Building rapport with extraverted and introverted agents

Jacqueline Brixey and David Novick

University of Southern California, University of Texas at El Paso

Abstract

Psychology research reports that people tend to seek companionship with those who have a similar level of extraversion, and markers in dialogue show the speaker's extraversion. Work in human-computer interaction seeks to understand creating and maintaining rapport between humans and ECAs. This study examines if humans will report greater rapport when interacting with an agent with an extraversion/introversion profile similar to their own. ECAs representing an extrovert and an introvert were created by manipulating three dialogue features. Using an informal, task-oriented setting, participants interacted with one of the agents in an immersive environment. Results suggest that subjects did not report the greatest rapport when interacting with the agent most similar to their level of extraversion.

Introduction

People often seek companionship with those who have a personality similar to their own [11]. There is evidence that personality types are borne out in dialogue choices [1]. Humans are uniquely physically capable of speech, and tend to find spoken communication as the most efficient and comfortable way to interact, including with technology [2]. They respond to computer personalities in the same way as they would to human personalities [10]. Recent research has sought to understand the nature of creating and maintaining rapport—a sense of emotional connection—when communicating with embodied conversational agents (ECAs) [2, 8, 14].

Successful ECAs could serve in a number of useful applications, from education to care giving. As human relationships are fundamentally social and emotional, these qualities must be incorporated into ECAs if human-agent relationships are to feel natural to users. Research has been focused on the development and maintenance of rapport felt by humans when interacting with an ECA [11] and in developing ECA personalities [3]. However, questions remain as to which agent personality is the best match for developing rapport in human-ECA interactions.

In this study, two agents representing an extravert and an introvert were created by manipulating three dialogue features. Using a task-oriented but informal set-

ting, participants interacted with an agent in an immersive environment, and then responded to a 16-question rapport survey.

This study specifically seeks to answer three questions: 1) Will all subjects establish a high-level of rapport with the extraverted agent? 2) Will extraverted subjects matched with an introverted agent show the lowest level of rapport due to mismatched personalities? 3) If all subjects establish rapport with the agent, will subjects report the highest level of rapport when interacting with the agent whose extraversion level matches that of the subject?

Extraversion and Introversion in Dialogue

Personality is a patterned set of organized traits and externalized behaviors that are permanent or slowly changing that influence a person's attitudes and emotional responses. Personality is considered a universal phenomenon of human psychology [16]. One prominent structure in the literature for personality traits and dimensions is the Five Factor Model (FFM). One factor in the FFM is extraversion-introversion, which is a consistent and salient personality dimension [16]. Extraversion is often displayed through "energetic" behavior and an outgoing and sociable attitude, while introversion is marked by quietness and seeking of solitude [5].

Extraversion in dialogue

Personality markers in speech are dialogue cues associated with personality dispositions and are revealed in the semantically equivalent but emotionally unique phrases expressed [2]. Extraverts tend to speak louder and talk more than listen [16]. Extraverts reflect their sociability by referring to other people, using more positive language, and saying more per conversation turn [16]. Introverts use fewer positive words, and give fewer compliments [10].

Social dialogue is talk in which interpersonal goals are the primary purpose, while task goals are secondary, and are used to build rapport and trust [1]. Social dialogue significantly increased trust for extraverts in ECA interactions but made no difference for introverts [2]. In contrast, introverts dislike social dialogue and prefer task-only dialogue [1].

Extraverted speech correlates negatively with concreteness [6], achieved by adding subordinate clauses instead of starting a new sentence. This increases the number of noun and verb phrases, a sentence's length and syntactic complexity [15], and overall word count. Word count is the most important surface feature for classifying extravert dialogue [10]. Extraverts also tend to use a less robust vocabulary and produce less formal sentences [10]. For this study, formality is measured by [9]:

F = (noun frequency + adjective frequency + preposition frequency + article frequency - pronoun frequency - verb frequency - adverb frequency - interjection frequency + 100)/2

Rapport with ECAs

Rapport is the harmonious feeling experienced when forming an emotional connection with another person. It has profound effects on human relationships, from customer satisfaction and loyalty [7], to student success [18]. The incorporation of social and emotional qualities into the framework of the ECA facilitates the building and maintenance of human-ECA relationships, and rapport provides a basis for long-term human-ECA relationships. The paralinguistic rapport model used in this study measures rapport in three dimensions: a sense of emotional connect, a sense of mutual understanding, and a sense of physical connection [14].

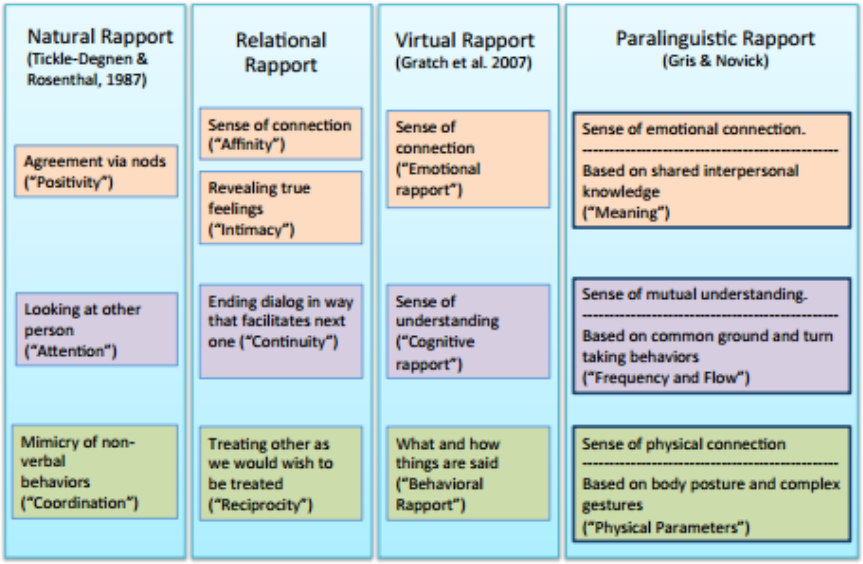

Figure 1. Paralinguistic Model of Rapport [14]

Previous research did not actively quantify the personality difference between an extraverted and introverted agent, rather qualitatively created agents that are different [4, 13, 17]. Further, while previous research has sought to quantify personality via dialogue markers [11], formality was not included in those metrics. Accordingly, this study sought to select features that can be quantified and include formality in that measurement. Previous research has also emphasized agent likeability, while this work focuses on rapport. Finally, the research to date has not matched the personality of the human user to an ECA of a corresponding personality, nor have previous studies addressed the level of rapport felt by users when interacting with ECAs portraying a specific personality type via dialogue choices.

Methods

To determine the effect of ECA extraversion and introversion on rapport, we manipulated three dialogue features in the speech of the extraverted ECA and the introverted ECA. These features were selected for their salience in the relevant literature and the ability to measure each feature.

1. *Positivity*, as measured by the linguistic inquiry and word count (liwc.wpengine.com). This measurement was set to be higher in extraverted dialogue.
2. *Word count*, as measured as the total number of words per scene. A higher word count tends to be a marker of extraversion.
3. *Formality*, as measured by the formality formula [9]. This feature tends to be higher for introverts.

Participants in the study interacted with the agent in a game, "Survival on Jungle Island" [8], an interactive game where participants find themselves stranded on a remote island with the agent and work to try to survive and escape off the island. The game comprises ten scenes, which are interactions centered on a topic, such as family, or a task, for example trying to start a fire. Figure 2 shows the agent in a scene from the jungle game. The user interacted with the agent via spoken dialogue, and each scene was written to incrementally disclose information about the agent and to request similar information from the user. Since these intimacy-building dialogues do not change regardless of the previous decisions made by the user, all users have an equal opportunity to build rapport with the agent.

Figure 2. The agent in a scene in the jungle game.

A script for the ECA was handwritten prior to manipulations [8] to ensure that the same content was given by the ECA to all participants. An example dialogue from Scene 2 is shown in Table 1. In this scene, the participant has just woken up on the beach and meets the agent.

All dialogues followed the same story arc and revealed the same information about the agent. While no metric was set that any of the factors had to be a specific ratio between the two agents, our objective was generally to make extraverted word count and positivity higher than that of introverted, and introverted formality higher than that of the extravert. Table 2 presents total word count, formality, and positivity for each scene. The extravert word count was, on average, 63% higher

than the introvert word count. The extravert formality was about 15% lower than the introvert formality. And the extravert positivity was about 100% higher than the introvert positivity.

Table 1. Example of extraverted ECA and introverted ECA dialogue

Line	Extraverted ECA	Introverted ECA
1	Oh, I'm so sorry, where are my manners, my name is Lina.	My name is Lina.
2	How about you, what's your name?	What is your name?
3	Great to meet you, I'm so glad I'm not alone anymore!	It is very nice to meet you!
4	Well I've been on this island for a few days now.	I landed here seven days ago.

Table 2. A summary of word count, formality, and positivity for the respective agents in the Jungle Game

	Introvert			Extravert		
Scene	**Word Count**	**Formality**	**Positivity**	**Word Count**	**Formality**	**Positivity**
1	128	40	2.34	196	33	4.08
2	65	57	1.54	163	43	3.07
3	239	41	3.77	353	38	3.97
4	136	51	3.68	218	40	4.13
5	152	54	5.26	278	46	6.47
6	301	59	3.65	471	37	4.25
7	129	48	1.55	187	41	2.67
8	6	50	0	13	49	0
9	5	51	0	11	50	0
10	6	47	0	13	46	15.38
Total	1167	498	21.79	1903	423	44.02
Avg	116.70	49.80	2.17	190.30	42.30	4.40
SD	100.26	6.16	1.87	152.58	5.49	4.32

In total, we recruited 59 subjects, 9 females and 50 males; four data points from the 59 recorded were discarded due to technical difficulties. After consenting, all participants completed a standard Myers-Briggs personality assessment to determine extraversion or introversion [12]. Participants were matched to interact with an agent at random. There were 15 participants in the introverted agent-extraverted user (IE) group, 15 in the extraverted agent-introverted user (EI) group, 14 in the introverted agent-introverted user (II) group, and 11 in the extraverted agent-extraverted user (EE) group. The physical appearance and behavior of the ECA was the same for all scenarios; only the ECA's language was changed.

Experiments lasted for 30 minutes, with approximately 15 minutes of interaction with the agent. Following the interaction, participants filled out a 16-question

rapport survey, with five questions related to emotional rapport, five related to cognitive rapport, and six questions dealing with behavior rapport. All survey questions were answered on a five-point Likert scale, with high agreement at 5. A manipulation check was also included on the rapport survey, where participants were asked, "How extraverted do you think the agent was?" and ranked the agent on a scale from 1 (very introverted) to 5 (very extraverted). Participants were also asked a free response question, "Do you prefer interacting with extraverts usually?" and to provide any comments about the experiment.

Results

The results for the research questions will be presented first, followed by a general discussion of the results. For the reported t-tests, the distributions of mean rapport scores for each experimental condition appear to be normal; Table 3 reports the Anderson-Darling p values, where $p > 0.05$ indicates that a normal distribution cannot be rejected. That is, all four conditions have acceptably normal distributions.

Table 3. Anderson-Darling test for normality of distributions of rapport scores.

Condition	Anderson-Darling p Value
EE	0.62
II	0.44
IE	0.89
EI	0.18

Research questions

1) Will all subjects establish a high level of rapport with the extraverted agent?

The results indicate that all participants established a higher level of rapport with the extraverted ECA than with the introverted ECA, as can be seen in Figure 3, which presents the averages and standard deviations of reported rapport based on answers to the 16-question survey. Overall, the EE group had the highest average level of rapport, followed by the IE group. Contrary to our hypothesis (and psychology literature), the introverted participants who interacted with the introverted agent (II) reported the lowest average levels of rapport overall and in each of the three subsections of rapport.

2) Will extraverted subjects matched with an introverted agent show the lowest level of rapport due to mismatched personalities?

The results indicate that this is not true; instead, introverts reported the lowest level of rapport when interacting with the introverted agent (see Figure 3). While extraverts did report a lower level of rapport with the introverted ECA than with

the extraverted ECA, the II group reporting the lowest level of rapport suggests that mismatched personalities do not predict the lowest level of rapport.

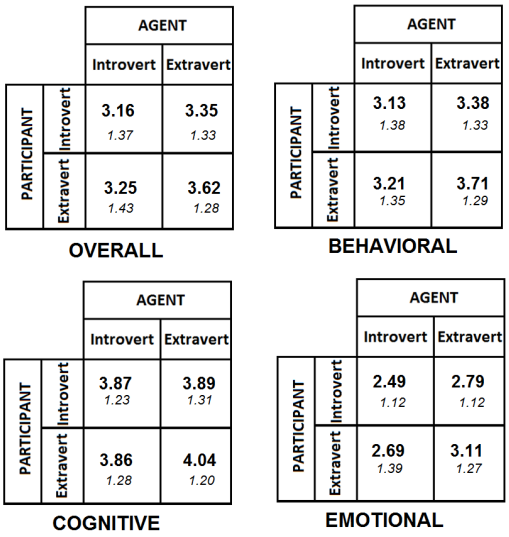

Figure 3. The averages (bold) and standard deviations (italicized) of the full data set

Table 4 presents the results from conducing t-tests on the data set. In general, the emotional and cognitive dimension did not show meaningful differences across the experimental conditions. However, there appear to be clear results for the behavioral dimension.

The result of $p<0.05$ for behavioral rapport for the EE versus EI groups suggests that extraverts developed lower levels of rapport in the mismatched interaction. The lack of a significant result in the t-test for II versus IE (a comparison of the impact on rapport for mismatching for introverted participants) suggests that a mismatched ECA personality did not have a significant effect on the development of rapport for introverted subjects. These results indicate that introverted and extraverted participants do not have the same reaction in building rapport with the ECA as a function of ECA extraversion/introversion.

Table 4. The results of a t-test on the data set, ** indicates $p<0.05$, * indicates $p<0.10$

Condition	Overall	Emotional	Cognitive	Behavioral
EE/II	0.09*	0.14	0.57	0.02**
EE/IE	0.22	0.31	0.54	0.08*
EE/EI	0.18	0.34	0.53	0.05*
II/IE	0.64	0.51	0.96	0.59
II/EI	0.72	0.58	1	0.81
IE/EI	0.91	0.97	0.95	0.77

3) Will subjects report the highest level of rapport when interacting with the agent whose extraversion level matches that of the subject?

The results suggest that extraverts did report the highest level of rapport with the extraverted ECA, but the II group showed the lowest average for rapport for all the groups (see Figure 3), which was not consistent with the psychology research on personality that reported that humans prefer to interact with those who have a personality most similar to their own. The significant ($p<0.05$) t-test result for behavioral rapport of the EE versus II groups indicates that introverts feel substantially less rapport on average when interacting with an agent of the same personality type than do extraverts.

Effect size

We examined effect size to provide insight into the size of the difference between the various groups' mean rapport, shown in Figure 3. We calculated effect size θ using the standardized mean difference between populations to provide additional perspective on the differences between the various groups' mean reported rapport scores (see Table 5). A larger absolute value for effect size indicates a stronger effect and complements the findings of the t-test results from Table 4 by giving insight into the strength of the statistical claim. We found an exceptionally strong effect of 0.84 for overall rapport when comparing the EE and II groups (effect > 0.8), disconfirming the expectation from psychology for our subjects in human-ECA interactions. The strong effect of 0.65 found in the EE versus EI comparison (effect > 0.8) suggests that extraverts will report lower levels of rapport when matched with an introverted agent. The lack of effect from the introverted participants in either agent-matching condition suggests that introverted participants do not feel more rapport with either agent and also indicates that extroverts in general report higher levels of rapport than introverted participants when interacting with an agent.

Table 5. The effect sizes in the full set of data, * indicates $\theta > 0.60$, and ** indicates $\theta > 0.80$

Effect size	Overall	Emotional	Cognitive	Behavioral
EE/II	0.84**	0.73*	0.24	1.19**
EE/IE	0.47	0.41	0.21	0.71*
EE/EI	0.65*	0.46	0.29	0.98**
II/IE	0.31	0.34	0.04	0.38
II/EI	0.13	0.19	0.01	0.12
IE/EI	0.15	0.11	0.05	0.25

The results of the analysis of effect are consistent with the question posed to participants on the rapport survey, "Do you prefer interacting with extraverts usually?" Introverted participants reported mixed preference, with 40% preferring other introverts, 40% preferring extraverts, and the remaining subjects having no

preference. However, 80% of extravert participants preferred other extraverts, with 8% preferring introverts and 12% with no preference. This result provides a new perspective on the psychology of introverts as well as on the dynamics of rapport in relation to extraversion, as it appears that introverts do not have the same expectations for their conversation partners, either human or ECA, as extraverts. Thus, the creation and maintenance of rapport with introverted participants will not be identical to that of extraverted participants.

Finally, all participants answered a manipulation check on the rapport survey, "How extraverted do you think the agent was?" Both the extravert subjects and the introvert subjects rated the extraverted agent as more extraverted than the introverted agent. However, these differences were small (see Table 6) and not statistically significant; overall, both extravert and introvert participants rated the extraverted agent as highly extraverted. Extraverted participants rated the introverted agent as being more introverted than did the introverted participants. Some responses from participants as to why they did not perceive the introversion of the agent were that the ECA initiated too many conversations and conversation topics, particularly those about herself. These responses match with descriptions that introverts prefer task dialogue to social dialogue [1] and to let others make decisions [10], features that were not incorporated into the present ECA interaction model. Another potential explanation is that the phrasing of the question might have led participants to expect the agent was intended to be extraverted.

Table 6. Perceived extraversion, by subject and agent condition

Condition	Mean Perceived Extraversion	Difference
EE	4.45	0.38
EI	4.07	
IE	4.47	0.07
II	4.40	

Conclusion

Our study's results suggest that while there are instances in which the behavior of humans in human-ECA interactions is the same as those in human-human interaction, human-ECA interactions with introverted agents may not be one of these instances. Should only one agent personality be available to implement, our results suggest that the best option would be an extraverted personality, as both introverts and extraverts reported higher levels of rapport with an extroverted agent than introverted.

The study also found that introverts did not show preference for either agent. Future work should explore how to better relate to and interact with introvert participants. Future work could also determine if introvert participants develop more rapport with an agent during a longer or multi-session interaction.

This study suggests that personality type expressed dialogue can be felt by users, and this differentiation affects the behavior dimension of rapport, giving new

insights into the inner workings and potential manipulations of to increase rapport with ECAs. Finally, as only three dialogue features were manipulated to differentiate the two agents, future work will incorporate more and different variations of extravert versus introvert dialogue features.

References

1. Bickmore, Timothy and Justine Cassell. “Social dialogue with embodied conversational agents.” *Advances in natural multimodal dialogue systems*. Springer Netherlands, 2005. 23-54.
2. Cassell, Justine. *Embodied conversational agents*. MIT press, 2000.
3. Cassell, Justine and Timothy Bickmore. “Negotiated collusion: Modeling social language and its relationship effects in intelligent agents.” *User Modeling and User-Adapted Interaction* 13.1-2 (2003): 89-132.
4. Chen, Yuting, Adell Naveed, and Robert Porzel. “Behavior and preference in minimal personality: a study on embodied conversational agents.” *International Conference on Multimodal Interfaces and the Workshop on Machine Learning for Multimodal Interaction*. ACM, 2010.
5. Eysenck, Sybil BG, Hans J. Eysenck, and Paul Barrett. "A revised version of the psychoticism scale." Personality and individual differences 6.1 (1985): 21-29.
6. Gill, Alastair, and Jon Oberlander. "Taking care of the linguistic features of extraversion." Proceedings of the 24th annual conference of the cognitive science society. 2002.
7. Gremler, Dwayne D., and Kevin P. Gwinner. "Customer-employee rapport in service relationships." Journal of Service Research 3.1 (2000): 82-104.
8. Gris, Ivan. “Two-way virtual rapport in Embodied Conversational Agents.” Doctoral dissertation, University of Texas at El Paso (2015).
9. Heylighen, Francis, and Jean-Marc Dewaele. "Variation in the contextuality of language: An empirical measure." Foundations of Science 7.3 (2002): 293-340.
10. Mairesse, François, et al. "Using linguistic cues for the automatic recognition of personality in conversation and text." Journal of artificial intelligence research 30 (2007): 457-500.
11. Mairesse, François, et al. “PERSONAGE: Personality Generation for Dialogue.” *Annual Meeting-Association for Computational Linguistics*, 45 (2007): 496-503.
12. Myers, Isabel, and Peter Myers. *Gifts differing: Understanding personality type*. Nicholas Brealey Publishing, 2010.
13. Nass, Clifford, et al. "Can computer personalities be human personalities?" Conference companion on Human factors in computing systems. ACM, 1995.
14. Novick, David, and Iván Gris. "Building rapport between human and ECA: A pilot study." International Conference on Human-Computer Interaction. Springer International Publishing, 2014.
15. Scherer, Klaus Rainer. Personality markers in speech. Cambridge University Press, 1979.
16. Scherer, Klaus R. "Speech and emotional states." Speech evaluation in psychiatry (1981): 189-220.
17. Van den Bosch, Karel, et al. "Characters with personality!" International Conference on Intelligent Virtual Agents. Springer Berlin Heidelberg, 2012.
18. Wilson, Janie H., Rebecca G. Ryan, and James L. Pugh. "Professor–student rapport scale predicts student outcomes." Teaching of Psychology 37.4 (2010): 246-251.