Persuading Users through Counseling Dialogue with a Conversational Agent

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ABSTRACT

We present an empirical study of the effect of a computer agent designed to engage a user in a persuasive counseling dialogue on attitudes towards regular exercise. We used two manipulations: (1) how closely the agent simulated human conversation, using either an embodied conversational agent (ECA) or a text-only agent, and (2) whether the agent attempted to build a user-agent relationship through social dialogue. Participants demonstrated a significant increase in positive attitudes (persuasion) following the persuasive dialogue; however, this change was significantly smaller when the agent used social dialogue. Participants' perceptions of the dialogue were most positive for an ECA with social dialogue, or a text-only agent without.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**] User Interfaces—Evaluation/methodology, Graphical user interfaces, Interaction styles, Natural language, Theory and methods, Voice I/O.

General Terms

Measurement, Experimentation, Human Factors

Keywords

persuasion, conversational agent, relational agent, health behavior

1. INTRODUCTION

Persuasive technologies developed to date have, for the most part, implemented persuasive techniques inspired by human-human interaction [16]. Rather than investigating a single persuasive technique, we are interested in modeling all the communicative activities that take place during a session with a human health counselor who is trained to change the health behavior and attitudes of her clients. Since physical activity is a behavior with many well-known long term health benefits [33], we focus on the promotion of attitudes that are known to be predictive of changes in exercise behavior [29].

In the current study, we investigate the efficacy of using an embodied conversational agent to simulate this face-to-face counseling with as much fidelity as possible, and compare this to a more conventional interface which delivers the same intervention via menus and text messages. We are also interested in the efficacy of the social affordances of embodied conversational agents for building trust and rapport with their users. An effective counselor will attempt to form a strong working relationship with the client, and this counselor-client relationship is predictive of outcomes [22]. Accordingly, we also investigate the use of social dialogue as a relationship-building tactic, and examine how this may impact the ability of the agent to change user attitudes compared to an agent that does not use social dialogue.

2. BACKGROUND AND RELATED WORK

2.1 Persuasion and Social Influence

The persuasiveness of a message may be affected by the interpersonal relationship between speaker and listener. A message is more persuasive if it comes from a source with whom the listener perceives a greater affiliation [12]. A relationship need not be extensive or long-lasting to cause a significant effect. Burger et. al. showed that participants were more likely to comply with a request from a confederate they had interacted with previously – even if the previous interaction consisted solely of sitting quietly in a room together for a short period of time [7]. Social dialogue may be an effective tactic for eliciting compliance with a request. Howard [18] showed that asking someone how they were feeling, and acknowledging the response, led to greater compliance with a charitable request. Similarly, Dolinski et. al. showed that a person approached with a charitable request was more likely to comply if the requester first engaged in casual social dialogue; they argue that the social dialogue provides situational cues which the listener associates with a relationship [15].

However, relational cues may not be persuasive for all kinds of decisions. The Elaboration Likelihood Model (ELM) of persuasion theorizes that people react differently to persuasive messages based on the personal relevance of the decisions involved. Decisions of high personal relevance are processed by the ``central route'', while decisions of lower relevance are

processed by the ``peripheral route''. When the peripheral route is used, then source characteristics, such as the perceived trustworthiness of the source of a persuasive message, have a greater influence on the decision-making process [28].

Within the domain of exercise, Jones et. al. [19] examined the effects of source credibility and message framing on the persuasiveness of messages that promoted physical activity. Participants reported more positive exercise intentions and behaviors when messages were attributed to a credible source and were positively framed – focusing on the benefits of exercise rather than the costs of not exercising.

2.2 Embodied Conversational Agents and Relational Agents

An Embodied Conversational Agent (ECA) is a computer-generated character with human-like appearance and interactive behaviors. ECAs are designed to carry out simulated face-to-face conversations with users, including appropriate use of conversational nonverbal behavior such as hand gesture [11].

Relational agents are computational artifacts designed to build and maintain long-term, social-emotional relationships with their users [3]. ECAs are particularly effective as relational agents, since many of the conversational strategies used to build interpersonal relationships involve nonverbal gestures [2]. Bickmore et. al. demonstrated the ability of relational agents to change exercise behavior [3,4]. However, user attitudes towards exercise after each interaction were not assessed and outcomes were not compared to a lower fidelity text interface.

2.3 Persuasion by Computer Agents

The Computers as Social Actors paradigm [27] argues that people will apply social rules to a computer. Following this paradigm, several studies have explored the variables that affect the persuasiveness of a computer agent. However, most of these studies either involved a computer agent delivering a monologue, rather than an interactive dialogue, or focused on intentionally artificial tasks of low personal relevance, such as the desert survival problem [21].

Stern et. al. [32] investigated some of the effects of fidelity by comparing the persuasiveness of a message delivered by recorded human speech to that of the same message delivered by synthesized speech of varying qualities. The human voice was perceived as more favorable by listeners, but no differences in persuasion or perception of the message were shown.

Zanbaka et. al. [36] examined the effects of gender and visual realism on the persuasiveness of speakers. Participants listened to a persuasive message delivered either by a male or female human, a male or female virtual human, or a male or female virtual non-human (although still anthropomorphic) character. A significant cross-gender effect was found -- male listeners were more likely to be persuaded by female speakers, and vice versa. However, no significant effects of visual realism on persuasiveness were found.

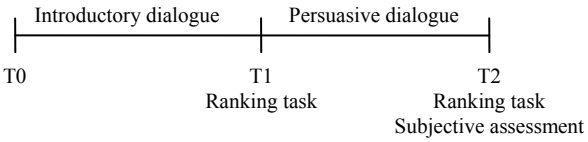

Figure 1. Timeline of an experiment session

Katagiri and Takahashi [20] investigated the effects of sociality on persuasion by observing users interacting with a guide agent, which recommended exhibits to visit. Although the study was limited by a small sample size, and no statistically significant results were observed, users were more likely to follow the agent's future recommendations when the agent thanked them for following previous recommendations.

Perhaps most relevant, Moon [24] demonstrated that a computer that uses a relational strategy of reciprocal, deepening self-disclosure in a text-based conversation with the user caused the user to divulge more intimate information and become more likely to buy a product.

3. RESEARCH DESIGN AND METHODOLOGY

To test whether a computer agent acting as a virtual counselor could persuade a user to change their attitudes towards exercise, we conducted an empirical study in which participants' attitudes towards exercise were assessed both before and after a dialogue with an agent.

Figure 1 shows the timeline of an experiment session. Participants first held a short conversation with a virtual agent (the *introductory dialogue),* after which (time T1) they performed a ranking task designed to measure attitudes towards exercise. They then held a second conversation (the *persuasive dialogue*), during which the agent argued for the importance of statements about the advantages of exercise. Finally (time T2), participants completed the same ranking task again, and perceptions of the agent and persuasive dialogue were assessed.

In order to test whether an agent that had greater fidelity to human face-to-face conversation would be more persuasive, participants interacted with one of two different agents: A text-only agent, (Figure 2), or an embodied conversational agent (Figure 3).

In order to test whether an agent that engaged in trust-building behavior would be more persuasive, we (independently) varied the content of the introductory dialogue. Participants experienced either a short conversation, consisting only of a minimal introduction to the agent, or a longer conversation including social dialogue.

In summary, the study is a 2x2 factorial between-subjects design. Independent variables are agent type (text or ECA) and the use of social dialogue, while the outcome variables are the change in attitudes towards exercise from T1 to T2, and the participants' subjective assessments of the persuasive dialogue, message, and agent.

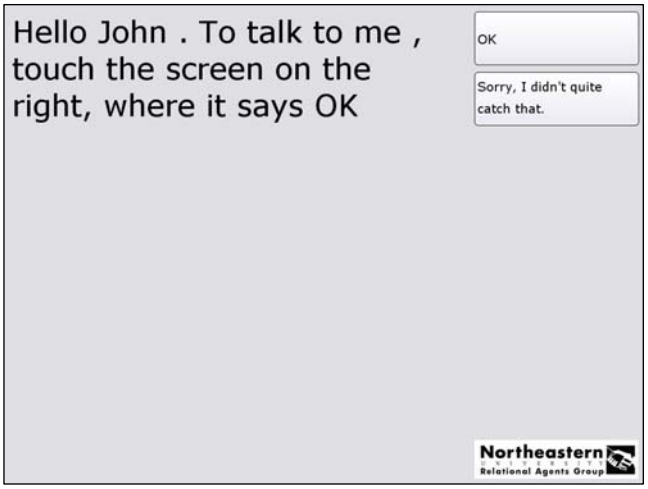

Figure 2. Text-only agent

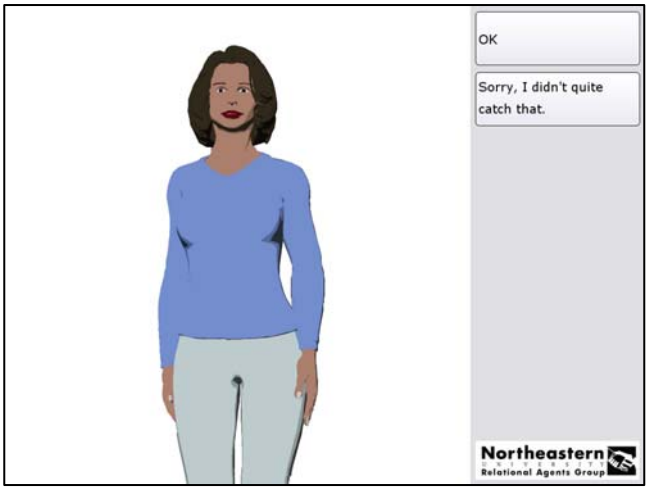

Figure 3. Embodied conversational agent

We hypothesize that participants will be measurably persuaded by dialogue with a computer agent, and that ECAs and agents using social dialogue will be most persuasive:

Hypothesis 1: Participants will assign significantly more importance to statements about the advantages of exercise following a persuasive dialogue with an agent.

Hypothesis 2a: Participants in the ECA conditions will show significantly more persuasion than those in the text-only conditions.

Hypothesis 2b: Participants in the ECA conditions will report significantly more positive perceptions of the dialogue, message, and agent than those in the text-only conditions.

Hypothesis 3a: Participants who engage in social dialogue will show significantly more persuasion than those who do not.

Hypothesis 3b: Participants who engage in social dialogue will report significantly more positive perceptions of the dialogue, message, and agent than those who do not.

3.1 Participants

47 participants were recruited via flyers posted on and near the Northeastern University campus, and via advertisements placed on craigslist.com. Participants received $10 as compensation for their time.

1.A: Hello John. To talk to me, please say OK.
2.U: OK.
3.A: OK. My name is Elizabeth, and I will be talking with you about exercise. When it is your turn to say something, please say one of the choices on the right.
4.U: I understand.
5.A: Great! We should be able to talk without any problems now.
6.U: OK.
7.A: How are you today?
8.U: Good.
9.A: That's good. I'm glad to hear it.
10.U: Thanks.
…
11.A: So John, let me tell you a little about myself.
12.U: Go ahead.
13.A: I'm only a couple of years old.
14.U: Really?
…
15.A: So, is this the first time you have had a conversation with a computer character?
16.U: Yes.
17.A: How do you feel about talking to a computer character?
18.U: It's kind of neat.
19.A: That is good to hear. I am glad this does not make you uncomfortable.
20.U: It doesn't.
21.A: So, I will leave while you answer some questions now. We will talk again later.
22.U: See you later.
23.A: Bye John. See you later.

Figure 4. Sample social dialogue

Participants ranged in age from 19 to 66 years old, with most under 25 (mean=30.17, SD=12.9). 53% were female, 57% were Caucasian, and 43% were students. There was no significant imbalance of gender ($\chi2(3)=1.92$, $p=0.589$) or of students ($\chi2(3)=1.10$, $p=0.779$) across groups. All indicated that they had experience using computers. None had participated in any previous study involving conversational agents.

3.2 Computer Agents

The text-only agent (Figure 2) delivered output as text on the screen. The embodied conversational agent (Figure 3) delivered output as synthesized speech with synchronized nonverbal behavior, generated using BEAT [13]. All participants interacted with the same conversational agent.

Both agents used multiple-choice input; participants were given between 2 and 6 choices of utterances at each turn of dialogue. Participants who interacted with the text-only agent chose their response using a touchscreen. Participants who interacted with the ECA were told to speak their choice, but to restrict their utterances to the choices given. However, we simulated speech recognition with a Wizard-of-Oz arrangement [13]: unknown to participants, a researcher listened via a microphone from an adjacent room, and selected the response that matched their utterance. If a participant gave an invalid utterance, they were asked to repeat themselves; this occurred with 3 participants, all at the beginning of the first dialogue. This arrangement was used because we wished to avoid any possible effects of speech recognition errors.

1.A: Hello again John. I would like to talk to you about exercise.
2.U: OK.
3.A: I would like to talk a little about what things are important to you when you decide whether to exercise.
…
4.A: Exercise can help you feel less stressed. Do you often feel too stressed?
5.U: Sometimes.
6.A: Well, exercise can be an excellent way to reduce stress.
7.U: OK.
8.A: Many studies have shown that exercise can improve your mood.
9.U: Tell me more.
10.A: Exercise causes your brain to release chemicals called endorphins, which helps you to respond to anxiety and stress.
11.U: OK.
12.A: Also, physical activity can be a great way to get your mind off of anything that is bothering you.
13.U: I see.
14.A: It is important to take good care of yourself, and that includes your mind as well as your body.
15.U: I agree, it is important.
…
16.A: Well, we are almost out of time, but I would like to finish up by telling you what I think is important to consider when you decide whether to exercise.
17.U: OK.
18.A: First, exercise does not need to be complicated, or a burden on your schedule.
19.U: OK.
20.A: Second, exercise has many benefits for you. It can help you look and feel more fit, and improve your mood and outlook on life.
21.U: OK.
22.A: OK. I have to go now, but thank you for taking the time to listen to me.
23.U: You're welcome.
24.A: Goodbye John.
25.U: Goodbye Elizabeth.

Figure 5. Sample persuasive dialogue

3.3 Dialogue

The text-only agent and the ECA used the same dialogues, with the exception of minor changes to 2% of the agent utterances to be consistent with the modality used.

3.3.1 Introductory Dialogue

In all cases, the first few turns of the introductory dialogue were identical: the agent introduced herself by name. For participants assigned to conditions without social dialogue, the agent immediately excused herself, and the conversation ended.

Following earlier work on relational agents [6], for participants assigned to conditions with social dialogue, the agent added a dialogue (lines 7 through 20 in Figure 4) including:

- general expressions of interest in the participant (line 7),
- small talk (e.g., "how is the weather?") [31],
- self-disclosure by the agent (lines 11-13) [1],
- prompting for self-disclosure by the participant (e.g., "are you a student here?"),
- empathetic statements (line 9), and
- meta-inquiries as to the state of the conversation (line 17).

Typical social introduction dialogues were about 20 speaking turns in length, whereas non-social introduction dialogues were always 4 turns in length.

Table 1. Ranking task used to assess attitudes towards exercise

	Suppose you are deciding whether to start a new exercise program. The following items are some things you might think about. Read the items and rank how important each item is to your decision.
	If you disagree with an item, or are unsure how to answer, that item is probably not important to you.
-	Exercise is important even if it is time-consuming.
	My doctor tells me that exercise is important.
+	I would feel less stressed if I exercised regularly
	My friends and family want me to exercise.
-	Exercise is important even if it is complicated.
+	Exercising puts me in a better mood for the rest of the day.
-	I feel like I'm more attractive to other people when I exercise.
	I would feel more comfortable with my body if I exercised regularly.
+	Regular exercise would improve my health.
+	I would have more energy for my friends and family if I exercised regularly.
	Note: + and – do not appear on the questionnaire as seen by participants.

3.3.2 Persuasive Dialogue

The persuasive dialogue (Figure 5) was typically about 30 turns long. The agent argued for the importance of statements about the advantages of regular exercise, and against statements which emphasize the disadvantages. Positive statements referenced advantages including health benefits and stress reduction, while negative statements mentioned time requirements and complication.

At several points, the agent attempted to elicit agreement from the participant, using statements that were unlikely to provoke disagreement (e.g. lines 14-15). Based on prior work with persuasive messages delivered by humans, we expected this to increase persuasion [28,37].

The agent closed the dialogue by first summarizing the important points (lines 16-20), as moderate repetition increases the persuasiveness of a strong argument [8]. This was followed by a polite farewell.

3.4 Measures

3.4.1 Persuasion

Attitudes towards exercise were measured using the ranking task shown in Table 1; this approach was inspired by the commonly-used desert survival problem [21].

The ranking task asked subjects to rate the importance of various statements which mentioned either advantages or potential disadvantages of regular exercise. To create a composite measure, items which the agent argued for (marked with +), were scored based on their assigned rank, ranging from 1 (if ranked as

Table 2. Perceptions of the relationship, argument, message, and speaker.

Agent	*Social*	*N*	*Bond*	*Argument*	*Message*	*Speaker*	*Simple*	*Bold*
Text	No	13	4.56 (0.62)	6.44 (0.76)	5.54 (1.10)	5.70 (0.91)	5.85 (1.77)	4.77 (1.09)
Text	Yes	12	4.40 (0.90)	5.99 (0.80)	4.23 (1.30)	5.92 (0.90)	6.00 (1.21)	4.33 (0.65)
ECA	No	9	4.56 (0.61)	5.87 (0.95)	4.91 (1.16)	5.49 (0.79)	6.00 (1.22)	5.00 (1.32)
ECA	Yes	13	5.08 (0.84)	6.56 (0.31)	5.26 (0.95)	5.92 (1.26)	6.54 (0.52)	4.38 (1.50)

Table 3. Pre and post attitudes towards exercise

Note: higher scores indicate that statements about the advantages of exercise (see Table 1) were ranked higher.

Agent	*Social*	*N*	*Pre*	*Post*	*Change*
Text	No	13	6.52 (1.17)	6.92 (0.68)	0.41 (0.60)
Text	Yes	12	6.79 (1.08)	6.99 (1.16)	0.20 (0.60)
ECA	No	9	6.38 (1.45)	7.21 (1.17)	0.83 (0.89)
ECA	Yes	13	6.31 (0.89)	6.27 (1.08)	-0.03 (1.01)

least important) to 10 (if ranked as most important). Items which the agent argued against (marked with -), were reverse scored. The remaining 3 items were not mentioned in the persuasive dialogue, and were not included in the composite measure.

3.4.2 Perceptions of the Argument, Message, and Agent

The participants' perceptions of the persuasive argument, persuasive message and agent were assessed using a set of 18 semantic differential items adapted from Mullennix et. al [25] and Zanbaka et. al [36]. All items used a 7-point scale.

Items for perception of the argument were: bad–good, foolish–wise, negative–positive, beneficial–harmful, effective–ineffective, and convincing–unconvincing. Reliability for this scale was good (Cronbach's α=0.832).

Items for perception of the message were: boring–stimulating, specific–vague, supported–unsupported, simple–complex, un-convincing–convincing, and uninteresting–interesting. However, the ``simple'' item did not correlate well with other items. Therefore, we dropped it from the scale, and treated it as a separate dependent variable; Cronbach's α increased from 0.759 to 0.794.

Items for perception of the agent were: incompetent–competent, honest–dishonest, unassertive–assertive, uninformed–informed, untrustworthy–trustworthy, and timid–bold. However, the ``bold'' item did not correlate well with other items. It was treated as a separate dependent variable; Cronbach's α increased from 0.777 to 0.798.

3.4.3 Other Measures

Previous studies [26] have shown that user personality traits such as extroversion may affect user preference for computer behavior. Therefore, we assessed extroversion as a possible covariate with the Wiggins scale of introversion/extroversion [35].

Need for cognition --- an individual's tendency to engage in and enjoy thinking about problems --- can affect responses to persuasion [9]. We assessed this trait using the Need for Cognition Scale short form [10].

As a measure of the participant's perceptions of their relationship with the agent, we administered the bond subscale of the Working Alliance Inventory [17].

3.5 Procedure

Participants were randomly assigned to one of four conditions, varying agent type (text or ECA), and use of social dialogue. Following a demographics questionnaire, participants were shown a picture of the agent they would interact with, and received instructions on its use.

The experimenter left the room at this point, and the remainder of the session was conducted automatically. Questionnaires were administered by computer, via a touchscreen interface. To avoid any impression by participants that the agent was asking the questions, all questionnaires and instructions were presented on a separate computer from the agent.

The remaining tasks were completed as follows:

1. Need for cognition and extroversion questionnaires,
2. Introductory dialogue with the agent,
3. Pre-intervention ranking task, and working alliance questionnaire,
4. Persuasive dialogue with the agent, and
5. Post-intervention ranking task, and measures on perception of the argument, message, and agent.

After all tasks, a short semi-structured interview was conducted with each participant. Participants who interacted with the ECA were informed of the use of the Wizard-of-Oz method.

4. RESULTS

4.1 Persuasion

Table 2 shows the mean scores on the aggregate persuasion measure before and after the persuasive dialogue, as a function of agent type and the use of social dialogue. We analyzed these scores using a 2x2x2 ANOVA, with agent type and social dialogue as between-subjects factors, and time of assessment (before or after the persuasive dialogue) as a within-subjects factor.

As it is not clear that data from the ranking task would satisfy the assumptions of an ANOVA, these assumptions were checked: The pre-dialogue scores did not deviate significantly from a

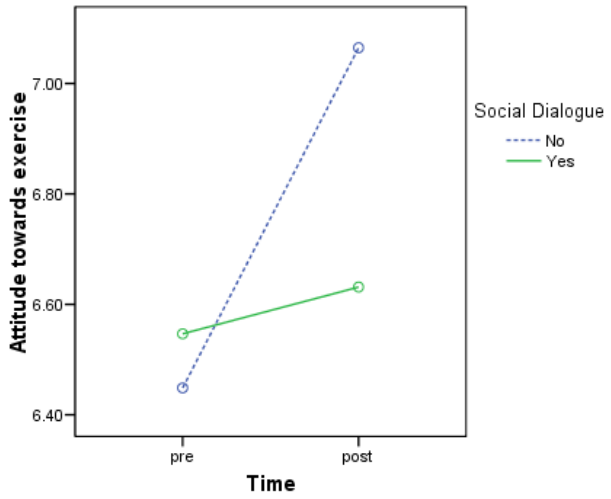

Figure 6. Effect of social dialogue on attitude change

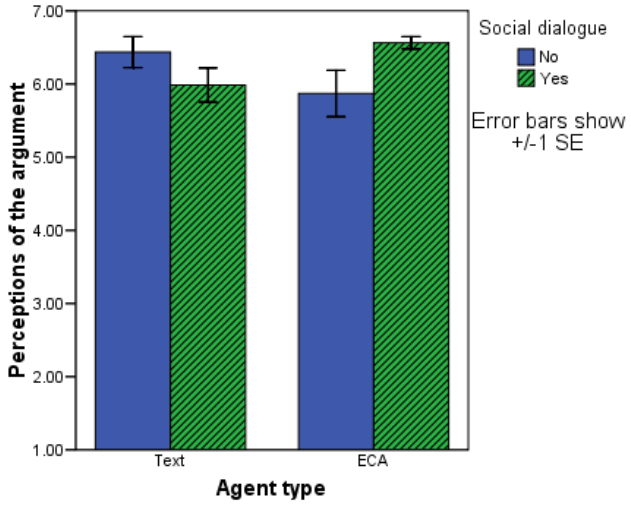

Figure 7. Effects of agent type and social dialogue on perceptions of the argument

normal distribution (Shapiro-Wilk test, W=0.973, p=0.339), and neither did the post-dialogue scores (W=0.984, p=0.757). Levene's test was used to validate that the scores were acceptably homoscedastic.

Overall, the agent was persuasive; participants ranked statements about the advantages of exercise as significantly more important after the persuasive dialogue, $F(1,43)=9.01$, p=0.004, with a moderate effect size (η^2=0.15).

There was a significant main effect of social dialogue; participants who experienced social dialogue with the agent reported a significantly smaller increase on the aggregate persuasion measure, $F(1,43)=5.18$, p=0.03, with a small to moderate effect size (η^2=0.09). Figure 6 shows this effect. There were no significant effects of agent type, and no significant interactions among the between-subjects variables.

Table 4. Correlations between bond and outcomes

** p<0.05, ** p<0.01*

Measure	*1*	*2*	*3*	*4*	*5*
1. Bond		-.14	**.45	**.50	**.47
2. Attitude Change			-.15	-.06	-.09
3. Argument				**.72	**.47
4. Message					**.62
5. Speaker					

4.2 Perceptions of the Argument, Message, and Agent

Table 3 shows the subjective assessments of the argument, message, and agent, as a function of agent type and the use of social dialogue. These results were analyzed using a factorial MANOVA.

There was a significant interaction between agent type and the use of social dialogue on perceptions of the argument, $F(1,43)=7.19$, p=0.01, with a moderate effect size, η^2=0.14. Participants reported more positive opinions of the argument when they interacted with an ECA with social dialogue, or a text-only agent without social dialogue. Figure 7 shows this effect.

A similar pattern was observed with perceptions of the message, where the interaction of agent type and social dialogue was also significant, $F(1,43)=6.17$, p=0.017, η^2=0.12.

4.3 Personality Traits

No significant effects of extroversion or of need for cognition were found.

4.4 Working Alliance

We found no significant effects of either social dialogue or agent type on the perceived agent-participant bond. However, there was a (non-significant) trend towards an interaction effect: participants who experienced social dialogue with an ECA reported a stronger bond with the agent, $F(1, 43)=2.351$, p=0.13.

There were significant positive correlations between bond and the subjective assessments of the message, argument, and agent. Table 4 shows these results; note that no significant correlation was found between bond and change in attitude.

5. DISCUSSION

The first research question addressed in this study (hypothesis 1) was whether a computer agent could conduct effective persuasive dialogue – that is, whether a computer agent could change attitudes within the context of a simulated conversation, rather than an isolated message or monologue. We found that participants had significantly more positive attitudes towards exercise following a persuasive dialogue with an agent, and therefore we conclude that persuasive dialogue with a computer agent can indeed be effective in changing attitudes, at least over short time periods.

Second, we tested whether more closely simulating face-to-face conversation (using an ECA rather than a text-only agent; hypothesis 2a), and building user-agent relationship (through the use of social dialogue; hypothesis 3a) would increase the

persuasiveness of an agent. We found no support for either of these hypotheses: there was no significant effect of agent type on attitude change, and the use of social dialogue had the opposite of the predicted effect, and *decreased* changes in attitude.

As a partial explanation of these results, we first note that none of the experimental manipulations had any significant effect on the perceived user-agent bond, as assessed by the Working Alliance Inventory. The use of social dialogue failed to develop a substantial user-agent relationship (at least, it failed to develop this particular dimension of relationship). This may indicate that the particular dialogue used here was ineffective, but also may indicate that forming a substantial bond within one short conversation is difficult. In counseling settings, a stable alliance may take several complete sessions to form [14], possibly involving a complex cycle of ruptures and repairs in the relationship [30]. Therapeutic alliance may therefore be a more suitable construct when concerned with attitude change over the course of a longer-term relationship, involving multiple interactions, rather than the short-term attitude change we assessed here.

According to the Elaboration Likelihood Model of attitude change, decisions that are of higher personal involvement are more likely to be processed by the "central route", which tends to form decisions that are more persistent over time, and can be more resistant to persuasion [28]. Cialdini and Goldstein [12] suggest that short-term engagement via dialogue can produce a "backfire" effect in this case. The issues of health and exercise have high personal relevance for much of the population, and therefore would tend to encourage central route processing. The wording of the instructions for the task used to assess attitudes (see Table 1), may also have biased participants in this direction; they could be interpreted as a request to carefully consider the topic.

During post-session interviews, we asked participants about their thought process during this task, and the answers we received give some support for this argument. Many reported that they thought about what was important or highly relevant to them, or that they relied on previous experience:

- "I know just from experience you have a better feel, a better self-esteem."
- "I just thought about how to apply it to my life and me personally… I'd say having a conversation made me think about it more, but I don't think anything was that different."
- "I just did it based on what motivates *me* to exercise."

The remaining research questions addressed the effect of the manipulated factors on subjective perceptions of the argument, message, and agent. We expected both the use of an ECA (hypothesis 2b) and the use of social dialogue (hypothesis 3b) to lead to more positive perceptions; the results of the study indicate partial and qualified support for these hypotheses. Social dialogue increased positive perceptions of the argument and message, but only when used by an ECA; social dialogue delivered by a text-only agent appears to be counterproductive.

We argue that this result indicates the importance of nonverbal communication. The ECA, compared to the text-only agent, adds hand gestures, eye movements, and facial expressions. These channels of communication may be particularly important in the context of social or affective dialogue [5,34]. This may also be due to the perceived appropriateness of the different agent types for different interactions: participants found the social dialogue appropriate when presented by an agent with a human appearance, but inappropriate when presented by the text-only agent.

5.1 Future Work

As mentioned above, this study made use of a short social dialogue as a relationship-building tactic. A potential future study could examine the effect of a more substantial user-agent relationship, possibly formed over the course of multiple interactions.

Future studies may also directly compare the use of persuasive dialogue to the monologues more commonly seen in studies of persuasion; are there situations in which a conversation may be more effective than a one-sided message? We also used a variety of tactics within the persuasive dialogue (such as attempting to elicit counterarguments, and prompting the user for agreement); future studies could separately test the effect of these tactics.

Finally, we are interested in other approaches to persuasive dialogue. Motivational interviewing is a counseling approach often applied to health behavior change in which the counselor attempts to change client attitudes (and eventually behavior) by eliciting positive statements from the client, rather than by presenting them with arguments [23]. We plan to design and evaluate a computer agent that uses tactics derived from motivational interviewing.

5.2 Conclusions

In this study an interactive counseling dialogue with a conversational agent persuaded users to change attitudes towards a relevant and important topic; conversational interfaces represent a useful design choice for persuasive technology. The difference between short-term compliance and long-term adherence should be carefully considered, as some tactics – such as social dialogue – may be appropriate only in long-term interventions. Finally, designers should consider the realism of the interface with regards to the type of dialogue it will conduct; successful use of social dialogue and other relationship-building tactics in persuasive technology may require an interface designed to more closely replicate face-to-face conversation.

6. ACKNOWLEDGMENTS

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