A Cross-Cultural Study of Playing Simple Economic Games Online with Humans and Virtual Humans

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Abstract. We compare the simple online economic interactions between a human and a multimodal communication agent (virtual human) to the findings of similar simple interactions with other humans and those that were run in the laboratory. We developed protocols and dialogue capabilities to support the multi modal agent in playing two well-studied economic games (Ultimatum Game, Dictator Game). We analyze the interactions based on the outcome and self-reported values of possible factors involved in the decision making. We compare these parameters across two games, and the two cultures of US and India. Our results show that humans' interaction with a virtual human is similar to when they are playing with another human and the majority of the people choose to allocate about half of the stakes to the virtual human, just as they would with another human. There are, however, some significant differences between offer distributions and value reports for different conditions (game, opponent, and culture of participant).

Keywords: Culture, Values, Decision Making, Virtual Human, Economic Games, Communicative Agents.

1 Introduction

In this paper we present a cross-cultural study of online negotiation in simple economic games, where participants play opposite either a virtual human or someone from their own culture. Economic models of rational behavior typically assume that people try to maximize their own profit in such games[15]. However, in social settings, including these games, previous research has found that people from most cultures take other factors into account as well, such as relative gain (cast as competition or fairness), gain of the other, and joint gain[17]. Online interaction represents an intermediate point between normal social interaction, and individual performance[6]. The participants are alone, acting on a computer interface, however, the situation is still posed as a social interaction: playing with either another person from their culture, or with a virtual human: an animated character who engages in spoken dialogue and non-verbal communicative behavior. We are interested in whether people playing under these conditions act similarly to those playing face in laboratory settings and with other humans. We are looking at both the game play and participants' self-report of what values they are concerned with when making moves.

M. Kurosu (Ed.): Human-Computer Interaction, Part II, HCII 2013, LNCS 8005, pp. 266–275, 2013.

We attempt to address the following questions. How different are players from the United States from Players in India? What impact does the type of game have on players' decisions and values? How similar or different do participants feel and act when playing a virtual human versus another person?

In the next section, we review related work in this area. In section 3, we describe our experimental conditions, and independent and dependent variables. We present the results in Section 4, and conclude in Section 5.

2 Background and Related Work

Two well-studied examples of economic games are the Dictator Game and Ultimatum Game. Both games involve allocation of a certain amount of money between two people. In both games, players are asked to split a sum between themselves and the other party. In the dictator game, one player decides on a partition of the sum. In the single shot ultimatum game[9], the first player proposes a partition. If the other player accepts the proposal, then the sum is partitioned to the players according to the proposal but if the other player rejects, then both players receive nothing.

Previous studies have extensively investigated human behavior in these games and some show that social factors affect the giving behavior in these games. For example even minimal social cues such as three dots in the watching eyes configuration in the dictator game affect the giving behavior in a positive way [20]. We expect that virtual humans would have a similar effect on humans and prompt participants to show giving behavior toward the agents. We are also interested to see whether the results obtained online are comparable to laboratory conditions when people are recruited and compensated for their time according to the amount of time they put in participation. However few studies have looked into what happens in these games when played online. One would suspect that online strangers playing with each other might not be influenced by social constraints but some recent studies have reestablished the classical findings such as the effect of framing and priming on Mechanical Turk[18] [2]. Experiments investigating the reliability of self-reported demographics on Mechanical Turk show that above 97% of these tasks are reliable [12][23]. [1] has also shown that running economic games experiments on Mechanical Turk are comparable to those run in laboratory setting even when using very low stakes for payment. The effect of adding stakes and the average behavior in the stakes conditions is also similar to what has been observed in the laboratory setting. These experiments alleviate concerns about the validity of economic games experiments run online versus ones in the laboratory.

Previous research shows that in the Dictator Game the subjects were more generous when there were no stakes involved compared to when high stakes or low stakes were involved [5] [8]. In the Ultimatum game increasing the stakes size does not increase the average proposals but increases the variance observed in them [8]. The responder behavior didn't change in [8] but decreased significantly in [4].

In the virtual agent community, researchers have investigated whether expression of emotions by virtual humans has the same effect of human emotion expression on

humans. Such effects have been mostly investigated in the context of the Prisoner's dilemma [13][7].

Prior research (e.g. [3][10]) has documented the influence of social and cultural factors on the decision making process. In the most general case, a human decider does not consider only the impact on his own utility, but also the impact on others, including individuals, groups and society as a whole. There are also differences in how individuals value the options in a decision-space as well as broad similarities in outlook between similar individuals. Culture also plays a role [3][10].

In our own previous work [16,17], we have attempted to model differences in game play as a result of differences in values. In [17], we considered four type of values and set weights on each of these depending on the social setting of the players (in-group/out-group, status differences) and intuitions based on Hofstede's culture model[16]. In [14], we learned weights using inverse reinforcement learning. While this work showed that learned values were better able to predict the behavior of the culture they were learned from than other culture, it was not conclusive about the actual values that the players had.

3 Experiments

3.1 Method

In our experiments participants played single shot versions of either the dictator game or the ultimatum game. Each game was played to split a sum of 100 points. In the ultimatum game the responder's policy was to accept any offer more than 40 points in both human and virtual human conditions.

Participants filled out a demographic questionnaire before starting the experiment. They received a $0.5 show up fee for participating in the task and were told that they will be playing over points and will earn another $0.05 for each additional 10 points that they accumulate in the game.

Participants were given a description of the game (ultimatum or dictator), and then asked for their move as proposer in the game. Once the participants in the experiment made their decisions in the games, they were asked to report how much they cared about each of the values in table 1, on a scale from -5 to 5 (-5 meaning that they were strongly against, 0 meaning that they didn't care at all, and 5 meaning that they cared a lot about achieving the goal). After this survey, they were given the results of the game (which was determined by their offer for the dictator game).

3.2 Opponents

There were two opponent conditions. In the first case, players were told that they were playing against another person from their country (US or India). In the second case they played against a virtual human. In the second case, the pre-game survey and the values questionnaire was administered by the virtual human as well, while in the human condition, they filled out a purely textual form.

Table 1. Values survey

Value	Description Given to participant
V_{self}	Getting a lot of points
V_{other}	The other player getting a lot of points
$V_{compete}$	Getting more points than the other player
V_{equal}	Having the same number of points as the other player
V_{joint}	Making sure that added together we got as many points as possible
V_{rawls}	The player with fewest points gets as many as possible[19]
$V_{lower\ bound}$	Making sure to get some points (even if not as many as possible)
V_{chance}	The chance to get a lot of points (even if there's also a chance not to get any points)

Our virtual human was developed using the SimCoach virtual human authoring platform, called Roundtable (described in [22]). The platform is built upon a broad set of virtual human technologies developed at USC-ICT that make it easier to create, test and deploy conversational virtual characters on the web. Characters can be developed to understand natural language textual input as well as fixed-choice menu options[21]. The Flores Dialogue manager [14] selects character actions based on the authored policy and the developing context. Finally, the textual form of character responses are explicitly authored and are bound to dialogue acts specified in the policy. Actions can be realized as speech performances, references to web resources or purely nonverbal reactions. The character was launched on the web and once provided the link to the server the participants were able to interact with the virtual character that can interact through audio and text. The character is shown in Figure 1.

3.3 Participants

Six hundred participants total, were recruited using Amazon Mechanical Turk. Roughly ½ were from the United States, while the other ½ was from India.

Table 2. Number of participants from the two countries playing two games

	US	India
Dictator Game Human	107	107
Dictator Game Virtual Human	46	38
Ultimatum Game Human	101	101
Ultimatum Game Virtual Human	53	47

Participants were assigned to one of the eight conditions, based on culture (US or India), game (Ultimatum or Dictator) and opponent (human or virtual human). Human studies were conducted one month earlier, with about 100 participants per condition, while virtual human conditions had about 45 participants per condition. The exact number of participants per condition is shown in table 2.

Fig. 1. Screen shot of the Simcoach character Ellie

4 Results

In this section we report the results of the experiments and possible explanations for the observed behavior. Figures 2 and 3 show offer distributions for the two games, contrasting cultures and opponents. Our results are broadly consistent with what has been shown in the literature for laboratory play[11][3]. Figures 4 and 5 show the differences in reported values in different conditions. The upcoming parts in this section examine the effect of culture, game and opponent in detail.

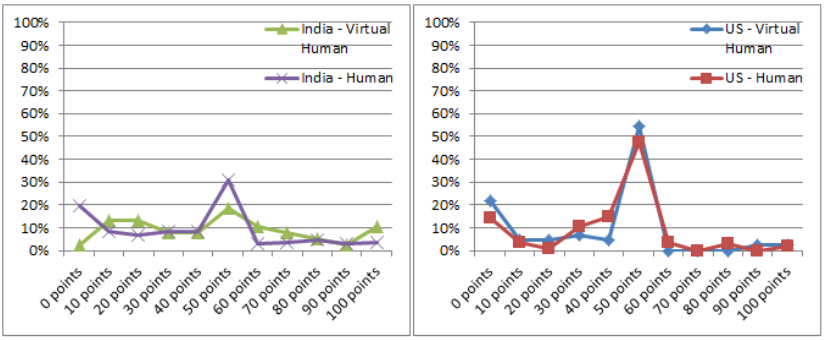

Fig. 2. Offer distribution in dictator game

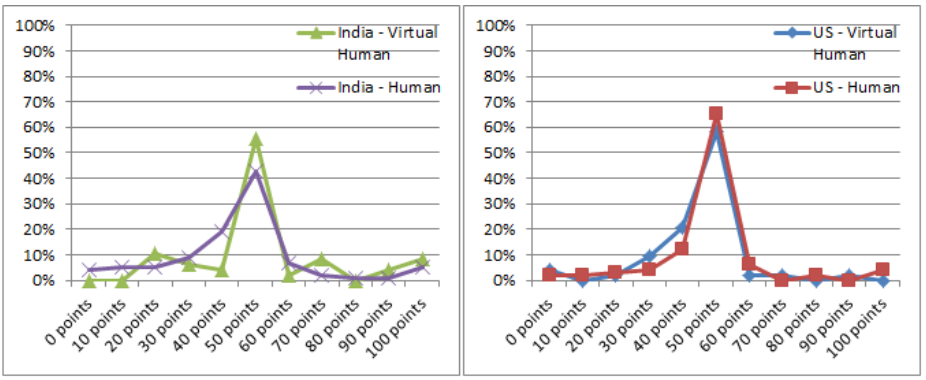

Fig. 3. Offer distribution in ultimatum game

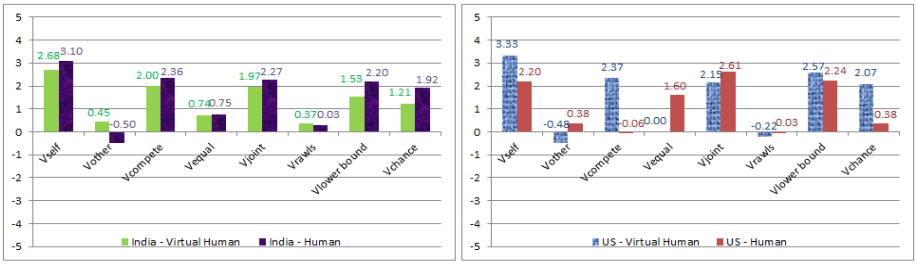

Fig. 4. Reported values in the dictator game

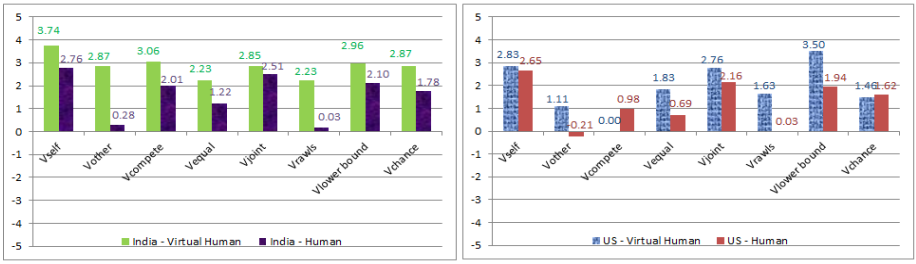

Fig. 5. Reported values in the ultimatum game

4.1 Game Effect

The average amount of offers made to the other party in the dictator game was 39.6 points whereas this amount was 47.6 points for the ultimatum game (see Figure 6 for the full distribution across all conditions). The offers made in the two games are significantly different from one another (p-value= 0.00).

The main difference between dictator game and ultimatum game is that proposers do not have to deal with the possibility of having their proposals rejected and that is most likely the reason why the average offer in ultimatum game is higher than the average offer in the dictator game.

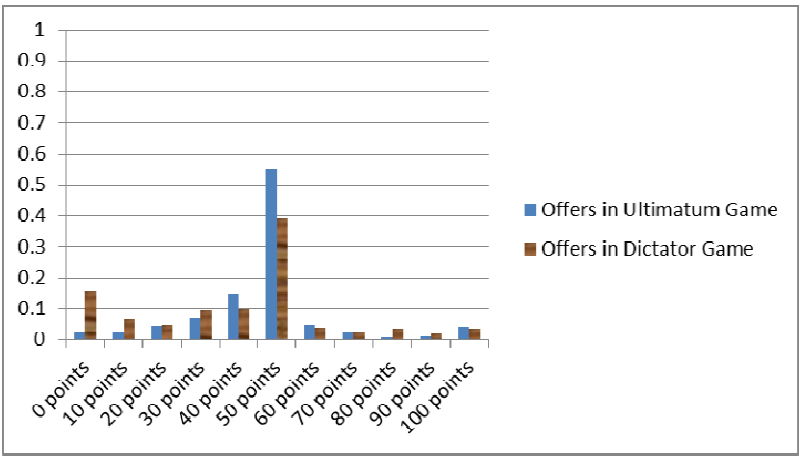

Fig. 6. Distribution of offers in dictator game and ultimatum game

In terms of the reported values there is significant difference observed between the two conditions on the following value dimensions: Vother (p value=0.00), Vcompete (p_value<0.01) , Vequal (p_value=0.00) , Vjoint (p_value<0.05) ,
V_{rawls} (p_value<0.05) , $V_{lower\ bound}$ (p_value<0.05)

4.2 Culture Effect

The average offer made by Indians was 43.85 whereas the average offer made by Americans was 43.02 points. No significant difference is observed between the offers made by participants from US and India. However we observed significant difference between the two cultures for the offers made in the ultimatum game when participants were playing with virtual humans (p value<0.05).

There is significance difference between the values reported by Indians and Americans for V_{self}(p value<0.01), $V_{compete}$ (p value=0.00), V_{chance} (p_value<0.05). In addition to the differences on the mentioned values which is consistently observed across all conditions, when participants from US and India play with virtual humans we also see difference on V_{other} dimension for the dictator game (p value=0.00) and on V_{lower} bound dimension when they are playing ultimatum game (p value<0.05). No such difference is observed when they are playing these games with another human.

4.3 Opponent Effect

Playing against a virtual human or a human does not bring about significant difference in the offers made in the games. The only condition under which significant difference among offers was observed was when Indians played the ultimatum game (p value<0.05).

However there were significant differences in the values reported V_{self} (p value= 0.00), V_{other} (p value=0.00), $V_{compete}$(p_value<0.05), V_{rawls} (p_value=0.00), $V_{lower\ bound}$ (p_value=0.00) V_{chance} (p value<0.05).

5 Discussion

Our goal is to make culturally inspired negotiating virtual humans and in this work we set out to answer the following questions: Is it possible to use virtual humans as representative of humans? Do humans behave the same way towards virtual humans as they would with other humans in economic domains? Would the same marketing strategies hold with virtual humans? Can virtual humans be successfully applied in the e-commerce domains and online interactions?

Our result shows that people from US and India both treat virtual humans similar to how they would have treated another human. A general look over the results shows that the most prominent cause affecting the game behavior and the offer values is the type of the game being played. Our results are consistent with reported results in the literature [11]. Considering the simplicity of these games, it's not surprising that the effect of the culture or the opponent (Human/Virtual human) might not be captured in these two games. However our results showed a strong correlation between culture and the opponent in the games with the values reported by participants. These results show that the valuation functions used by people from the two countries are different and the reasons should be further investigated. We took a closer look to the application of Virtual Humans in economic domains and we conclude that virtual humans can be a reasonable substitute to humans in online economic interactions.

Our future work involves creating culture-specific decision-procedures for virtual humans based on the reported values for each culture. These models will be validated by comparing game play of virtual humans using these models to individuals from the cultures.

Acknowledgements. We would like to thank Simcoach team members Eric Forbell, Nicolai Kalisch, Kelly Christofferson, and Fabrizio Morbini for their generous help in authoring our virtual characters and completing our online experiments.

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