Agreeable People Like Agreeable Virtual Humans

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Abstract. This study explored associations between the five-factor personality traits of human subjects and their feelings of rapport when they interacted with a virtual agent or real humans. The agent, the Rapport Agent, responded to real human speakers' storytelling behavior, using only nonverbal contingent (i.e., timely) feedback. We further investigated how interactants' personalities were related to the three components of rapport: positivity, attentiveness, and coordination. The results revealed that more agreeable people showed strong self-reported rapport and weak behavioral-measured rapport in the disfluency dimension when they interacted with the Rapport Agent, while showing no significant associations between agreeableness and self-reported rapport, nor between agreeableness and the disfluency dimension when they interacted with real humans. The conclusions provide fundamental data to further develop a rapport theory that would contribute to evaluating and enhancing the interactional fidelity of an agent on the design of virtual humans for social skills training and therapy.

Keywords: rapport, virtual agents, personality, nonverbal feedback, evaluation.

1 Introduction

Numerous studies have been conducted to explore the impact of personality traits on social interactions between humans and other humans or with agents. Personality embodies a human's characteristics that represent the consistent and permanent patterns of his/her emotion, thought, and behavior [2,7,25]. The "Media Equation" perspective [26] proposes that people respond to computer interfaces as if they were communicating with real persons. Hence, human-computer interaction should capture various effects on interactants' sense of being together and connected, that is *rapport* with agents, depending on the interactants' predisposition. Therefore, we raise the question "what are the various outcomes of social interaction between humans and agents if we examine humans' individual differences in personality?"

In the rapport related studies, Tickle-Degnen and Rosenthal [28] define three components of rapport: positivity as feeling of "mutual friendliness and caring," mutual

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attentiveness as feeling of "intense mutual interest in what the other is saying or doing," and coordination as feeling of "balance, harmony, and in sync." In his response to the article of Tickle-Degnen & Rosenthal [28], Izard [16] suggested exploring the relationships between personality traits and specific elements of rapport.

In this study, we seek to deepen and generalize our prior findings on the cognitive, emotional, and behavioral impact of rapport and to specifically investigate the role of contingency, which is timely feedback, on establishing rapport to provide some fundamental data to further develop the rapport theory that would contribute to evaluating and enhancing the interactional fidelity of virtual humans for social skills training and therapy [19]. In addition to practical insights into building virtual humans, this work illustrates how virtual human technology can provide fundamental insights into open questions in social psychology.

2 Related Work and Research Questions

Contingent Nonverbal Feedback of Rapport Agents

Our research on the Rapport Agent [11] investigates how virtual characters can elicit the harmony, fluidity, synchrony, and flow one feels when achieving rapport.

The Rapport Agent is designed to elicit rapport from human participants within the confines of a dyadic narrative task. In this setting, a speaker is led to believe that the character accurately reflects the nonverbal feedback of a human listener. In fact, these movements are generated by the Rapport Agent.

The central challenge for the Rapport Agent is to provide the nonverbal listening feedback associated with rapportful interactions. Such feedback includes the use of backchannel continuers [27] (nods, elicited by speaker prosodic cues, that signify the communication is working), postural mirroring, and mimicry of certain head gestures (e.g., gaze shifts and head nods). The Rapport Agent generates such feedback by real-time analysis of acoustic properties of speech and speaker gestures.

We have specifically investigated whether contingency of virtual humans' feedback would allow people to feel high rapport in one-on-one social interaction. We found the Rapport Agent embodying contingent feedback allows people to create great rapport. In a series of this study [11,12,13], we conclude that *contingency* matters for people's creating rapport, that is, the timing of nonverbal feedback of listeners.

Recent research suggests that virtual humans can establish something akin to rapport with people by producing rapid nonverbal feedback that is elicited by (i.e., contingent on) behaviors produced by the human interaction partner [11,12,13]. Mirroring general findings on rapport, these studies illustrate that the contingency of nonverbal feedback of virtual humans is crucial for interactants' sense of rapport.

Personality, Nonverbal Behavior, and Agents

In the studies of personality and agents, researchers [4,5,15,22,23] report the results of studying the effect of attributes of personality on people's interaction with agents. Isbister [15] found people liked an embodied character which showed a personality complementary to their own, while other researchers [22,23] report that people preferred computer interfaces that embodied a similar type of personality to their own. Bickmore and his colleagues [4,5] explored the relations between personality traits,

specifically extro/introversion and trust in an interaction partner when people interacted with an embodied conversational agent. They found that extroverted people constructed their relationships with the agent more than introverted people did.

Research investigating the impact of personality traits on mediated interactions has primarily focused on how people respond to agents that represent some set of personality traits. Such research has not investigated virtual humans that are able to respond in meaningful social ways to human subjects. There is no research that explores the relationship between humans' personality traits and their evaluation of interaction quality when humans interact with agents that specifically embody only nonverbal feedback.

Furthermore, the results of Berry and Hansen [3] show that associations between the measures of the five-factor personality, nonverbal behavior, and social interaction quality showed that personality may play an important role in affecting social experience in human-to-human interactions. This finding provides impetus for further studies investigating the relations between personality, agents' nonverbal behavior, and social interaction between humans and agents.

Based on the results of our previous research and the literature review, in this study we will examine associations between interactants' personality traits and agents' contingent nonverbal listening feedback behavior associated with rapport-like interactions, which embodies rather agreeable responses to interactants' behaviors. Such feedback entails the use of backchannel continuers, postural mirroring, and mimicry of certain head gestures of a real person who is interacting with the agent. The Big Five traits of personality (Five-Factor Model) [10] is the most dominant model to differentiate people's personalities [7,9,17,24]. These five factors of personality are extroversion, agreeableness, conscientiousness, neuroticism, and openness [8,14,20]. In this study, we use these five traits to measure participants' personality characteristics. We investigate how these personality traits are related to people's sense of rapport when they get contingent feedback from the Rapport Agent.

3 Experimental Design [1]

The study was designed with two conditions: Rapport Agent (n = 24) and Face-to-Face (n = 40: 20 speakers, 20 listeners), to which participants were randomly assigned using a coin flip. A confederate listener was used in the Rapport Agent condition. The Rapport Agent synthesized head gestures and posture shifts in response to features of a real human speaker's speech and movements.

3.1 Participants and Procedure

Sixty participants (63% women, 37% men) were recruited using Craigslist.com from the general Los Angeles area and were compensated $20 for one hour of their participation. On average, the participants were 38.4 years old.

Pairs of participants completed the pre-questionnaire and were led to the computer room. The speaker then viewed a short segment of a video clip taken from the Edge

[1] The experiment with the Rapport Agent condition and the Face-to-Face condition reported in this study were conducted as part of a more extensive design involving four conditions [12].

Training Systems, Inc. Sexual Harassment Awareness video. After the speaker finished viewing the video, the speaker was instructed to retell the stories portrayed in the clips to the listener.

Speakers and listeners could not see each other, being separated by a screen. The speaker saw an animated character displayed on the 30-inch computer monitor. Speakers in the Rapport Agent condition were told that the avatar on the screen displayed the actual movements of the human listener. While the speaker spoke, the listener could see a real time video image of the speaker retelling the story displayed on the 19-inch computer monitor. The monitor was fitted with a stereo camera system and a camcorder. For capturing high-quality audio, the participant wore a lightweight close-talking microphone and spoke into a microphone headset.

Next, the experimenter led the speaker to a separate side room. The speaker completed the post-questionnaire while the listener remained in the computer room and spoke to the camera what s/he had been told by the speaker. Finally, participants were debriefed individually and probed for suspicion about the listener using the protocol from Aronson, Ellsworth, Carlsmith, and Gonzales [1].

3.2 Equipment

To produce listening behaviors used in the Rapport Agent condition, the Rapport Agent first collected and analyzed the features from the speaker's voice and upper-body movements. Two Videre Design Small Vision System stereo cameras were placed in front of the speaker and listener to capture their movements.

Watson, an image-based tracking library developed by Louis-Phillipe Morency, uses images captured by the stereo cameras to track the participants' head position and orientation [21]. Watson also incorporates learned motion classifiers that detect head nods and shakes from a vector of head velocities. Both the speaker and listener wore a headset with microphone. Acoustic features are derived from properties of the pitch and intensity of the speech signal using a signal processing package, LAUN, developed by Mathieu Morales [11].

Three Panasonic PV-GS180 camcorders were used to videotape the experiment: one was placed in front the speaker, one in front of the listener, and one was attached to the ceiling to record both speaker and listener. The camcorder in front of the speaker was connected to the listener's computer monitor for displaying video images of the speaker to the listener.

The animated agent was displayed on a 30-inch Apple display to approximate the size of a real life listener sitting 8 feet away. The video of the speaker was displayed on a 19-inch Dell monitor to the listener. A male virtual character was used in the Rapport Agent condition.

3.3 Measurements

3.3.1 Response Variables

Self-Reported Rapport. We constructed a 10-item rapport scale (Cronbach's alpha = .89), presented to speakers in the post-questionnaire. Scales ranged from 0 (disagree strongly) to 8 (agree strongly). The self-reported rapport scales contain three

components [28]: positivity, mutual attentiveness, and coordination. In this study, the positivity is defined as connection rather than friendliness and caring, as the agent did not carry facial expressions or deliver talks to create interactants' feelings of mutual caring and friendliness.

Behavioral Measures of Rapport. We videotaped participants' verbal outcomes of their storytelling. Behavioral measures of rapport included number of pausefillers, number of prolonged words, number of incomplete words, number of disfluencies (pausefillers + incomplete words), and number of meaningful words (wordcount - pausefillers - incomplete words)

3.3.2 Explanatory Variable

Personality. The pre-questionnaire packet included questions about participant's personality traits. The personality traits are composed of Big Five Scales [10] ranged from 1 (disagree strongly) to 5 (agree strongly): extraversion, agreeableness, conscientiousness, neuroticism, and openness.

4 Results

Zero-order Correlations (Pearson Correlations) were computed to find associations between demographic variables, the personality traits and the measurements of rapport. The results revealed no statistically significant associations between demographic variables and the personality traits or between demographic variables and the measurements of rapport (See Table 1).

Table 1. Zero-order correlations among Demographic Variables, Personality Traits, and Self-Reported Rapport in the Rapport Agent condition and in the Face-to-Face condition

		Demographic Variables		**Personality Traits**				
		Age	Gender	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness
RAPPORT AGENT								
Self-Reported Rapport (Overall)		.280	-.008	.296	.540**	.504**	-.197	-.013
Self-Reported Rapport (3 components)	Positivity	.246	.085	.258	.417*	.220	-.239	-.161
	Attentiveness	.274	-.063	.221	.456*	.403*	-.100	.078
	Coordination	.305	-.012	.116	.518**	.480*	-.221	-.252
FACE-to-FACE								
Self-Reported Rapport (Overall)		.099	.054	-.034	.349	.525*	-.142	-.079
Self-Reported Rapport (3 components)	Positivity	-.102	-.026	.091	.407	.390	-.016	-.194
	Attentiveness	.346	.158	-.112	.255	.428	-.214	-.082
	Coordination	.285	-.108	-.200	.370	.534*	-.201	-.067

* $p < .05$, ** $p < .01$

4.1 Correlations between the Personality Traits and Self-reported Rapport

Firstly, the results showed strong positive correlations between two personality traits and overall self-reported rapport in the Rapport Agent condition. Those two personality traits were Agreeableness (r = .54) and Conscientiousness (r = .50). In addition, the results revealed overall self-reported rapport was strongly associated only with Conscientiousness (r = .53) in the Face-to-Face condition (See Table 1).

Secondly, we looked at the correlations between each of the three components of rapport and the personality traits. In the Rapport Agent condition, the results showed that positivity was moderately correlated with Agreeableness (r = .42). The results further revealed that coordination was moderately correlated with Conscientiousness (r = .48) and strongly associated with Agreeableness (r = .52), while attentiveness was modestly associated with both Conscientiousness (r = .40) and Agreeableness (r = .46). In the Face-to-Face condition, the results showed coordination was highly correlated with Conscientiousness (r = .53) (See Table 1).

4.2 Correlations between the Personality Traits and Behavioral Measures of Rapport

The results revealed strong positive correlation between two personality traits and interactants' disfluency in their storytelling when they interacted with the Rapport Agent. The interactants' disfluency was highly associated with Extraversion (r = -.60) and moderately correlated with Agreeableness (r = -.42). In the Face-to-Face condition, the number of interactants' prolonged words was modestly associated with Agreeableness (r = -.50) (See Table 2).

Table 2. Zero-order correlations among Demographic Variables, Personality Traits, and Behavioral Measures of Rapport in the Rapport Agent condition and in the Face-to-Face condition

	Demographic Variables		**Personality Traits**				
	Age	Gender	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness
RAPPORT AGENT							
Meaningful Words	-.013	-.299	-.089	.157	-.314	.075	-.127
Disfluency	-.021	-.346	-.600**	-.415*	-.196	.211	-.194
Prolonged Words	.201	.134	.134	-.058	.040	-.168	.141
FACE-to-FACE							
Meaningful Words	-.260	.130	.119	-.293	-.005	.230	-.115
Disfluency	-.240	-.119	.088	-.081	.037	.130	-.098
Prolonged Words	-.201	-.035	.041	-.495*	-.102	.205	-.124

* $p < .05$, ** $p < .01$

5 Conclusions

We found that more agreeable (i.e. pro-social and cooperative) people felt strong rapport when they experienced the contingent nonverbal feedback by the Rapport Agent, as they did while communicating face-to-face. More conscientious people reported strong rapport when they communicated with both the Rapport Agent and a real

person. In human-to-human interactions, previous studies demonstrated that more agreeable people showed greater satisfaction about their interaction partners as well as self-reported interaction quality [3]. Similarly, the findings indicate that more agreeable interactants perceive strong rapport with the Rapport Agent and with another human although the relationship is apparently stronger for the Rapport Agent condition than for the Face-to-Face condition. Furthermore, we discovered other significant results involving interactants' (speakers') verbal behaviors. More extroversion and agreeableness of interactants were associated with weak rapport in the disfluency dimension when they experienced the contingent nonverbal feedback of the Rapport Agent. This outcome reflects the study by Berry and Hansen [3] that found a positive association between Extroversion as well as Agreeableness and independent observers' ratings for interaction quality in human-to-human interaction. The findings indirectly support the idea that people would respond to the contingent feedback of the Rapport Agent as if they were interacting with a human being, which is proposed by the "Media Equation" perspective in a series of studies by Nass and his colleagues [15,22,23,26].

When we looked at the relationship between the three components of rapport and the personality traits, the results revealed similarity in the association between the overall self-reported rapport and the personality traits. Based on the findings, we propose that kinder, more pro-social, and more cooperative people would feel a strong sense of rapport through feeling coordination in interaction with the Rapport Agent. Furthermore, the greater agreeableness of interactants was correlated with the strong feeling of rapport through sensing positivity in communication with the Rapport Agent as Izard proposed, while neuroticism of emotionally negative interactants was not statistically significantly associated with their sense of rapport for the positivity dimension with the Rapport Agent. This outcome somewhat contradicts the results discovered in the previous study [18] that showed more anxious people felt less rapport with the non-contingent feedback of agents. We expected more vulnerable and anxious interactants (i.e., subjects high in neuroticism) would feel strong rapport with agents' contingent feedback. This finding suggests that we need to further investigate our definition for positivity that is defined as interactants' feelings of connection with their partners in this study. In addition to these findings, it was found that people who are not dominant and pro-social (i.e., agreeable) would pay more attention to what an agent does as their interaction partner, if the agent provides contingent nonverbal feedback.

In conclusion, the results of both self-reported and behavioral-measured rapport in this study indicated that agreeable persons felt strong rapport with the Rapport Agent that embodies somewhat agreeable features: *contingency*. This leads to the potential way to develop agents' personality features which would be embodied by appropriate nonverbal feedback and be preferred by sociable persons with conscientiousness. This also points to the prior findings that indicated people preferred a computer interface represented by a type of personality similar to their own [22,23].

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