Recognition of Implicit Rules on the Simulation Game BARNGA
-Towards Development of Social Agent-

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Abstract—We developed an Online BARNGA, which is social simulation game towards development of social agent. We observe human's social skills of leaning to implicit understanding. This game based on BARNGA whose purpose is experience to explore factors related to communication problems in intercultural situations with cards game: trick taking game. In BARNGA, differences of a game's rule represent cultural difference. Likewise, implicit rules can represent likely differences of a game's rule. Then we observe behavior of players on the game and analyze social skills.

I. INTRODUCTION

Recently, autonomous agents are acting parts in human living fields. However we have not known a steadfast methodology how agents interact with humans. Therefore researches of Human-Agent interaction (HAI) [1] are popular toward autonomous agents to act and cope in various human societies. In HAI, an agent interacts with a human. However some researchers point out that agents interact with multiple humans, because humans interact with multiple humans in society [2]. From these stand points, we have been developed a learning agent called Multi User Learning Agent (MULA) [3], [4], which can adapt to multiple humans efficiently.

Our aim is to make the learning model of a social agent. To observe the ability of a human to adapt himself to the society where he lives, we conducted an experiment based on BARNGA. First, we develop social environment, Online BARNGA, which is social simulation game about encountering social issues and getting along. Second, we observe players in that environment, and analyze behavior of players. We report Human’s Social Skill obtained through this experiment.

The outline of this paper is as follows. In Section 2, we introduce common skills that a human adapt to human society. In Section 3, we explain what skills are adapting societies in our research. In Section 4, we introduce Online BARNGA that we can observe human behaviors of adapting societies. In Section 5, we show a result of the game, and discuss the human’s skills. In Section 6, we conclude.

II. SOCIAILITY OF HUMAN

A. Social Human’s behavior and social agents

We are interested in a research of human’s behaviors, a human sometimes considers agents like robots, as living creatures [5], [6]. In such cases, agents should be providing with behavior of creatures like human. A lot of developed agents have Social Skills. For example, Shibata et al. provided a concept of individuality and sociality that is introduced as a method to avoid conflicts of individual interests in multi-agent systems [7]. And Moriyama et al. developed an agent which learns appropriate behaviors in Multi-Agent environment with and without social dilemmas [8]. Yamada et al. discuss an agent to adapt groups [9]. We show examples of measure of socialities in next section.

B. Skill of adapting societies

The term sociality is a very popular word, however it is underspecified at the same time. Generally speaking, sociality is considered as the ability for getting on easily with others in society. We introduce common two measures of sociality.

First, EQ (Emotional Intelligence Quotient) [10], which proposed a psychological measure by Mayer and Salover, consist on multiple intelligences. Typical intelligences are intrapersonal intelligence and interpersonal intelligence. Examples of intrapersonal intelligence are self-regard, emotional self-awareness, assertiveness, independence and self-actualization. Examples of interpersonal intelligence are empathy, social responsibility and interpersonal relationship.

Second, SST (social skills training) [11], which proposed a cognitive behavior therapy by Liberman, is adopted in many clinical psychiatry. Social skills in SST are that a human can act according to circumstances, in other words sensing atmosphere on the moment.

Both of interpersonal intelligence and sensing the atmosphere are about the same skills as acquirement of common rule. These are important skill for humans. If humans have these skills, they can interact with others to avoid some clash.

In next section, we explain acquirement common rule.
A. Acquirement of implicit rules

Consider human’s adaptability to a society. Learning rules in the society is one of the necessary skills for them, because human society consists of various rules. There are two kinds of the rules in human society. We summarize the rule classification in TABLE I. The first ones are the avowed rules, like byelaws and laws. These are almost unique and be acquired through passive learning. We can get these comparatively easy. The second ones are the implicit rules, like manner, common senses, and so on. These are almost anomaly and differ in various societies and be acquired through active learning. It is hard to acquire these rules because we learn by going through these.

We introduced the skills, which are sensing an atmosphere and learning implicit understanding, at previous section are same skills of implicit rules. We note these skills, and observe ways of acquiring implicit rules. In this research, we develop an environment to acquire implicit rules from BARNGA which is a simulation game.

B. BARNGA

BARNGA [12] is a popular simulation game of cultural clashes. This game is designed to explore factors related to communication problems in intercultural situations. These points out that obvious cultural difference create problems.

We explain an overview of the game. There are several tables. Four or five players sit each table. While playing BARNGA, each player must not engage conversation to the other players. So they have to communicate with non verbal way like gestures. After reading rules of playing cards (trick taking game), the players start to play cards at each table. Once the game starts, the players can not reconfirm the rules. The rules of playing cards differ from one table to another. In BARNGA, differences of rules between tables are regarded as differences of culture. The players stop playing cards after playing for a while. Then the players with the highest and the lowest score are traded between tables. And then, the players play the cards again at each table. In this second bout, players feel something is wrong. Because they cannot refer the rules, they get into difficulty with other players at each table. The reason why we employed BARNGA for Online BARNGA is that we can regard differences of rules between tables as social implicit understanding.

C. Online BARNGA

We developed an online game simulator, Online BARNGA, based on BARNGA to observe human’s social behavior. The improvements of Online BARNGA are 1) coming online, 2) interaction between players and 3) bringing in point score system. We explain each of these.

1) Coming online: We make BARNGA online, because we log player’s state (hand, place and ranking), player’s behavior (starter, discard and selecting winner) and player’s behaving time. Players connect server PC with client PC. Advantages of coming online are logging players’ data and observing clearly non verbal interdiction between players. In the future, artificial agents participate in this game easily.

2) How to decide a winner: In BARNGA, players get into difficulty, because the rules are different. And then, they decide a winner through interaction with gestures. In contrast, at Online BARNGA, a way of deciding a winner is different from BARNGA to get data of the struggles. First, a dealer is selected and he or she decides winner. Then, if players have a complaint about the decision, they can express an objection on a panel as Fig. 5. The panel is written "Do you complain about the dealer’s decision?", and has 2 buttons which are "Yes" and "No".

3) Bringing in point score system: In Online BARNGA, ranking of players is complicated. So, we introduce point score system in the game. Players strive for primacy. If a player is selected a winner by the dealer, the score of the player adds Winner Points. If a player complains, a winner’s and dealer’s score take off Penalty Points, and complainer’s score takes off Expense Points and adds Bonus Points. TABLE II show points list in the game. Penalty Points and Bonus Points depend on a rate(\(r\)) of complainer per all players but a dealer on a table.

IV. EXPERIMENT

A. Experimental Outline

The purpose of this experiment is to observe human behaviors getting implicit rules. Players experience to explore the implicit rules in the experimental game: Online BARNGA.

In Online BARNGA, powers of social behaviors depend on points score. Especially Penalty Points carry weight. When Penalty Points is large, powers of sanctions are strong. Therefore players may conform. Meanwhile, when Penalty Points is small, players may become selfish, because powers of sanctions are week. In addition, when terms between trades are short, kind of rules increase in each table. Then players clash and the environments may become disorderly. If the environments are disorderly, we can observe how players acquire implicit rules. If the environments are disorderly, we can observe how players’ behaviors effect a select rule. Therefore
we experiment in two environments: an experiment in orderly environment and an experiment in disorderly environment.

B. Settings of Experimental Game

In Online BARNGA, 15 players played, and there are three tables. Participating in the game, the players operate PC with an interface (Fig. 1). Players can get information of game situation and behaviors through the interface. And if players push the upper right button, they can refer to log data of their own past and the real-time ranking list as Fig. 2. Each player’s mission is getting score higher than others. Fig. 3 shows a flowchart of Online BARNGA. The procedure is as follows.

1) There are 3 tables. And, 5 players sit down (login) at each table.

2) After all players sit down, the game rules displayed differ depending on each table. If players push OK button, the rules get out and they will never be able to see the rules. A player waits until all players push OK button.

3) A dealer is selected from players. At the first time on the game, dealer is the first player to sit on a table.

4) Players are dealt the cards. We use cards from A to 7, and then the number of player’s hands is 5 at the first time. Players can sort hands themselves.

5) At first a dealer discards from own hands. Then, a player discards from own hands in conformity with turns.

6) When all players discard in a table, a dealer decides a strong card from opened cards on a place. The player discarding this card is a winner. A winner gets Winner Points. All players are informed about the winner name.

7) If players do not accept dealer’s decision, they can complain on a pop-up panel. When players complain, dealer’s and winner’s score take off Penalty Points for Dealer and Winner depending on rate of complainer per players in a table. Complaining players’ score take off Expense Points and add Bonus Points depending on rate
of complainer per players in table.
8) This Server counts the number of players’ hands.
9) If players have hands, a dealer is alternated next. Then, go to 5).
10) If players don’t have hands, this server checks the number of shuffling times. If the number is less than a predefined threshold of shuffling times, go to 4).
11) If the number is the threshold, the server trades players as Fig. 4.
12) After trading, this server checks the number of game times. If the number is less than the threshold, go to 3). If the number is equal to the threshold, the game over.

C. Rules of the card games

The game on tables is trick taking game. The unique point of the game is the way of coming off a winner. We explain basic common rules of the game for a dealer’s decision to a winner. A dealer decide a winner with own rule. The strongest card’s suit (trumps) and rank are specified in the rules.

In the game, the strongest card’s rank and suit depends on each table’s rule. If there are trump cards in a place, the strong card’s suit is trump.

Each table’s rule is as follows.

- Table 1
  Trumps: SPADES
  Strength of Rank: 7, 6, 5, 4, 3, 2, A
- Table 2
  Trumps: DIAMONDS
  Strength of Rank: A, 7, 6, 5, 4, 3
- Table 3
  Trumps: HEARTS
  Strength of Rank: 2, A, 7, 6, 5, 4, 3

D. Two environments

An orderly environment and a disorderly environment are created by settings of scores as TABLE II and game time between trades.

In the orderly environment, we decide conditions as follows. If there is only one complainer, he or she suffer a big loss. A situation which all players complain has higher total score than any kind of situation. When more than 3 players complain, complainers gain more points than a dealer. When a dealer select himself/herself as a winner and more than 2 players complain, the dealer loses points. Each scores are settled as follows: \( WP = 400 \), \( PP_W = 400 \), \( PP_D = 200 \), \( BP = 80 \), \( EP = 40 \). Game time between trades is settled 4.

In the disorderly environment, we decide conditions as follows. When all players complain, a dealer only loses points. Each scores are settled as follows: \( WP = 100 \), \( PP_W = 80 \), \( PP_D = 80 \), \( BP = 40 \), \( EP = 20 \). And when a dealer select himself/herself as a winner and more than a player complain, the dealer only loses penalty point for dealer. Game time between trades is settled 1.

E. Questionnaire

We take the questionnaire after the game was over to investigate feelings of players on the game. The contents of questionnaires are as follows.

1) Did you notice the differences of rules between tables?
2) If you notice the differences, write what are the differences.
3) How do you play and what do you feel on this game?
4) Write your views freely on this game.

V. EXPERIMENTAL RESULT

A. Features of players

Observing 15 players, we find three typical types of players. Some players changed type along the way, some player played on a type. The three types are explained as follows.

1) Players of following a rule (Type 1): Deciding a strong card or complaining to a decision, a player of Type 1 follows own rules. Starting of the game, the number of these players is 11. Ending of the game, the number of these players is 6.

2) Players of pursuing own profits (Type 2): Becoming a dealer, a player of Type 2 decides own card is the strongest every time. If the other players don’t complain, dealer can get profit. Then if there are many players of this type in one table, players of other type is change the players of this type. Starting of the game, the number of these players is 2. Ending of the game, the number of these players is 9.

3) Players of cutting and trying (Type 3): Sometimes a player of Type 3 acts with own rule, sometimes he or she acts without own rule. Noticing rules of differences between tables, the player cut and tries to follow the other. And when the player doesn’t understand clearly his or her rule, he or she cut and try. Beginning of the game, there are 2 players at Table 1 and Table 3. Ending of the game these 2 players change Type 3 to Type 1. At third trading, there is a player who cut and tries to follow the other at.
B. Experimental result in orderly environment

We observed 3 terms with 2 trades. However a problem had come up at Table 3, we could observe at first and second terms.

At experiment in orderly environment, we can observe that many players take up rules. These players are categorized Type 1. We show transition of number of Type 1 as Fig. 3, a phase consists of 5 games.

After trades, some players do not take up rules and are categorized Type 2 or Type 3. These players cut and try or decide themselves as winner, because they do not know a rule of new tables. They can learn through playing game, therefore they can take up rules at new tables. However at Table 2, many players do not take up rules. They are strategic behaviors according to questionnaire results. Consequently, traded players are difficult to learn rules.

We show number of complainer in each table, as Fig. 7, a phase consists of 5 game. After trades some players do not follow a dealer’s instructions. This reason is that players of Type 2 or Type 3 exist in Table 2.

Many players follow a dealer’s instructions. However a few players do not follow with strategies. These strategies are behaving greedy before traded players learn rules, and consistently deciding themselves as winner. In this environment, these players change behaviors, because a dealer loses points when some players complain.

In this game, many player can learn trumps. However they can not learn strength of rank. This reason that players often encounter situation of understanding trumps and do not much encounter situation of understanding strength of rank.

C. Experimental result in disorderly environment

We show the process of the numbers of each type at Fig. 8. We explain features of each situation at tables.

1) Opening Game (before trading): In Table 1 and Table 2, most players are Type 1. Because selected winners are justified, few players complain. In Table 3, many players are Type 2 and Type 3. Because selected winners are not justified, the number of a complainer is increased. And players of Type 1 change Type 1 to Type 2, because these players can not play normally.

2) Middle Game (first trading): Players of Type 1 account 80 percent of all players. In Table 1 and Table 2, complainers increase because players come to grips with the difference of rules between tables. On the other hand, in Table 3, complainers decrease, because a player of Type 3 was traded.

3) End Game (multiple trading): In all tables, complainers increase, and some players understand this situation. So they feel that a complainer is outshined by a seriousness player, change Type 1 to Type 2.

According to questionnaires, 80 percent of all players can notice the differences of rules between tables, the other 20 percent of players completely unaware the difference. Only one of the players noticing the differences of rules tries to adapt to another, but he can not adapt absolutely and acquire another rule. Therefore all players can not learn other rules. In this game, when complainers increase, Bonus Point increase. Then 40 percent of all players are willing to complain. We show the numbers of complaining at Fig. 9. The numbers of complaining become widespread. Likewise, being dealer, many players select oneself as a winner, because it remains possible that he or she benefits.
**D. Discussion**

In orderly environment, many players learn implicit rules and adapt society observing behaviors of the others. In disorderly environment, many players only feel difference of rules. New implicit rules which are complaining occur, and some players understand and execute this. This common behavior is implicit, because this is not gone on record. Similarly, selecting oneself as a winner occurs. These are implicit rules because theses are not publicly-available.

Players change types with *notices* and *behaviors*. In these experiments, there are five changes as TABLE III. These changes effect social or nonsocial actions.

Behaviors of adapting to others and complying rules give a positive impression. On the other hand, behaviors of complaining and selecting oneself as a winner are give a negative impression. If a society is positive, positive behaviors are social behaviors. If a society is negative, negative behaviors are social behaviors.

**VI. Conclusion**

We developed Online BARNGA based on BARNGA which is simulation game of cultural clashes towards development of a social agent. We observed players’ social behaviors which are acquiring implicit rules on this game. In the orderly experimental environment, players learnt through not only their experiences but also behavior of the others. In the disorderly experimental environment, some new implicit rules were acquired. Abilities of *Notices* and *Behaviors* at acquired implicit rules is important in human society. We will develop Social Agent with *Notices* and *Behavior*.

**REFERENCES**