion on preference among the possible actions at the current trial.

After *A* and *B* exchange their expressed opinions with real actions to each other, the practical rewards are brought to *A* and *B* individually, and they are emotionally affected with satisfactory or unsatisfactory feeling. This may renew *A*'s (*B*'s) interpersonal perception on *B*'s (*A*'s) attitude for *A* (*B*), and *A*'s (*B*'s) interpersonal attitude for *B* (*A*) may be modified owing to the perceived *B*'s (*A*'s) opinion and *A*'s (*B*'s) interpersonal perception. Thus the inner and exhibited process described above can be continued iteratively.

In the subsequent sections the game theoretic decision behaviors in human life situations are focused on for

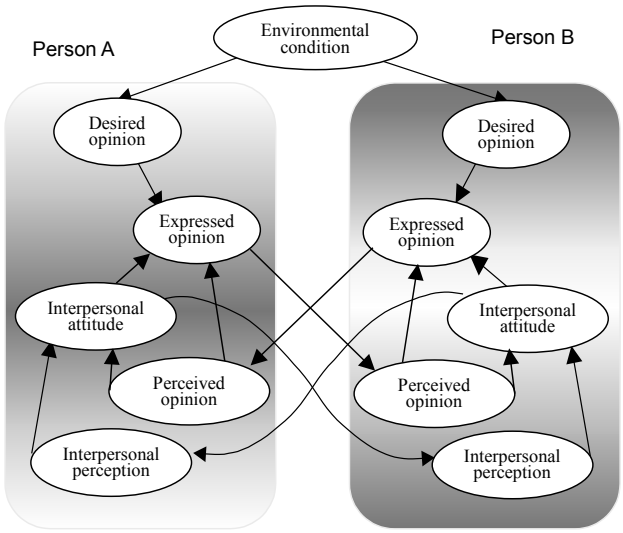


Fig.1 Structural framework generating inner processes for collective decision making under interpersonal affections

understanding collective human decision behavior in competitive or collaborative situations under interpersonal affective communication.

III. Game Theoretic Decision Behavior

A. Pay-off matrix and rational decision behavior

According to the conventional game theory [3] a fundamental formalism on two-person non-zero-sum games and some important concepts are briefly described. The players are denoted by A and B, their respective action sets by $S_A = \{a_1,a_2,\ldots,a_m\}$ and $S_B = \{b_1,b_2,\ldots,b_n\}$. Then the payoff matrix $\boldsymbol{P}$ is given by:

$$\boldsymbol{P} = \begin{bmatrix} (p_{11},q_{11}) & \Lambda & (p_{1n},q_{1n}) \\ \mathrm{M} & (p_{ij},q_{ij}) & \mathrm{M} \\ (p_{m1},q_{m1}) & \Lambda & (p_{m,n},q_{m,n}) \end{bmatrix}, \quad (1)$$

where p_{ij} is the payoff to A and q_{ij} is the payoff to B when A and B take their actions a_i and b_j respectively.

Then A (B) wishes to take the action to maximize his / her payoff considering B's (A's) action strategy under the given payoff matrix P. As an individual rational decision behavior *"dominant action"* a_{i*} is introduced if;

$$p_{i*j} \geq p_{ij} \quad \text{for all } j. \quad (2)$$

And if exist, the point (a_{i*}, b_{j*}) is said to be *"equilibrium by dominant action."*

In rational decision behavior, if stable solutions for both A and B exist, the solutions satisfy equilibrium conditions. Of course, such solutions cannot exist in general. Here, *"Nash equilibrium points"* are the points (a_{i*}, b_{j*})'s which fulfill the condition;

$$p_{i*j*} \geq p_{ij*} \quad \text{for all } i, \text{ and } \quad q_{i*j*} \geq q_{i*j} \quad \text{for all } j. \quad (3)$$

The equilibrium points may be rational as individuals. However, we have to notice the equilibrium points might not be efficient as the society, e.g., *Prisoner's Dilemma* is well known as such case. For this *"Pareto optimality"* should be introduced. The points (a_{i*}, b_{j*})'s are said *Pareto optimal* if their exist no other point (a_i, b_j) which satisfies;

$$p_{ij} \geq p_{i*j*} \quad \text{and} \quad q_{ij} \geq q_{i*j*}, \quad (4)$$

and at least one of them holds inequality. As the illustrative example, consider *Prisoner's Dilemma* game with payoff matrix;

$$\boldsymbol{P} = \begin{bmatrix} (9,9) & (0,10) \\ (10,0) & (1,1) \end{bmatrix}. \quad (5)$$

While the point (a_2,b_2) is an equilibrium point, other three points (a_1,b_1),(a_1,b_2) and (a_2,b_1) are *Pareto optimal*.

B. Decision behavior under interpersonal affection : a questionnaire survey

As a pre-research, at first, a questionnaire survey was conducted about consciousness for game theoretic decision behavior in human life situations. In the questionnaire, behavior of a player, preference among the points as action pairs, priority for various attitudes and so on were investigated in two-person non-zero-sum game situations of three different payoff matrix types (I,II and III) that assumed the concrete situation for three kinds of personal relations. The conditions of game situations given in the questionnaire survey are shown in Table 1.

Table 2 shows the summarized responses by 77 subjects for Q1, i.e. the subject's action choice. For situation type I the *primary* payoff matrix may be given as;

$$\boldsymbol{P} = \begin{bmatrix} (1,1) & (4,1) \\ (1,4) & (1,1) \end{bmatrix}. \quad (6)$$

Then points (a_1, b_2) and (a_2, b_1) are *Pareto-optimal*, but there exist no *Nash equilibrium points* as pure strategies. For person A and B the first actions a_1 and b_1 are respectively *dominant actions*, hence the resulting point may be (a_1, b_1) which is not *Pareto-optimal*. Thus an individually rational decision strategy seems to be the first action a_1 for person A. However the survey resulted in mostly half of subjects choosing action a_2 for the case of partner relationship in acquaintance and family member. This shows the *primary* payoff matrix may be modified under inter personal affection. For situation type III the *primary* payoff matrix may be given as;

$$\boldsymbol{P} = \begin{bmatrix} (3,3) & (2,4) \\ (4,2) & (1,1) \end{bmatrix}. \quad (7)$$

Then points (a_1, b_1) ,(a_1, b_2) and (a_2, b_1) are *Pareto-optimal*, where (a_1, b_2) and (a_2, b_1) are *Nash equilibrium points*. The survey resulted in most subjects choose action a_1 for all cases in partner relationships. This shows the *primary* payoff matrix may be modified under inter personal affections. In practice the average desire grade for each paired action of subject's own (Q2) and of the partner (Q3) derive the subjective

Table 1 Conditions of game situations for the survey

Situation	Possible actions	(a_1 or a_2 / b_1 or b_2)
I-1) Lifeboat for one person	1.Geting on boat	2.Not getting on boat
I-2) One Phone using	1.Using phone	2.Not using phone
II-1) Outside leisure by pair of lovers	1.Cinema theater (Own favorite)	2.Football stadium (Partner's favorite)
II-2) TV watching by pair of lovers	1.Channel X (Own favorite)	2.Channel Y (Partner's favorite)
III-1) Group meal cooking	1.Cooking	2.Not cooking
III-2) Water saving in lacking situation	1.Saving water	2.Not saving water
Partner relationship	To be concretely set by subject for (b)(c)	
(a) Stranger		
(b) Acquaintance	Friend, Lover/Love	
(c) Family member	Parent, Brother, Sister	
Questionnaire		
Q1.Choose an action (1 or 2) in each situation		
Q2.His/her own desirable grade for each paired action		
Q3.Partner's desirable grade for each paired action		
Q4.Priority among several aspects of interpersonal attitude		

Table 2 Responses by 77 subjects for Q1 in Table 1

	Stranger		Acquaintance		Family	
Situation	a_1	a_2	a_1	a_2	a_1	a_2
I-1	60	14	36	33	37	30
I-2	51	21	32	37	41	31
III-1	57	15	67	4	64	6
III-2	59	13	66	6	53	17

quasi-payoff matrix modified under interpersonal affection. In case of partner relationship in stranger, acquaintance and family member, the matrices are obtained as follows.

$$\text{[For stranger]} \quad \boldsymbol{P} = \begin{bmatrix} (3.6,3.4) & (2.2,3.2) \\ (2.8,2.0) & (1.2,1.2) \end{bmatrix}, \tag{8}$$

$$\text{[for acquaintance]} \quad \boldsymbol{P} = \begin{bmatrix} (3.8,3.7) & (2.5,3.0) \\ (2.7,2.3) & (1.1,1.2) \end{bmatrix}, \tag{9}$$

$$\text{[for family member]} \quad \boldsymbol{P} = \begin{bmatrix} (3.5,3.5) & (2.4,3.0) \\ (3.0,2.5) & (1.2,1.2) \end{bmatrix}. \tag{10}$$

They may lead to a unique solution (a_1,b_1) being equilibrium by the dominant actions with Pareto optimality.

From obtained findings, we compared among partner relationships and investigated the decision mechanism on the basis of game theory. And then, model structures of the game theoretic decision seemed to have to take into account interpersonal perception / attitude so that irrationality of (altruistic) decision behavior could be understood by modifying the *primary* payoff matrix in human life situations. The response for Q4, i.e., the subjective priority among interpersonal attitudes, suggests they are conscious with not only his/her own payoff but also the partner's payoff simultaneously. Thus interpersonal "*reliability*" and "*self-sacrifice*" will be addressed in the subsequent sections.

C. Behavior Change under successive iteration of game theoretic decisions.

Under successive iteration of game theoretic decisions a person is changing his/her own interpersonal perception and attitude for the partner corresponding to the series of mutual opinions and attitudes expressed in the past. Thus, the renewed interpersonal attitudes may bring the renewed decisions expressed by the persons *A* and *B* simultaneously.

IV. Experiments of Two Person Interactions in Game Theoretic Decisions

A. Outline of experiments.

As shown in Fig.1 interpersonal attitude / perception may play crucial roles in the inner process for game theoretic decision under interpersonal affection. Based on the findings of Section 3 "*reliability*" and "*self-sacrifice*" are focused on as specific factors for interpersonal attitude / perception. In this context experiments using subjects were conducted for understanding mechanism of two-person game theoretic decision behavior with inner process in mind when the game is successively iterated.

The outline of the experiments is shown in Table 3. The given game situation has the *primary* payoff matrix being similar to the game "Meal cooking" or "Water lacking" of situation Type III in section 3. More specifically the contents of the given game is mentioned as follows. The subjects engage in the iterative decisions as the players of a two-person game, in which the player has to choose one of the two actions, i.e., a_1 (or b_1) = "a simple calculation (*Uchida –Kraepelin*) task" and a_2 (or b_2) = "free time spending with relaxation, e.g., reading magazines." The players are shown the *primary* payoff matrix described in Table 4. Note that the calculation task could be shared and both subjects get low monetary reward in case of the action pair (a_1,b_1) , and if none of the two players engage in the calculation task, i.e.,(a_2,b_2), they cannot get any monetary reward. The experimental flow of the successive iterative decisions with response gathering using checklist is shown in *Fig.*2.

In the experiment "reliability" and "self-sacrifice" are the key terms for capturing human inner state on interpersonal perception and attitude. *Reliability* as interpersonal attitude of person *A* means "credibility that the partner *B* cooperatively behaves with *A*." *Self-sacrifice* as interpersonal attitude of person *A* means "tendency to devote himself / herself to the partner *B*." If *A* has high reliability for *B*, *A* might believe *B* tends to take action b_1. If *A* is highly self-sacrificing to *B*, *A* might tend to take action a_1.

As interpersonal perception person *A* could estimate the levels of *B*'s reliability and self-sacrifice for *A*. This may make the players estimate the partner's modified preferences among the possible action pairs $\{(a_i, b_j)\}$.

B. Experimental results.

The experimental results for the eight pairs of subjects were obtained. Table 5 and Fig.3 show the result of the iterative game by the pair of subjects, say, *e* and *f*.

Table 3 Outline of experiment using subjects

Subjects	Students
Samples	8 pairs (2 persons / a pair)
Game situation	Work sharing collaboration
Response items	R1) Choice of an action (1 or 2) R2) Subjective preference grade of his/her own and of the partner on paired actions R3) Subjective grade on reliability & self-sacrifice for the partner and perceived reliability & self-sacrifice for the subject R4) Priority among several aspects of interpersonal attitude

Table 4 Objective payoff matrix given linguistically

		Person B b_1	*Person B* b_2
Person A	a_1	¥100+Calculation, ¥100+Calculation	¥100+Calculation x 2, ¥150+Relaxation
	a_2	¥150+Reluxation, ¥100+Calculation	¥0+Reluxation, ¥0+Reluxation

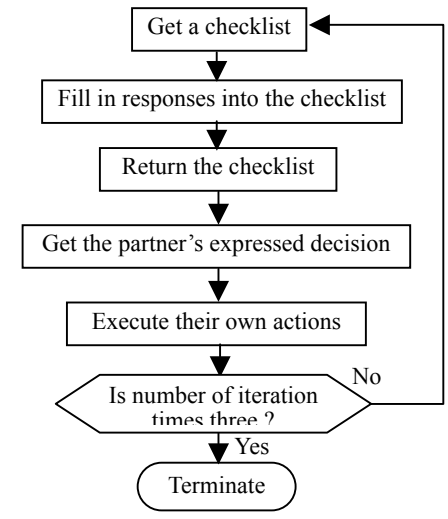


Fig.2 Iterative experiment flow

Table 5 Expressed action and payoff matrix in successive iteration

<1'st trial> <2'nd trial> <3'rd trial>

[Subject *e*]

Action= a_1

	b_1	b_2
a_1	3,3	2,4
a_2	4,2	1,1

Action= a_1

	b_1	b_2
a_1	4,3	2,4
a_2	3,2	1,1

Action= a_2

	b_1	b_2
a_1	3,3	2,4
a_2	4,2	1,1

[Subject *f*]

Action= a_1

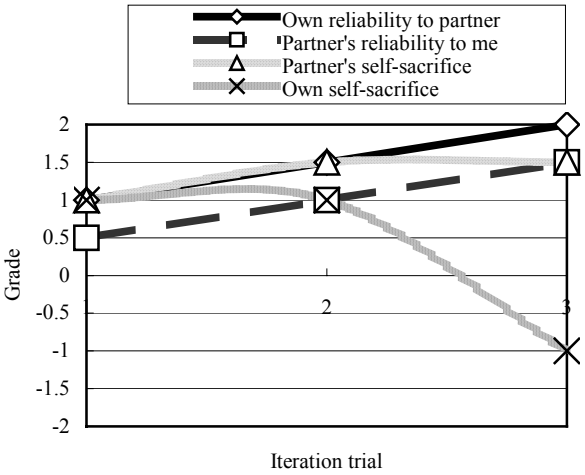
	b_1	b_2
a_1	3,3	2,4
a_2	4,2	1,1

Action= a_1

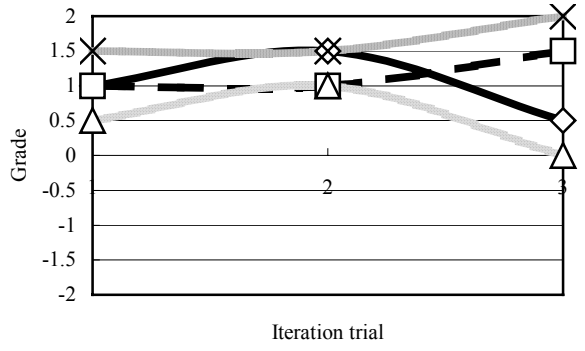
	b_1	b_2
a_1	3,3	2,4
a_2	3,2	1,1

Action= a_1

	b_1	b_2
a_1	3,3	2,4
a_2	4,2	1,1



(a) Responses by Subject *e*



(b) Responses by Subject *f*

Fig.3 An example of responses in iterative games

[Subject *e*] At initial trial he set his inner states for his own reliability, self-sacrifice and partner's self-sacrifice at moderately positive level, and for partner's reliability at slightly lower but positive level. Then he gradually increase their state grades except for his own self-sacrifice grade. Hence the expressed decisions at first and second trials are the altruistic action a_1. At final trial his own self-sacrifice grade was changed to negative level suddenly owing to his own high reliability and high self-sacrifice with partner's higher self-sacrifice. Then he chose selfish action a_2.

[Subject *f*] At initial trial his inner states are similar to Subject *e*, but in terms of self-sacrifice his own is rather higher than partner's. Then *f* increases his reliability slightly, while *f* holds his self-sacrifice grade. At second trial his own reliability and self-sacrifice grades are high, then his reliability to the partner decreases. His self-sacrifice grade is going to attain the highest level.

C. *Discussions.*

Investigating the experimental results it was confirmed that the practical decision behavior is different from the rational decision for the objective payoff matrix in the game theoretic situation. In rational decision framework, the payoff matrix is, say, given by Eq. (7), then points (a_1, b_1) ,(a_1, b_2) and (a_2, b_1) are *Pareto-optimal*, where (a_1, b_2) and (a_2, b_1) are *Nash equilibrium points*. However the expressed decision points are (a_1, b_1) in 9 times,(a_1, b_2) or (a_2, b_1) in 11 times and (a_2, b_2) in 4 times over the whole experimental trials (three trials respectively for eight pairs). Note that the point (a_1, b_1) was frequently observed though it is not the case of *Nash equilibrium*. For understanding the observed game theoretic decision behavior in human life situation they may discuss the inner cognitive mechanism to obtain the subjectively modified payoff matrix affected by interpersonal attitude on "*reliability*" and "*self-sacrifice*", and to change the states of interpersonal attitude under interpersonal perception and the expressed decision in the successive iterative game trials.

V. MATHEMATICAL MODELING UNDER INTERPERSONAL AFFECTIVE COMMUNICATIONS

A. *Modified pay-off matrix.*

It is considered that modification of the objective payoff matrix is affected by interpersonal perception and attitude on "*reliability*" and "*self-sacrifice*". Let

$$\boldsymbol{P} = \begin{bmatrix} (p_{11},q_{11}) & (p_{12},q_{12}) \\ (p_{21},q_{21}) & (p_{22},q_{22}) \end{bmatrix} \tag{11}$$

be the given payoff matrix in two person games, where a_1 (b_1) is altruistic action and a_2 (b_2) is selfish action for person A (B). Let R_A (R_B) be *reliability* grade, and S_A (S_B) be *self-sacrifice* grade, where $0 \le R_A, R_B \le 1$ and $0 \le S_A, S_B \le 1$. If R_A =0, A has the lowest reliability for B; and if R_A =1, A has the highest reliability for B. If S_A =0, A is self-sacrificing to B not at all; and if S_A =1, A is much highly self-sacrificing to B. Note that R_B, and S_B are subjective inner states of person B, but A can perceive them through communication. Thus A's interpersonal perception on R_B, and S_B are to be denoted by R'_B, and S'_B. Then the authors try to propose conceptually the modification of $\boldsymbol{P}$ to $\boldsymbol{P}^*_A$ by weighting the elements of the matrix $\boldsymbol{P}$ according to the inner states on interpersonal attitude and perceptions, i.e., R_A, S_A, R'_B, and S'_B. The simplest modification of $\boldsymbol{P}$ may be expressed by $\boldsymbol{P}^*_A$ described below.

$$\boldsymbol{P}^*_A = \begin{bmatrix} (R_A S_A p_{11}, R'_B S'_B q_{11}) & \\ (R_A(1-S_A)p_{21}, (1-R'_B)S'_B q_{21}) & \\ ((1-R_A)S_A p_{12}, R'_B(1-S'_B)q_{12}) & \\ ((1-R_A)(1-S_A)p_{12}, (1-R'_B)(1-S'_B)q_{22}) & \end{bmatrix} \tag{12}$$

Note that the modified payoff matrix is depending on person and his current inner states on interpersonal perception and attitude.

The proposed modification is applied to the case appeared in the experiment. In Table 6 an illustrative example on modified subjective payoff matrices is shown for the case of the first experimental trial by the subject pair (*e*, *f*). This derives as rational decisions a_1 for both subjects *e* and *f* from the view point of *equilibrium by dominant action*, *Nash equilibrium* and *Pareto optimality*.

Thus the modification of objective payoff matrix may be affected by the inner states on *reliability* and *self-sacrifice* as interpersonal attitude and perception.

Table 6 Modification of payoff matrices for the first experimental trial by subject pair (*e,f)*

[Subject *e*] First trial

Primary payoff matrix

		Subject *f* b_1	Subject *f* b_2
Subject *e*	a_1	3,3	2,4
	a_2	4,2	1,1

Expressed action= a_1
R_A=0.75,S_A=0.75; R'_B=0.63,S'_B=0.75

Modified payoff matrix

		Subject *f* b_1	Subject *f* b_2
Subject *e*	a_1	1.69,1.41	0.38,0.63
	a_2	0.75,0.56	0.06,0.09

Estimated action= a_1

[Subject *f*] First trial

Primary payoff matrix

		Subject *e* b_1	Subject *e* b_2
Subject *f*	a_1	3,3	2,4
	a_2	4,2	1,1

Expressed action= a_1
R_A=0.75,S_A=0.88; R'_B=0.75,S'_B=0.63

Modified payoff matrix

		Subject *e* b_1	Subject *e* b_2
Subject *f*	a_1	1.97,1.41	0.44,1.13
	a_2	0.38,0.19	0.03,0.09

Estimated action= a_1

B. Analysis of interpersonal perception and attitude change.

This section addresses to dynamical properties of inner state transition on interpersonal attitude, i.e., *reliability* and *self-sacrifice* for partners. More specifically the differences on reliability grade and self-sacrifice grade between current trial and next trial in the successive attitude change are to be formally captured as the functions mentioned below.

$$\Delta R_A = f(R_A, R'_B; S_A, S'_B; a, b) \quad (13)$$

$$\Delta S_A = g(R_A, R'_B; S_A, S'_B; a, b) \quad (14)$$

The functions f and g are hardly identified with quantitative preciseness through present subjective experiments. Thus, for understanding the qualitative properties of the functions *f* and *g*, *Quantification Method I* was employed for qualitative data analysis. All the response data by the whole subjects pairs obtained through the subject experiments are employed for the analysis. Table 7 shows the items and their categories which appeared in the quantification analysis, and their symbolic expressions in the subsequent tables and figures. All the item variables are respectively categorized from three to four levels except for ΔR_A and ΔS_A, which are quantitative variables. Note that some items are introduced as combinations of plane variables, e.g., "*reciprocality* of *A* for *B*" being introduced for "high reliability of *B* for *A*" with "high self-sacrifice of *A* to *B*."

The analysis by *Quantification Method I* results in multiple correlations 0.927 for ΔR_A and 0.831 for ΔS_A, and partial correlations and rages shown in Table 8 for ΔR_A and Table 9 for ΔS_A. And the item-category scores are summarized in Fig.4 for ΔR_A and Fig.5 for ΔS_A.

These results attain highly explanatory structure modeling. The relational structure between various plane factors is illustrated in Fig.6 including action generating mechanism under interpersonal attitude and perception.

The reliability change analysis derives that the complex factors on mutual reliability, mutual self-sacrifice and expressed joint actions of his/her own and partner's are crucial, while the self-sacrifice change analysis derives that the combination of higher self-sacrifice of his/her own and higher reliability of the partner for him/herself is extracted as one of the influential factors to force decreasing change

Table 7 Item categories in quantification analysis

Item	Category	Symbol
Joint Action	$(a_1,b_1),(a_1,b_2)$ $(a_2,b_1),(a_2,b_2)$	act_A*aact_B (1,1)/(1,2)/(2,1)/(2,2)
Reliability A	small,middle,big	rel_A (sml)/(mid)/(big)
Reliability B	small,middle,big	rel_B (sml)/(mid)/(big)
Self-sacrifice A	small,middle,big	sac_A (sml)/(mid)/(big)
Self-sacrifice difference between B and A	negative, zero, positive	Dif_sac(B-A) (neg)/(zero)/(pos)
Mutual reliability A&B	small,middle,big	rel_A&rel_B (sml)/(mid)/(big)
Mutual self-sacrifice A&B	small,middle,big	sac_A&sac_B (sml)/(mid)/(big)
Reciprocality B for A	small,middle,big	sac_A&rel_B (sml)/(mid)/(big)

Table 8 Partial correlations and ranges in reliability change analysis

Item	Part. Corr.	Range
act_A * act_B	0.735	4.74
sac_A	0.853	3.78
relc_A & rel_B'	0.883	1.97
sac_A & sac_B'	0.683	1.98
rel_A	0.817	1.60
Dif-Sac(B-A)	0.787	1.67
rel_B'	0.844	1.17

Table 9 Partial correlations and ranges in self-sacrifice change analysis

Item	Part. Corr.	Range
Dif-Sac(B-A)	0.812	4.74
act_A * act_B	0.706	3.78
sac_A & rel_B'	0.572	1.97
sac_A	0.643	1.98
sac_B'	0.544	1.60
rel_A	0.596	1.67
rel_B'	0.475	1.17

Note that the *perceived reliability* and *self-sacrifice* do not coincide with the ones as the partner's inner states in general. However the obtained results could be effective to construct a deeper qualitative model for understanding the cognitive process in game theoretic decision under interpersonal affective communications.

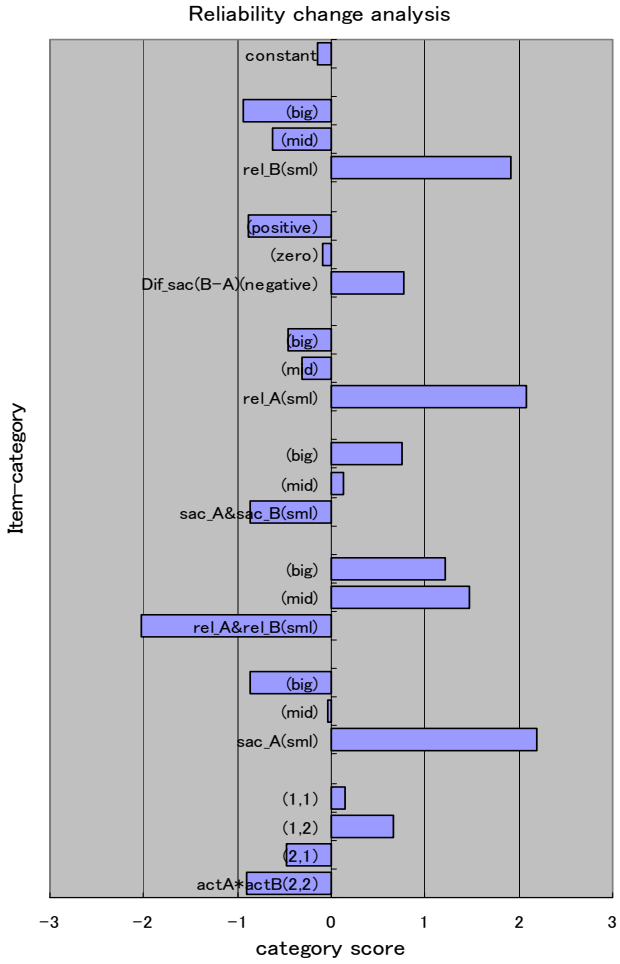


Fig.4 Item-category scores for *reliability* change

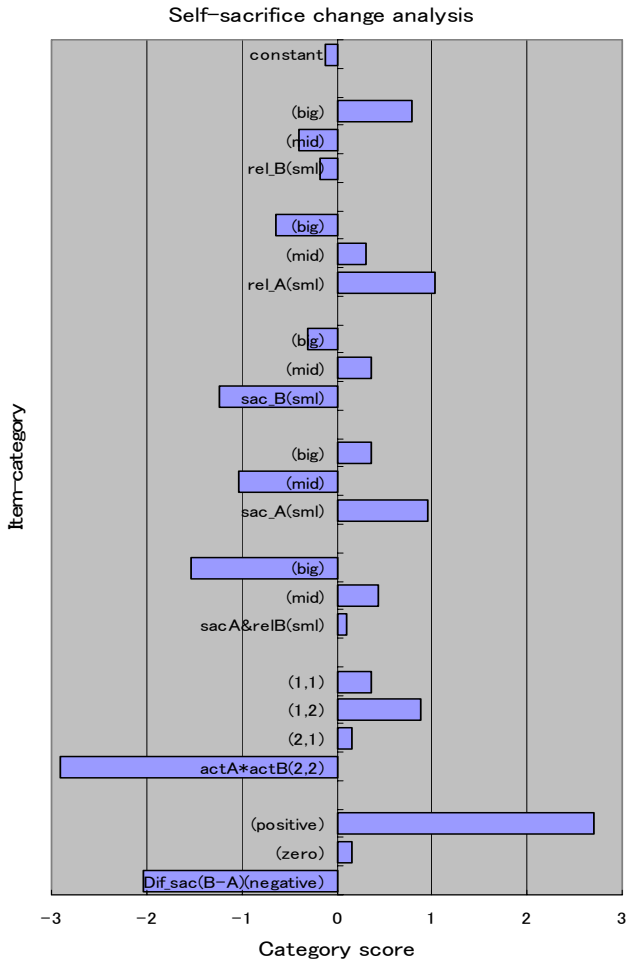


Fig.5 Item-category scores for *self-sacrifice* change

VI. CONCLUSION

The present study focused on game theoretic decision behavior under interpersonal affective communications. Though the basic frame stands on game theory for economic or political behavior, the addressed problem is realistic in human life situation even for collective decision in everyday or even emergency, say, evacuation, by friends or family members. In this context hypothetical framework of interactive decision process was introduced taking the personal inner states on interpersonal perception and attitude as multi-agent systems into accounts. Through a questionnaire survey and experiments on two-person non-zero-sum game in human life situation, a conceptual structure model showing relationship between action and affection factors was derived for understanding game theoretic decision behavior under interpersonal affective communications. On the basis of the obtained results soft computational human modeling as multi-agent systems could be developed for human-centered decision agents supporting human life.

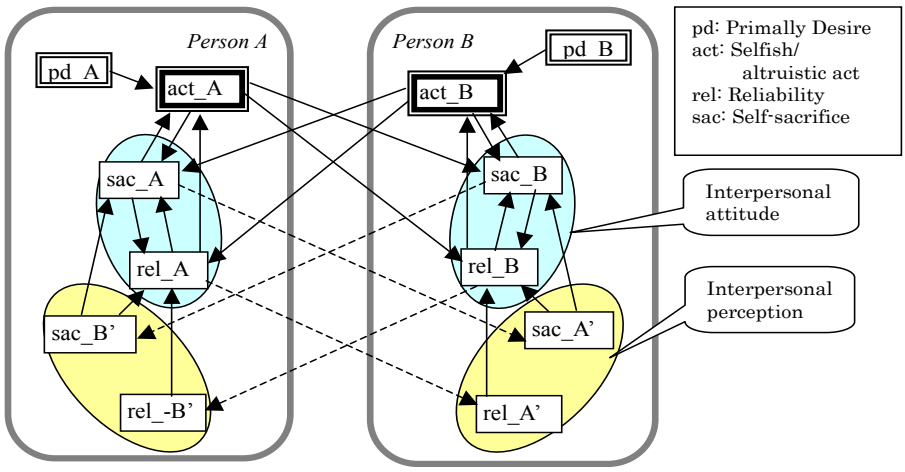


Fig. 6 Structure model showing relationship between plane factors for game theoretic decision behavior under interpersonal affective communications

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