Let's Be Serious and Have a Laugh: Can Humor Support Cooperation with a Virtual Agent?

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Abstract. A crucial goal within human-computer interaction is to establish cooperation. There is evidence that among the tools being available, humor might be a promising and not uncommon choice. The appeal of humor is supported by its fundamentality for human-human interaction and the variety of functions humor serves, for it can achieve much more than making the user smile. In the present experiment, we sought to further investigate the potential effects of humor for virtual agents. Subjects played the iterated prisoner's dilemma with a virtual agent that was intended to be funny or not. Additionally, we manipulated cooperativeness of the agent. First, although humor did not increase cooperation among subjects, our results indicate that humor modulates how cooperation is perceived in an agent. Second, humor facilitated the interaction with respect to enjoyment and rapport. Third, although increased enjoyment and overall affective reactions were both measured subjectively, the results were not in line with each other.

Keywords: Virtual agent, Humor, Cooperation, Prisoner's dilemma.

1 Introduction

Humor is the source of pleasure and entertainment, of distress relief, and the experience of teaching and discovering [1]. It stands for delight and positive emotions. We may attribute these desirable aspects to a communicator we find humorous. Humor makes it easier to connect with others. Experiencing humor at a given occasion leads to the desire to repeat the experience. In interpersonal communication, a speaker is evaluated more favorably when she displays humor. If a person is believed to have a sense of humor, this assumption automatically creates a halo effect with regard to other desirable personality traits such as friendliness, pleasantness, and creativeness [2]. However, from the viewpoint of human-computer interaction (HCI), humor has received only little attention. In scenarios where humans and lifelike artificial characters need to cooperate or negotiate a task, the use of humor may serve a variety of

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goals. It could make the interaction more natural and meaningful and even affect the outcome. Humor is a form of cognitive play, leading to a considerable amount of pleasure and motivation.

We review the role of humor for social interactions and how it has been applied to HCI. In interpersonal communication, humor is one of the most important facilitators and an important social skill. Humor can be used to promote social influence and cooperation, in a completely playful manner. It is, however, not easy to channel this potential. Our aim was to create a funny agent in order to analyze experimentally how its humorousness and cooperativeness influence human partners in a social dilemma.

2 Theoretical Background

Humor in Social Interactions. Humor is an important tool to shape social interactions and influence others [5]. It plays a role for rapport, cooperation, and person perception. Understanding humor and laughter as social skills that people need to learn, control, and regularly practice [6] indicates how difficult it is to implement it into technology. The richest source of humor lies within natural and spontaneous everyday interactions [3]. Accordingly, within everyday conversation, humor serves as social facilitator that can be deployed in a variety of different contexts such as negotiating requests and building group solidarity [4]. Humor is an antecedent of rapport; it fosters a positive and friendly environment [7] and connects people with each other [8]. But humor may also interfere with involvement and thus with rapport, because joking requires recipients to ignore the obvious meaning and find interpretations that are funny [9]. If listeners fail to understand a humorous remark or feel that it is rather inappropriate, specific facilitative functions of humor are disrupted. On the other hand, if listeners participate in the joking and appreciate it, experiences and attitudes are shared, rapport is promoted, and politeness is conveyed [10]. Humor influences person perception. Evidence from social psychology provides support for effects on liking [11] and credibility [12]. In line with this, sense of humor is very often used as social category [13]. According to [2], having sense of humor is associated with being more friendly, pleasant, interesting, cooperative, imaginative, creative, clever, and less cold and passive. Finally, experimental studies successfully manipulated the experience of humor in the context of interpersonal interaction and showed the effect on outcome variables. [14] showed that in a fictional bargaining situation, conversational humor ("Well, my final offer is $7,000 and I'll throw in my pet frog") leads to social influence to the extent that subjects agreed to pay a significantly higher price for a painting. Subjects laughed more, reported more amusement, and were more likely to agree that their partner was a fun person.

Humor in Human-Computer Interaction. It is argued that social cues relying on human cognitive and affective processes lead to more meaningful interactions with artificial entities and more user appreciation [15, 16]. It was proposed to implement humorous behavior into human-agent interactions in order to tease out the potential of humor for establishing social relationships [16]. An experimental study by [18] revealed that a virtual exercise advisor displaying a set of relational behaviors including

social dialogue, empathy, and humor led to increased liking, trust, and higher self-reported desire to continue working with it. Until today, experimental approaches placing detailed scrutiny on humor have remained scarce.

[17] found evidence for why humor could fit into task settings. In two different experiments, the authors had subjects chat and solve the Desert Survival Problem with a humorous or non-humorous computer. In both experiments the computer made pre-programmed comments, but in study 1 subjects were led to believe they were interacting with another person. In the humor conditions subjects received a number of funny comments, for instance: "The mirror is probably too small to be used as a signaling device to alert rescue teams to your location. Rank it lower. (On the other hand, it offers endless opportunity for self-reflection)". In the no-humor conditions, the computer/partner would leave out the funny remark. Subjects who knew they communicated with a computer (study 2) responded less sociable and showed less mirth. Nevertheless, when isolating study 2, some important effects remained. Subjects in the humor condition liked the computer more, showed more mirth responses, made more sociable comments, and joked back more. The study showed that it is possible to create humorous computers, even with preprogrammed text-based jokes. A similar experiment focused on the effect of virtual agent humor on social influence [19]. Social influence was conceptualized as rating similarity in the Lunar Survival Scenario. Again, participants were asked to engage in text-based communication with a virtual entity and again, the computer's reasoning about the items' relative relevance was subject to the humor manipulation (e.g. "We can use the FM receiver to communicate with another ship, or we can pass time with some fun music on the radio"). This time participants were presented a chat interface that showed a picture of their partner, a male virtual agent named Bradley. The interaction was no longer pre-scripted as the agent had the ability to answer questions. Differences between initial and post-chat item rankings reflected the extent to which the agent was able to influence its partner toward the ideal item rankings. When Bradley was perceived as funny, he was more effective at influencing the participants. Moreover, for participants in the humor condition, a positive correlation between perceived humorousness and influence on their rankings emerged. Strikingly, the manipulation check for perceived humorousness of the agent was not successful. Instead, there was a considerable fraction of no-humor participants who judged the agent as funny.

Taken together, humor may play a crucial role for establishing relationships with virtual agents [20] but there are not enough studies on the potentials and pitfalls. For instance, more experimental investigations are needed to explore potential research directions for task-related settings. We present such an investigation.

Hypotheses. We expect an agent that makes conversational and situation-specific jokes to be judged as funnier compared to an agent that does not joke (H1; manipulation check). This manipulation check is important because there were "misperceptions" of an agent's funniness in the past [19]. Cooperation determines a large fraction of the appeal of interacting with computers. The question to what extent users cooperate with computers in social dilemmas has gained some attention in the past [21, 22]. Humorous (non-animated) virtual agents can foster cooperation [19], but none of the previous

studies varied the degree of cooperation. We therefore combined manipulations of humor and cooperation. We hypothesize that in a social dilemma, the cooperative agent is judged as more cooperative than the competitive agent (H2; manipulation check). According to the norm of reciprocity [23], we expect that the agent's observable behavior will evoke similar reactions by the subjects. Thus there will be more cooperation when playing with the cooperative agent (H3). Given the meaning of humor for social interactions and social influence, we expect the funny agent to elicit more cooperation than the unfunny version (H4). Furthermore, a funny agent will evoke more positive affective reactions (H5) and lead to increased rapport (H6).

3 Method

Experimental Design and Subjects. We conducted an experiment in which subjects played the iterated Prisoner's Dilemma Game (PDG) with a virtual agent. The study was based on a 2 (*Agent humor:* humor vs. no humor) x 2 (*Agent behavior:* cooperative vs. selfish) between-subjects design. Eighty (80) subjects participated in the experiment (44 females, 36 males). Their age ranged between 19 and 34 years (M = 24.91, SD = 3.06). Subjects were randomly assigned to one of the four conditions.

Table 1. Payoff matrix in the iterated prisoner's dilemma (investment game version)

	Project green	Project blue
Project green	Subject: 5€ Agent: 5€	Subject: 3€ Agent: 7€
Project blue	Subject: 7€ Agent: 3€	Subject: 4€ Agent: 4€

Materials. In the social sciences, the PDG is a widely used and well-elaborated method to explore determinants of cooperation and altruism. The fictional scenario puts subjects in the role of an arrested convict. Since their partner was also arrested, the convicts can either remain silent (cooperate) or testify against the partner (defect). The combination of both decisions determines the punishment for both convicts. Recently the PDG was also used to investigate cooperation with virtual agents capable of facial emotional displays [21].

In the present study, subjects did not know how many rounds were left but were given a hint when half of the turns were over. There was no display on played rounds, rounds left, or elapsed time. Since in the iterated version it does not make sense instructing subjects to either remain silent or testify multiple times in a row, the iterated PDG was cast into an investment game [e.g. 22]. In this version, subjects are asked to choose between two projects, Project Green and Project Blue. The payoff matrix does not change, Project Green is the cooperative option and Project Blue is the selfish choice (see Table 1). The utility-maximizing choice for both players is to play selfishly in each round. However, both players' payoff is higher for mutual cooperation than for mutual selfishness, thus the resulting dilemma. Two windows were

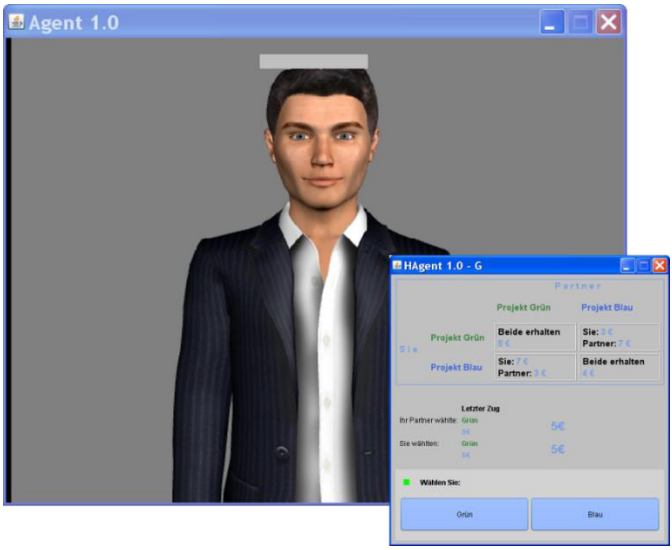

Fig. 1. Agent and PDG window with arranged overlap

presented, one for the agent and one for the PDG (see Fig. 1). The game window showed the payoff matrix and the game statistics, consisting of both players' last choices, the last and the total payoff.

The agent was created with the CharAT avatar editor, a proprietary toolkit (Copyright by Charamel GmbH, 2008-2010). It chose between the two options and gave occasional task-related feedback on the previous turns (see Table 2). Decisions were random-based with a bias for one of the two choices, depending on the behavior condition. While the agent was able to speak, it was not allowed to directly negotiate with the player.

Procedure. Upon arrival, subjects were told that they are about to play an investment game with a virtual counterpart and were asked to rate the interaction subsequently. They were told that their goal would be to maximize their own outcome. The more points they earned the higher their chance to win a 25€ voucher. Each round would be initiated by the agent. After each round both players' decisions and their individual payoff were revealed. The detailed overview of the game was explained by the virtual partner. After the investigator's introduction the agent explained the rationale behind the game and introduced the possible outcomes, depending on both players' investment choices. The instructions were adopted from [22]. After the game was finished, subjects rated their interaction with the agent using the post-questionnaire. They were debriefed and thanked for their participation. Each session lasted approximately 40 minutes.

Manipulations. We manipulated the agent's decision policy and its humorousness. In the humor condition the agent teases, baffles, and engages the player in a playful way. Since the PDG itself only features minimal interactive cues, it was assumed that even trivial jokes would facilitate the interaction. A simple time-based rule was

implemented to add enough variety into the decision about when the agent should make a joke or say something trivial and unfunny instead. First we tracked how long the subject took for her turns. On this time series we performed exponential smoothing to compute naïve predictions about future turn times of this subject. We used the predicted values for future turns as threshold and checked if the subsequent turn time was above or below this threshold. If it was below, indicating that the subject was quicker than expected, the agent performed a joke. If it was above, indicating that the subject took longer than expected, the agent made a normal comment. As a result, the agent quasi-regularly switched between funny and unfunny comments and adapted to the subject. The content was held identical in terms of (ostensibly) personal information the agent disclosed. Table 2 provides examples of jokes and control comments by the agent. The sets of jokes and control comments each contained 22 utterances for the agent to choose from. While the agent did say something after each round, it did not always make a joke (control comment). Instead, when the requirement for a joke was not given, the agent either said "Now it's my turn again" or "OK, now it's my turn". The agent cooperated (played selfishly) 66% of the time. The exact decision order was random-based with the exception of the first five rounds. Here the agent played the following sequence: (project) green, green, blue, blue, green. The fixed sequence was implemented to avoid too many identical choices in a row at session beginning, making it harder for the subjects to guess the agent's gaming behavior [21]. Based on pre-evaluations and the joke collection size, the round limit was set to 38 rounds.

Table 2. Examples of conversational jokes and control comments by the agent

Humor	No humor
Please press start if you wish to begin. Age before beauty, so it's my turn first.	Please press start if you wish to begin.
You are better than the last player. With him I could not even play Uno.	You are better than the last player, he was indeed very unlucky.
Maybe I should have another look at the rules, with my reading glasses.	Maybe I should have another look at the rules.
I hope you haven't found any software errors yet. Do you have any idea how difficult it is to find good staff nowadays?	I hope you haven't found any software errors yet. It surely shouldn't be too hard to write error-free software.
Don't let yourself get distracted by me. Attention, behind you!	Don't let yourself get distracted by me.
You can read the Matrix like no other.	You understand the game like no other.
Here's something I'd like to know. When you see me like this, do you think I'm wearing pants?	Here's something I'd like to know. When you see me like this, do you ask yourself why I'm dressed like this?

Dependent Measures. Humorousness of the agent was assessed with five items [17] ('funny', 'witty', 'entertaining', 'creative', 'playful'; Cronbach's $\alpha = .84$). Subjects were asked to indicate how much they had to smile and laugh. Two statements were

used: “My partner made me laugh” and “I sometimes had to smile” (correlation: $r = .65$, $p < .001$). Perceived cooperation of the agent was measured with two statements: “My partner predominantly chose Project Green” and “My Partner predominantly chose Project Blue” (reverse coded). Both statements correlated highly with each other ($r = .70$, $p < .001$). Affective reactions were assessed using the Positive and Negative Affect Schedule [24]. The scale consists of 20 items divided into the 10-items subscales positive (e.g. active, strong, proud; $\alpha = .88$) and negative affect (e.g. ‘afraid’, ‘nervous’, ‘angry’; $\alpha = .77$). Perceptions of rapport were assessed using the items [25] derived from [26, 27]. For this subjects were asked to rate themselves in the interaction (11 items, e.g. ‘comfortable’, ‘involved’) and to rate the interaction itself (18 items, e.g. ‘harmonious’, ‘awkward’). For the first set, varimax rotated principal component analyses revealed the factor ‘Positivity’ (29.11% explained variance, $\alpha = .83$), indicating whether subjects perceived themselves as positive during the interaction. For the second set, the factors ‘Intense’ (17.10%, $\alpha = .78$), ‘Well-coordinated’ (16.45%, $\alpha = .80$), ‘Awkward’ (14.68%, $\alpha = .75$), and ‘Boring’ (12.97%, $\alpha = .75$) emerged. Cooperation was measured counting each time subjects chose project green (maximum: 38 times). All items and statements were rated on 5-point Likert scales.

4 Results

The humor manipulation was successful (H1), a two-way MANOVA revealed a main effect of humor on humorousness of the agent: the funny agent ($M = 3.29$, $SD = .13$) was perceived as funnier than the non-funny agent ($M = 2.64$, $SD = .13$), $F(1, 76) = 13.18$, $p < .01$, $\eta_p^2 = .15$. In line with this, there was a significant main effect of humor on smiling and laughter: when interacting with the funny agent ($M = 3.58$, $SD = .18$), subjects indicated to express more smiling and laughter than when interacting with the non-funny agent ($M = 2.68$, $SD = .18$), $F(1, 76) = 12.37$, $p < .01$, $\eta_p^2 = .14$. There also was a significant correlation between self-reported smiling and laughter and humorousness of the agent ($r = .52$, $p < .001$). The behavior manipulation was also successful (H2). There was a significant main effect of behavior on perceived cooperation of the agent: the cooperative agent ($M = 3.52$, $SD = .11$) was perceived as more cooperative than the selfish agent ($M = 2.47$, $SD = .11$), $F(1, 76) = 46.67$, $p < .001$, $\eta_p^2 = .38$. Unexpectedly, there was a significant main effect of humor on perceived cooperation of the agent. The funny agent ($M = 2.84$, $SD = .11$) was perceived as less cooperative than the non-funny agent ($M = 3.15$, $SD = .11$), $F(1, 76) = 4.05$, $p < .05$, $\eta_p^2 = .05$. H3 was supported as there was a significant main effect of agent behavior on cooperation. Subjects cooperated more with the cooperative agent ($M = 12.19$, $SD = 1.08$) than with the selfish agent ($M = 9.18$, $SD = 1.06$), $F(1, 76) = 3.95$, $p = .05$, $\eta p^2 = .05$. However, two-way ANOVA results on subjects’ cooperation show that the main effect of humor on cooperation was not significant ($F(1, 76) < .001$, $p = .99$). H4 was not supported. Two-way MANOVA results showed that interacting with the funny agent did not significantly enhance affective reactions. Neither positive ($F(1, 76) = 1.65$, $p = .20$) nor negative affective reactions ($F(1, 76) = 1.53$, $p = .22$) were influenced by agent humor (H5 not supported). Further analysis revealed that

positive affective reactions correlate significantly with perceived humorousness of the agent ($r = .42$, $p < .001$) but not with self-reported smiling and laughter ($r = .16$, $p > .05$). Two significant effects were observed for rapport. First, there was a significant main effect of humor: interacting with the funny agent ($M = -.33$, $SD = .15$) led to less experiences of awkwardness compared with the non-funny agent ($M = .34$, $SD = .15$), $F(1, 76) = 9.56$, $p < .01$, $\eta p^2 = .12$ (H6 supported). Second, there was also a significant main effect of behavior on rapport such that interacting with the cooperative agent ($M = .25$, $SD = .16$) led to more positivity than the selfish agent ($M = -.24$, $SD = .15$), $F(1, 76) = 4.88$, $p < .05$, $\eta p^2 = .06$.

5 Discussion

Using a social dilemma, we evaluated under which circumstances people cooperate with a virtual counterpart. Leading to social influence in past HCI research, humor was implemented as a tool to support cooperation. Although we succeeded in designing a funny agent for a task-related environment that made subjects smile and laugh, subject cooperation was not affected by humor. This result should be discussed considering the funny agent was perceived as less cooperative. The attributions subjects drew as a result of this impression may explain to a certain degree why they did not cooperate more with the funny agent. Agent humor may have contributed to the impression that it did not take the task seriously enough. While it is unclear if this affected perceived task difficulty, subjects probably demanded a partner who takes the game and themselves more seriously. Since it did not, they may have associated its behavior with a tendency toward the selfish choice.

Cooperation of the agent determined whether subjects also cooperated. In task situations, designing cooperative agent behavior is thus useful to facilitate cooperation among humans. Although the selfish choice promised a better outcome, subjects chose to cooperate occasionally. The display of the agent's choices within the game was minimal and did not include any social cues whatsoever. While the effect of such minimal cues on subject cooperation is encouraging, it might be further improved by trust-relevant nonverbal cues [28] and the display of moral emotions [21]. Furthermore, subjects correctly identified the agent in the cooperative condition as a cooperative actor. Thus it may be speculated whether they followed specific intentions, such as returning the favor and, conversely, punishing the agent for selfishness in the other condition, reflecting the inherent concern for fairness within social decision making [29]. However, the punishment explanation must take into account that in the selfish condition, the rational option to avoid losing the game is to play selfishly as well.

Our results show that in conflicting and ambiguous situations, virtual agent humor can enhance the flow of interaction. Agent cooperation had a similar effect as subjects indicated more positivity toward the agent. On the other hand, the role of affective reactions in this study is surprising in that they correlated with perceived humorousness of the agent, yet they were not enhanced by virtual agent humor. It is also unclear why positive affective reactions did not correlate with self-reported smiling and laughter. Since subjects reported increased smiling and laughter in the humor condition and thus showed clear signs of enjoyment, it can be ruled out that negative

contextual aspects such as goal obstruction became more salient. It can also be ruled out that subjects merely recognized the agent's attempts at humor and simply played along by smiling and laughing. This explanation, although it fits well with the application of social norms, is incoherent to the increased humorousness ratings. Since the subjective measuring of affective reactions may have been confounded by contextual elements, it can be speculated that the higher humor ratings of the funny agent did in fact reflect enhanced positive affect: "Funniness ratings presumably reflect the degree to which each stimulus elicited mirth in the participants" [13, p. 182]. In future experiments, psychophysiological measures could resolve this issue.

Although we could not support the positive relation between humor and cooperation in HCI, we were able to show how humor may influence the perception of virtual agents on supposedly non-related levels, for instance cooperativeness. As a social tool, humor can facilitate the interaction with a virtual agent, yet we need to know which forms of humor are most appreciated in a given situation (sarcasm, irony, wordplay, classic jokes). Researchers should be motivated to approach humor in HCI by asking how humor affects the user understanding of the situation, given that it is surprising and may require cognitive effort. Users do not share the same appreciation for humor, nor do they react to and use humor in the same way, a funny virtual agent thus needs to adapt to user preferences.

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